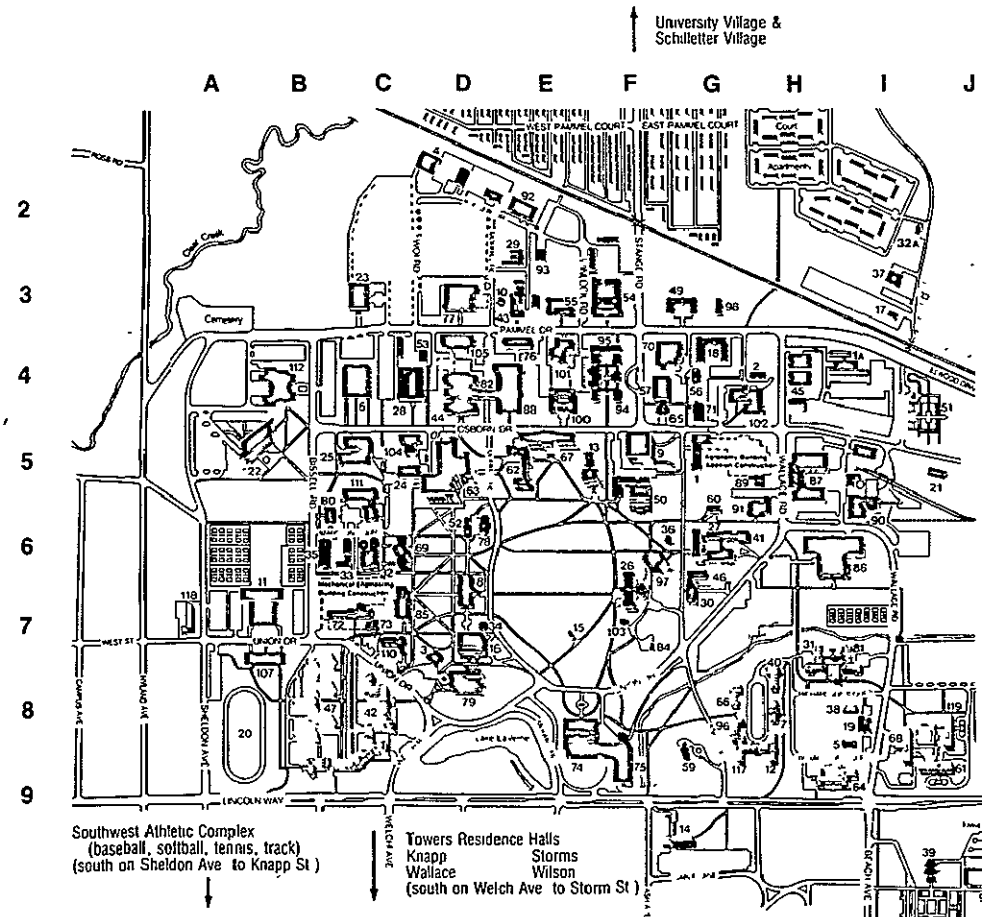
PN-AAR-703
ISN: 37933

Program and Abstracts
World Soybean Research Conference—III

12-17 August 1984 Iowa State University, Ames, Iowa USA



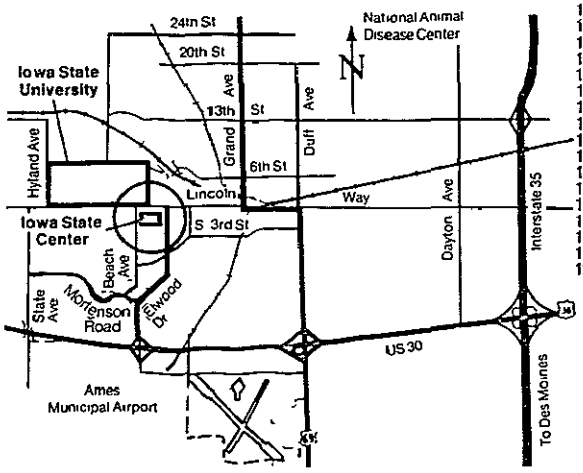
Campus Offices

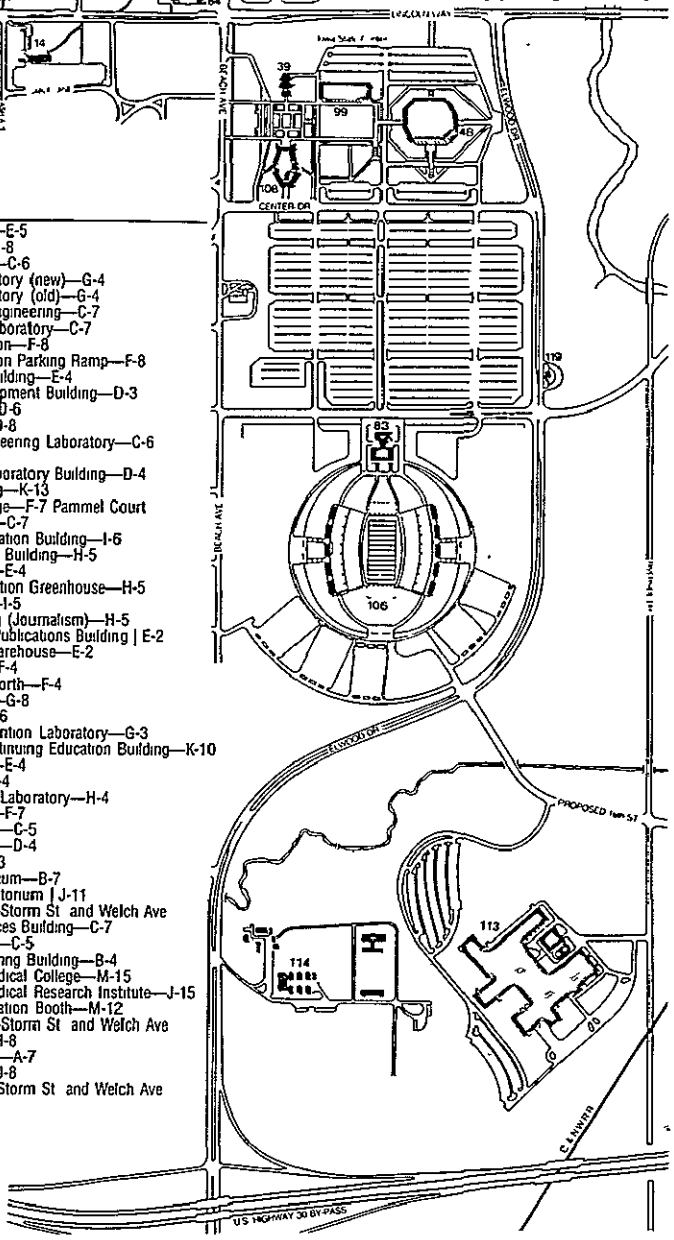
The President—117 Beardshear Hall
Vice President for Academic Affairs—110 Beardshear Hall
Vice President for Business and Finance—125 Beardshear Hall
Vice President for Planning and Development—125 Beardshear Hall
Vice President for Research | 201 Beardshear Hall
Vice President for Student Affairs—118 Beardshear Hall
College of Agriculture—124 Curtiss Hall
College of Business Administration—300 Carver Hall
College of Design—134 College of Design
College of Education—E62A Quadrangle
College of Engineering—104 Marston Hall
College of Home Economics—122 MacKay Hall
College of Sciences and Humanities—208 Carver Hall
College of Veterinary Medicine—2508 College of Veterinary Medicine
Graduate College—201 Beardshear Hall
Admissions—7 Beardshear Hall
Admissions Visitor Suite—252 Memorial Union
Alumni Office—Alumni Suite, Memorial Union
Brunnier Gallery—Scheman Building
Energy and Mineral Resources Institute—109 Office and Laboratory Bldg
Office of Continuing Education—Scheman Building
Personnel Office—16 Beardshear Hall
Registrar—107 Beardshear Hall
Residence (Student Housing)—1211 Friley Hall
Scholarships and Loans—12 Beardshear Hall
Student Life—Student Services Building
Tickets, athletic events—R A Olsen Building
Tickets, ISU Center events—C Y Stephens Auditorium
University Extension—108 Curtiss Hall

Visitors are not exempt from university parking regulations, and, therefore, must pay the penalties assessed or follow appeal procedures as indicated on any parking ticket they may receive.

University Buildings

1. Agronomy Hall—G-5
1A Agronomy Greenhouse—I-4
2 Agronomy Laboratory—H-4
3 Alumni Hall—D-7
4 Ames Lab Service Buildings—D-1
5 Andrews-Richards House—I-8
6 Armory—C-4
7. Barton Hall—H-8
8. Beardshear Hall—D-6
9 Bessey Hall—F-5
10 Bevier House—E-3
11 Beyer Hall—B-7
12 Birch Hall—H-8
13 Botany Hall—F-5
14 Buchanan Hall—G-9
14A Bus Maintenance Facility—J-5
15 Campanile—F-7
16 Carver Hall—D-7
17 Car Pool—I-3
18 Cattle Barn—G-4
19 Child Development—I-8
20 Clyde Williams Field—B-8
21 Coal Preparation Plant—J-5
22. College of Design—B-5
23 Communications Building—C-3
24 Computer Science Building—D-5
25 Coover Hall—C-5
26 Curtiss Hall—F-6
27 Dairy Industry—G-6
28 Davidson Hall—D-4
29 Driver Training Laboratory—E-2
30 East Hall—G-6
31 Elm Hall—I-7
32 Engineering Annex—C-6
32A Engineering Extension Service Building—I-2
33 Engineering Research Institute—C-6
34 English Office Building—D-7
35 Exhibit Hall—C-6
36 Farm House—G-6
37 Fire Service Education Building—I-3
38 Fisher-Nickell House—I-8
39. Fisher Theater—J-10
40 Freeman Hall—H-8
41 Food Technology Laboratory—H-6
42. Friley Hall—C-8
43 Genetics Laboratory—E-3
44 Gilman Hall—D-4
45 Greenhouses—H-4 Hawthorn Court
46 Heady Hall—G 6
47. Helser Hall—B-8
48 Hilton Coliseum—L-10
49 Horse Barns—G-3
50 Horticulture Building and Greenhouse—F-5
51 Horticulture Gardens—J-4
52 Hub—D-6
53 Industrial Education I—D-4
54 Industrial Education II—F-3
55 Insectary—E-3
56 Judging Pavilion—G-4
57 Kildee Hall—G-4
58 Knapp Hall—Storm St and Welch Ave
59 The Knoll (President's Home)—G-8
60 Landscape Architecture Building—G-5
61 Larch Hall—J-9
62 LeBaron Hall—E-5
63 Parks Library—D-5
64 Linden Hall—I-9
65 Lush Auditorium—G-4
66 Lyon Hall—G-8
67 MacKay Hall—E-5
68 Maple Hall—J-8
69 Marston Hall—C-6
70 Meats Laboratory (new)—G-4
71 Meats Laboratory (old)—G-4
72 Mechanical Engineering—C-7
73. Mechanics Laboratory—C-7
74. Memorial Union—F-8
75 Memorial Union Parking Ramp—F-8
76 Metallurgy Building—E-4
77 Metals Development Building—D-3
78 Morrill Hall—D-6
79 Music Hall—D-8
80 Nuclear Engineering Laboratory—C-6
81 Oak Hall—I-7
82 Office and Laboratory Building—D-4
83 Olsen Building—K-13
84 Osborn Cottage—F-7 Pammel Court
85 Pearson Hall—C-7
86 Physical Education Building—I-6
87 Physical Plant Building—H-5
88 Physics Hall—E-4
89 Plant Introduction Greenhouse—H-5
90 Power Plant—I-5
91. Press Building (Journalism)—H-5
92. Printing and Publications Building | E-2
93 Purchasing Warehouse—E-2
94 Quadrangle—F-4
95 Quadrangle North—F-4
96 Roberts Hall—G-8
97 Ross Hall—F-6
98 Ruminant Nutrition Laboratory—G-3
99 Scheman Continuing Education Building—K-10
100 Science Hall—E-4
101 Science II—E-4
102 Seed Science Laboratory—H-4
103 Sloss House—F-7
104 Snedecor Hall—C-5
105 Spedding Hall—D-4
106 Stadium—K-13
107 State Gymnasium—B-7
108 Stephens Auditorium | J-11
109 Storms Hall—Storm St and Welch Ave
110 Student Services Building—C-7
111 Sweeney Hall—C-5
112 Town Engineering Building—B-4
113 Veterinary Medical College—M-15
114. Veterinary Medical Research Institute—J-15
115 Visitor Information Booth—M-12
116 Wallace Hall—Storm St and Welch Ave
117 Welch Hall—H-8
118 Westgate Hall—A-7
119 Willow Hall—J-8
120 Wilson Hall—Storm St and Welch Ave





World Soybean Research Conference—III

Iowa State University
12-17 August 1984

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Norman Chambers, Iowa Soybean Promotion Board
Clarence Grogan (Deceased), USDA, Cooperative State Research Service
Robert Judd, National Soybean Processors Association
Thomas Kelly, USDA, Office of International Cooperation and Development
Robert Leffel, USDA, Agricultural Research Service
Timothy Mounts, USDA, Agricultural Research Service
Charlotte Roderuck, World Food Institute, Iowa State University
Loren Schulze, United States Agency for International Development
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Publications Office

Acknowledgment of Financial Assistance

The broad scope of the program for World Soybean Research Conference—III has been made possible by the generous donations from public and private institutions Their support made it possible to ensure the participation of international scientists and to minimize the cost of the conference for everyone We gratefully acknowledge their willingness to facilitate the communication among soybean specialists.

Benefactors (Donations of $5,000 or more)
Agricultural Division of CIBA-GEIGY and Funk Seeds International
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Food and Agricultural Organization of the United Nations
Iowa Crop Improvement Association
Iowa Soybean Promotion Board
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Wilson Hybrids, Inc.

The Conference

World Soybean Research Conference—III is the culmination of three years of planning by numerous individuals Iowa State University was asked to serve as host of the conference by Robert Judd, a member of the Executive Committee of World Soybean Research Conference—II and a long-time leader in the support of soybean research in the United States. Thanks to the dedicated effort of persons at Iowa State University and throughout the world, an extensive program was developed. The broad scope of participation by international specialists is the result of generous financial assistance by private and public institutions

The success of the conference will depend on the active participation of all persons who attend The speakers have devoted countless hours in preparing information on past, present, and future soybean research activities Their dedicated effort will serve as the foundation for dialogue and discussion.

The soybean is a major component of the diet of millions of people throughout the world. The ability of the international community of soybean specialists to enhance the supply and usefulness of this important crop will be a vital factor in the health and welfare of future generations. Our success will depend on the exchange of information gained through effective research. World Soybean Research Conference—III will provide the opportunity for such communication to take place

Welcome to Iowa State University and Ames

Iowa State University is pleased to serve as host for the conference. As a land-grant institution, the goals of the university and those of the conference are in harmony. The faculty and students are ready to do whatever possible to make the conference a productive event.

Iowa State University was created as the Iowa Agricultural College and Model Farm by the Iowa General Assembly in 1858. The college became a land-grant college under the terms of the federal Morrill Act in 1863 and its first classes were taught in 1869. Iowa State was the worldwide pioneer in the establishment of agricultural studies on a college level, was the first state institution to found a veterinary school, help move the engineering profession to its present key position in an industrial society, emphasize basic sciences, and take leadership in establishing the profession of home economics. It was renamed Iowa State College of Agriculture and Mechanic Arts in 1898, and became Iowa State University of Science and Technology in 1959

Over the years, Ames has grown to include the USDA's National Animal Disease Center and the National Veterinary Service Laboratories, the United States Department of Energy's Ames Laboratory, the Iowa Department of Transportation, many small businesses and four larger manufacturing companies Ames' Parks and Recreation Department maintains over 574 acres of woods, streams, and open meadows, 21 parks with picnicking, tennis, ice skating, nature walks, and other recreational activities. Iowa State Center hosts many performances by nationally and internationally known groups in the performing arts And sports fans can take in a number of spectacular events from 21 intercollegiate men's and women's teams competing in Big Eight Conference events The area surrounding Ames offers the outdoorsman several natural and artificial lakes with excellent boating, sailing, fishing, camping, swimming, and picnicking.

General Information

Meeting Rooms

All conference activities will take place in the Iowa State Center, a complex of four adjacent buildings at Iowa State University. The Scheman Continuing Education Building will be the central meeting facility Plenary sessions will be held in C Y Stephens Auditorium and the conference banquet will be in Hilton Coliseum

Poster Sessions

Posters will be displayed in Rooms 167-179 Scheman throughout the conference. Authors of posters will be available for discussion at the time listed on each poster.

Registration

Registration will take place in the first floor of the Scheman Building. The desk will be staffed from 1300 to 1900 on Sunday, 12 August and from 0730 to 1700 on Monday through Friday of the conference. The staff will be available to provide information and deal with special requests

Lodging

Lodging has been provided on a first-come basis in the university residence hall and at motels in the city The Maple-Willow-Larch Residence Hall is located across the street from the Iowa State Center. Room check-in is located on the main floor of the residence hall Rooms must be vacated by 1600 on Friday, 17 August. Persons who plan to stay in Ames on Friday evening should make reservations early in the week at an Ames motel. The residence halls are not available after Thursday evening because they must be prepared for the arrival of students A list of Ames motels is available at the Scheman Registration Desk.

A list of camping facilities in the area is available at the Scheman Registration Desk

Meals

Meal packages will be available for all conference participants in the Maple-Willow-Larch residence hall immediately north of the Scheman Building. The meal package can be purchased until 1200 on Monday, 13 August at the front desk of the residence hall or at the Scheman Registration Desk. The $33.00 package includes

five breakfasts (Monday through Friday), four lunches (Monday through Thursday), and two dinners (Monday and Wednesday). Well-balanced meals are served cafeteria-style in the dining room of the residence hall and correspond to the regular menus served to the students during the school year Breakfast is served from 0630 to 0830; lunch from 1130 to 1300, and dinner from 1700 to 1830

A cafeteria-style dinner will be available on a cash basis at the Scheman Building on Sunday evening, 12 August, because no food service is provided by the residence hall at that time Continental breakfasts and a buffet lunch will be available at Scheman on a cash basis each day

Individual meals can be obtained at the Memorial Union of Iowa State University, located four blocks west of Scheman on Lincoln Way Various fast food restaurants are located on or near Lincoln Way about five blocks west of Scheman. A list of more elaborate dining facilities is available in the information packet provided at registration

Tickets for the conference banquet can be purchased until 1700 on Monday, 13 August and tickets for the conference barbecue until 1700 on Wednesday, 15 August The tickets are available at the Scheman Registration Desk

Transportation
A conference shuttle bus will run regularly during Sunday through Friday between the Iowa State Center and the Holiday Inn-Gateway Center, Silver Saddle Motel, Ramada Inn, Ames Travelodge, and University Inn The shuttle schedule is available in the information packet provided at registration.

Transportation around Ames is provided by the city bus system, Cy-Ride. A bus schedule is provided in the information packet Transportation also is provided by the Cyclone Area Taxi Service (232-1343) If emergency transportation is required, contact the Scheman Registration Desk

Charter bus transportation to the Des Moines airport will begin at 1700 on Thursday, 16 August and continue until 1200 Saturday, 18 August A reservation for the bus is required and a ticket should be purchased at the Scheman Registration Desk by 1700 on Wednesday, 15 August The bus ticket will cost $10.00 per person. Please reserve a bus that leaves at least 90 minutes before the departure of your flight All departures on Thursday and Friday will be from the north entrance of Scheman. Baggage can be checked at the Scheman Registration Desk on Thursday and Friday mornings. Persons departing on Saturday morning will be picked up at their motel.

Persons that must depart from the conference before Thursday at 1700 should contact the Scheman Registration Desk for the schedule of the Inter-City bus that provides limited service to the Des Moines airport

A representative of World Wide Travel, the official travel agency of Iowa State University, will be available at the Scheman Registration Desk to assist with arrangements for air travel. Please ask the receptionist at the Registration Desk for the schedule. At other periods of time, you can call World Wide Travel (292-8182) or walk to the agency about five blocks west of Scheman at 103 Welch.

Special Activities
Sunday, 12 August
1930-2200 Conference reception in the south courtyard of Scheman. A ticket is provided to conference registrants without charge

Tuesday, 14 August
1830 Conference banquet in Hilton Coliseum. Tickets may be purchased at the Scheman Registration Desk until 1700 on Monday, 13 August at a cost of $15 00 The banquet will include a cocktail hour, dinner, and special entertainment The speaker will be television farm broadcaster Chet Randolph, who will address the topic, "A Look at Soybean Research from over the Fence." Musical entertainment will be provided by talented young people from throughout Iowa who perform as the Iowa State Fair Singers.

Wednesday, 15 August
1730-2130 Tour of ALMACO, builder of specialized research equipment, at Nevada, Iowa, about 12 miles east of Ames. Reservations for the free bus transportation can be made at the Scheman Registration Desk until 1700 on Tuesday, 14 August.

1830-2130 Open house at research facilities on the campus of Iowa State University. No reservations are required.

Thursday, 16 August
1830 Conference barbecue in the south courtyard of Scheman. Tickets may be purchased at the Scheman Registration Desk until 1700 on Wednesday, 15 August at a cost of $7.00 Country music by The Blue Sky Band will be performed from 1900 to 2300

Friday, 17 August
0800-1130 Tours of the field research activities at Iowa State University. Reservations for the free tours can be made until 1700 on Wednesday, 16 August. The tours will begin and end at the north entrance of Scheman.

1400-2300 Transportation will be available to the Iowa State Fair in Des Moines, Iowa at a cost of $10 00 per person. The cost for admission is $3.50 for adults, $1 00 for children 5 to 12 years old, and no charge for children under 5 years of age. The bus will leave from the north entrance of Scheman at 1400 and return to Ames at 2300 Persons will be delivered to their motel on the return trip

Family Activities
A hospitality room for families is available in 299 Scheman and will be staffed from 1300 to 1700 on Sunday and from 0900 to 1700 on Monday through Thursday. Refreshments will be available and information can be obtained on points of interest in the Ames area Family activities that have been scheduled are the following

Sunday, 12 August
1930-2200 Conference reception in the courtyard of the Scheman Building

Monday, 13 August 299 Scheman
1000-1200 Welcome to Iowa State University and Ames

1400-1500 History of Iowa

Tuesday, 14 August
0930-1600 Tour—"Discovering old and new Des Moines" Lunch and all admissions are included in the tour price of $19 00 per person. The tour will depart from the north entrance of Scheman at 0930 Tickets may be purchased from the Scheman Registration Desk until 1200 on Monday, 13 August.

1830 Conference banquet Tickets may be purchased from the Scheman Registration Desk until 1700 on Monday, 13 August

Wednesday, 15 August 299 Scheman
0930-1200 Presentation on soy oil and soy foods by the American Soybean Association

1730-2130 Tour of ALMACO at Nevada, Iowa.

1830-2130 Open house at research facilities on the campus of Iowa State University

Thursday, 16 August
0930-1630 Tour of Living History Farms near Des Moines. Lunch and all admissions are included in the tour price of $22.50 per person. The tour will depart from the north entrance of Scheman at 0930. Tickets may be purchased from the Scheman Registration Desk until 1200 on Wednesday, 15 August.

1830 Conference barbecue Tickets may be purchased from the Scheman Registration Desk until 1700 on Wednesday, 15 August

Friday, 17 August
0800-1130 Tours of field research at Iowa State University

1400-2300 Transportation will be available to the Iowa State Fair in Des Moines, Iowa at a cost of $10.00 per person.

Messages, Program Changes, and Other Pertinent Daily Information
A message board is located in the first floor lobby of the Scheman Building near the Registration Desk. If you want to post a message, please ask for a message card at the Registration Desk Messages received at the ISU Residence Hall or at Scheman will be posted on the board. Persons residing in motels should contact the front desk of the establishment Telephone messages will be received at the Scheman Registration Desk from 0800 to 1700 (515-294-1400) and at the ISU Residence Hall from 0700 to 2400 (515-294-8401). Emergency messages between 2400 to 0700 can be directed to the ISU Campus Security (515-294-4428).

The *World Soybean Research Chronicle* will be published daily during the conference. It will contain program changes and other last minute information for conference participants. The *Chronicle* will be distributed each morning in C Y. Stephens Auditorium and copies will be available during the day at the Scheman Registration Desk If you have information for the publication, please give it to the receptionist at the Registration Desk before 1400 to be included in the next day's edition.

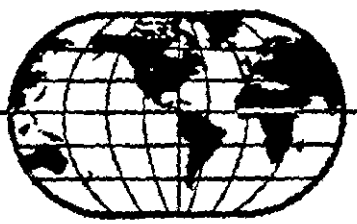
Manuscripts
Invited speakers who have not turned in their manuscripts may leave them at the Scheman Registration Desk.

Conference Publications
Copies of the conference program containing the abstracts of plenary, invited, and contributed papers are provided to each registrant. Extra copies of the publication are available at the Scheman Registration Desk at a cost $5 a copy. The plenary and invited papers will be published in the conference proceedings to be available in 1985. Copies ordered at the Registration Desk during the conference will cost $45 A higher price may be charged for copies purchased from the publisher after the conference.

Special needs
Please contact the Scheman Registration Desk with any special requests.

World Soybean Research Conference—III Program

Reid G. Palmer, Chair



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Sunday Afternoon
12 August

Conference Registration **1300-2100**

First Floor of the Scheman Continuing Education Building
Iowa State University

Sunday Evening
12 August

Conference Reception **1930-2200**

South Courtyard of the Scheman Continuing Education Building

Monday Morning
13 August

Opening Ceremony **0830-0925**

C.Y. Stephens Auditorium
Presiding W.R. Fehr, Iowa State University, USA

0830
Welcome to Iowa State University
W. Robert Parks, President of Iowa State University

0840
Welcome to Iowa
R.H. Lounsberry, Iowa Secretary of Agriculture

0850
Welcome to the World Soybean Research Conference
R.W. Howell, Chair, World Soybean Research Conference—I
B.E. Caldwell, Chair, World Soybean Research Conference—II

0910
Presentation of a proposed constitution for World Soybean Research Conferences

Session 1 **0925-1000**
Plenary Session

C.Y. Stephens Auditorium
Presiding· R.G. Palmer, USDA/ARS, and Iowa State University, USA

0925 (1)†
World Supply, Demand, and Competition for Soybeans and Products
S. Mielke, Oil World, West Germany

Break **1000-1020**

Session 2 **1020-1200**
Invited
International Soybean Networks and Programs

Room 230-240 Scheman
Presiding: D.K. Whigham, Iowa State University, USA

1020 (2)
The Food and Agricultural Organization's Soybean Program
H.A. Al-Jibouri, FAO, Italy

1035 (3)
INTSOY—Participant in an International Soybean Research Network
H.E. Kauffman, INTSOY/University of Illinois, USA

1050 (4)
The Asian Vegetable Research and Development Center's Soybean Program
S. Shanmugasundaram, AVRDC, Taiwan

1105 (5)
The European Cooperative Research Network on Soybean
M Arnoux, INRA, France

1120 (6)
The Soybean Improvement Program at the International Institute of Tropical Agriculture
E.A. KUENEMAN*, W.R. Root, K.E. Dashiell, and S.R. Singh, IITA, Nigeria

1135 (7)
Soybeans in Brazil: Production and Research
E.R. Bonato and A. DALL'AGNOL, EMBRAPA, Brazil

Session 3 **1020-1200**
Invited
Breeding and Genetics—Germplasm and Methodology

Benton Auditorium, Scheman
Presiding: J.H. Williams, University of Nebraska, USA

1020 (8)
Cultivar Development in the Tropics
A DALL'AGNOL and R. Kiihl, EMBRAPA, Brazil

1045 (9)
Strategies for Cultivar Development in Temperate Climates
J.A. Schillinger, Asgrow Seed Co., USA

1110 (10)
The Application of Quantitative Genetics Theory to Plant Breeding Problems
S.K. St.Martin, Ohio State University, USA

1135 (11)
Equipment and Techniques for Field Research in Soybeans
J.C. Thorne, Northrup King Co., USA

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† Numbers within parentheses refer to the abstract printed at the back of this program.

* Coauthored papers will be presented by the author listed in boldface and capital letters.

Session 4 **1020-1200**
Invited
Developmental Aspects of Physiology

260-262 Scheman
Presiding· W.J. Wiebold, Ohio State University, USA

1020 (12)
Correlative Effects of Pods on Plant Development
I.A. TAMAS, P J .Davies, B.K. Mazur, and L.B. Campbell, Ithaca College and Cornell University, USA

1045 (13)
Soybean Seedling Growth and Vigor
J S. Burris, Iowa State University, USA

1110 (14)
Growth and Development of Soybean Root Systems
T.C. Kaspar, USDA/ARS, and Iowa State University, USA

1135 (15)
Photo-Thermal Regulation of Flowering in Soybean
R.J. SUMMERFIELD and E.H. Roberts, University of Reading, England

Session 5 **1020-1200**
Invited
Economics—Supply and Demand Prospects

150-154 Scheman
Presiding: D.D. Hacklander, Crops Branch/NED/ERS/USDA, USA

1020 (16)
Potential Protein Demand Soybean Meal and Competing Products
V. McMinimy, A.E Staley, USA

1045 (17)
Potential Vegetable Oil Demand Soybean Oil and Competing Products
D. Gustafson, DBI Inc , USA

1110 (18)
Project 2002. The Long-Range Future for Soybeans from a U.S. Perspective
D. SHARPE, American Soybean Association, USA

1135 (19)
Supply, Use, and Price Prospects for Soybeans and Other Oilseeds
J. Matthews, WAOB/USDA, USA

Session 6 **1020-1200**
Invited
Pathology—Diseases Affecting Seeds

250-252 Scheman
Presiding. J.B. Sinclair, University of Illinois, USA

1020 (20)
Factors Influencing the Incidence and Severity of *Phomopsis* Seed Decay
P.R. Thompson, University of Maryland, USA

1045 (21)
Purple Seed Stain and *Cercospora* Leaf Blight Caused by *Cercospora kikuchii*
H J. Walters, University of Arkansas, USA

1110 (22)
Soybean Mosaic Virus
Y. Maury, INRA, France

1135 (23)
Soybean Bud Blight Seed Transmission of the Causal Virus
R.I. Hamilton, Agriculture Canada, Canada

Session 7 **1020-1200**
Invited
Rhizobium

204-208 Scheman
Presiding· L.R. Frederick, USAID, Washington, D C , USA

1020 (24)
Effect of Soil Environmental Factors on Rhizobia
R.J. Roughley, N.S.W. Department of Agriculture, Australia

1045 (25)
Rhizobium Strain Competition for Nodulation
M.J. Trinick, CSIRO, Australia

1110 (26)
Bacteroids in the Soybean: *Bradyrhizobium japonicum* Symbiosis
J.C. Zhou, Huachung Agricultural College, People's Republic of China; Y.T. TCHAN and J M Vincent, University of Sydney, Australia

1135 (27)
Fast-Growing Soybean Rhizobia
H.H. KEYSER, USDA/ARS, USA, M.J. Sadowsky, McGill University, Canada; and B.B. Bohlool, University of Hawaii, USA

Break **1200-1330**

Monday Afternoon
13 August

Session 8 **1330-1510**
Invited
Breeding and Genetics—Germplasm and Methodology

Benton Auditorium, Scheman
Presiding, C.E. Caviness, University of Arkansas, USA

1330 (28)
Off-Season Nurseries Enhance Soybean Breeding and Genetics Programs
S.R. deCianzio, Iowa State University and University of Puerto Rico, USA

1355 (29)
Soybean Cytogenetics
R.G. Palmer, USDA/ARS, and Iowa State University, USA

1420 (30)
Collection and Utilization of Wild Perennial *Glycine*
A.H.D. BROWN, J.E. Grant, J.J. Burdon, J.P. Grace, and R. Pullen, CSIRO, Australia

1445 (31)
Utilizing the Genetic Diversity of Annual Soybean Species
Junyi Gai, Nanjing Agricultural College, People's Republic of China

Session 9 **1330-1510**
Invited
Developmental Aspects of Physiology

260-262 Scheman
Presiding I.A. Tamas, Ithaca College, USA

1330 (32)
The Physiology of Reproductive Abscission in Soybeans
W.A. BRUN, J.C. Heindl, and K.J. Betts, University of Minnesota, USA

1355 (33)
Influence of Seed Fill Duration on Soybean Growth and Development
R.P. PATTERSON and C.D. Raper, Jr., North Carolina State University, USA

1420 (34)
Nitrogen Mobilization During Seedfill in Soybeans
D.B. EGLI and J.E. Leggett, University of Kentucky, USA

1445 (35)
Regulation of Senescence: Cytokinin and Minerals
L.D. Noodén, University of Michigan, USA

Session 10 **1330-1510**
Invited
Economics—Government Policy Impacts

150-154 Scheman
Presiding P. Dickson, ADM Co., USA

1330 (36)
Trade Policy Issues in the Soybean Sector
J.P. Houck, University of Minnesota, USA

1355 (37)
Impact of Government Programs on Soybean Production, Trade, and Policies
A. WOMACK and S. Johnson, University of Missouri, USA

1420 (38)
South American Policy Impacts and Issues
R.L. THOMPSON, CEA, USA; and G.W Williams, Iowa State University, USA

1445 (39)
European Policy Impacts on the Soybean Sector
W.S. Huyser, IMF, USA; and W.H. MEYERS, Iowa State University, USA

Session 11 **1330-1510**
Invited
Pathology and Nematology

250-252 Scheman
Presiding D.P. Schmitt, North Carolina State University, USA

1330 (40)
Chemical Control of Nematodes Attacking Soybeans
M.E. Zirakparvar, Union Carbide Agricultural Products Co. Inc., USA

1355 (41)
Strategies for Race Stabilization in Soybean Cyst Nematode, *Heterodera glycines*, Ichinohe
R.D. Riggs, University of Arkansas, USA

1420 (42)
Concept of Race in Soybean Cyst Nematode
V.H. Dropkin, University of Missouri, USA

1445 (43)
Plant-Parasitic Nematodes Associated with Soybeans
D.P. Schmitt, North Carolina State University, USA

Session 12 **1330-1445**
Invited
Rhizobium

204-208 Scheman
Presiding: L.R. Frederick, USAID, Washington, D.C., USA

1330 (44)
Effect of Hydrogen Recycling in Nodules on Growth and Nitrogen Fixation in Soybeans
H.J. EVANS, F.J. Hanus, R.A. Haugland, M.A. Cantrell, L.S. Xu, S.A. Russell, and A.R. Harker, Oregon State University, USA

1355 (45)
Environmental Interactions Influencing Innovative Practices in Legume Inoculation
J. Brockwell, CSIRO, Australia

1420 (46)
Problems of Soybean Inoculation in the Tropics
P.H. Graham, University of Minnesota, USA

Break **1510-1530**

Session 13 **1530-1710**
Contributed: Oral
Breeding Methods

Benton Auditorium, Scheman
Presiding. B Moraghan, Asgrow Seed Co., USA

1530 (48)
Multivariate Analysis of a Collection of Soybean Cultivars for Southwestern Spain
R. BARTUAL and E. Carbonell, INIA, Spain

1540 (49)
Advanced Biometrical Techniques Used in the Identification of Soybean Genotypes for Hybridization Programme
S.K. RAO and C.B. Singh, J.N. Agricultural University, India

1550 (50)
Gene Action for Seed Yield, its Quality, and Other Traits in Soybean
G C. SAINI, and V.P. Gupta, Himachal Pradesh Agricultural University, India

1600 (51)
Genetics of Yield and its Attributes in Soybean
M.L. TAWAR and S.P. Singh, J.N. Agricultural University, India

1610 (52)
NC Design I Analysis in Two Soybean Crosses
Pushpendra and HARI HAR RAM, G B. Pant University, India

1620 (53)
Genetic Analysis in Soybean
A. Ayyamperumal, TNAU, India

1630 (54)
Early Generation Testing, Response to Selection and Comparison of Selection Methods in Soybean
V.P. GUPTA and G.C. Saini, Himachal Pradesh Agricultural University, India

1640 (55)
Stability Parameters of Selected Soybean Cultivars in the Southeastern United States
E.R. SHIPE and J.S. Rice, Clemson University, USA

1650
Soybean Breeding in Subtropical Argentina
R. Caro, Obispo Colombres, Argentina

1700
Soybean Production in Subtropical Argentina
O. Ricci, Obispo Colombres, Argentina

Poster (56)††
G × E Interaction in Soybean Across Cropping Systems
V.P. GUPTA and G.C Saini, Himachal Pradesh Agricultural University, India

Poster (57)
Genetics of Adaptability Parameters and Their Association in Soybean Across Cropping Systems
V.P. GUPTA and G.C. Saini, Himachal Pradesh Agricultural University, India

Poster (58)
Mechanism of Adaptability in Soybean Across Cropping Systems
G C. SAINI and V.P. Gupta, Himachal Pradesh Agricultural University, India

Poster (59)
Comparison of Introduced and Induced Soybean Variability in Wielkopolska Region
J. Jaranowski, G. Konieczny, J. Nawracala, and H. SKORUPSKA, Academy of Agriculture, Poland

†† Posters will be displayed in Rooms 167-179 Scheman throughout the conference Authors of posters will be available for discussion at the time listed on each poster

Poster (60)
Maturity Conversion of Late Tropical and of Early Temperate Soybean Germplasm
K.S. McWhirter, University of Sydney, Australia

Poster (61)
Variation of Soybean Hybrid Population in Reponse to Different Environments
F.S. Thseng, National Chung-Hsing University, Taiwan

Poster (62)
Soybean Cultivar Selection for Tropical Areas Based on the Number of Internodes
J NIETO-HATEM, H.T. Gutierrez-Lopez, and R. Reza-Aleman, INIA, Mexico

Session 14 1530-1640
Contributed: Oral
Breeding—Pathology—Entomology—Nematology

230-240 Scheman
Presiding· J. Miller, Asgrow Seed Co , USA

1530 (64)
Alternative Methodology for Screening for Resistance to Soybean Cyst Nematode
R.J THOMAS and W.R. Fehr, Iowa State University, USA

1540 (65)
Host Plant Resistance to Australian Soybean Pests
D.J. ROGERS, H.B Brier, and J Rose, Queensland Department of Primary Industries, Australia

1550 (66)
Selection Mechanisms of Soybeans and Other Grain Legumes by the Mexican Bean Beetle
D. FISCHER and M. Kogan, Illinois Natural History Survey, USA

1600 (67)
Efficient Selection for Brown Stem Rot Resistance in Soybeans
S.A. SEBASTIAN and C.D. Nickell, University of Illinois, USA

1610 (68)
Inheritance of Reaction Type to Brown Spot and Senescence in Soybean
C.L. Bhardwaj, V.P. Gupta, O.P. Sood, B.M. SINGH, and N.D. Rana, Himachal Pradesh Agricultural University, India

1620 (69)
Induced Mutations for Rust Resistance in Soybeans
S. SMUTKUPT, A. Wengpiyasatid, and S. Lamseejan, Kasetsart University, Thailand

1630 (70)
Breeding of Soybean Cultivars Resistant to Frog-Eye Leaf Spot
Huang Guichao, Academy ASH, People's Republic of China

1640
Incidence of Soybean Diseases in Argentina
C. Martinez, INTA, Argentina

Poster (71)
Inheritance of Yellow Mosaic Virus in Soybean under Natural Conditions
G.C. SAINI and V.P. Gupta, Himachal Pradesh Agricultural University, India

Poster (72)
Evaluation of Soybean Lines and Cultivars for Resistance to *Sclerotinia sclerotorium* Lib de Bary
C.A. MARTINEZ, G.L. Botta, N.A. Mancuso, and A J. Ivancovich, EERA/INTA, Argentina

Poster (73)
Soybean *Rps* Genes and Reactions to Phytophthora
R.I Buzzell, T.R. Anderson, Agriculture Canada, and B.D. RENNIE, University of Guelph, Canada

Poster (74)
Effects of Blending Soybean Cyst Nematode Resistant and Susceptible Soybeans
R.J. THOMAS, H Tachibana, and W.R. Fehr, Iowa State University and USDA/ARS, USA

Poster (75)
Interactions of Moisture Stress and Brown Stem Rot on Yield in Soybean
A.H. EPSTEIN, H. Tachibana, and J.D. Hatfield, Iowa State University and USDA/ARS, USA

Poster (76)
A Strain of Soybeans Resistant to Multiple Adverse Factors
H. TACHIBANA, J.D. Hatfield, R.J. Thomas, and W.R. Fehr, USDA/ARS, and Iowa State University, USA

Poster (77)
Use of a Computerized Data Base to Study Brown Stem Rot and Yield Interaction in Soybeans
J.D. HATFIELD and H. Tachibana, Iowa State University and USDA/ARS, USA

Session 15 **1530-1700**
Contributed: Oral
Developmental Aspects of Physiology

260-262 Scheman
Presiding: W.A. Brun, University of Minnesota, USA

1530 (78)
Diagnosis of Soybean Injury by Analysis of Chlorophyll and Protein
W.L. KOUKKARI, B.W. Kennedy, L. Carlson, D.P. Pacolt, and M. Couderchet, University of Minnesota, USA

1540 (79)
Synthesis and Breakdown of Glycolipids in Senescent Plastids
D.W. Newman, Miami University, and D.S DALGARN, Saginaw Valley State College, USA

1550 (80)
Seed Growth and Yield at Different Locations in the Soybean Canopy
S.U. Wallace, Clemson University, USA

1600 (81)
Delayed Maturity in Soybeans Grown in the Central Valley of California
M.W. Schonbeck, Shell Development Co , USA

1610 (82)
Seed Water Content Fluctuation and Metabolic Activity During Imbibition of Soybean
R A. AMABLE and R.L. Obendorf, Cornell University, USA

1620 (83)
Dynamic Simulation of Physiological Processes in Soybeans
G.E. MEYER, University of Nebraska, and R.B. Curry, OARDC, USA

1630 (84)
Effects of Low Soil Oxygen on Root Growth and Photosynthesis
D. Del Castillo, F D. Whisler, B. ACOCK, and H.F. Hodges, MAFES, USA

1640 (85)
Biochemical Characterization of Soybean Ovary Growth from Anthesis to Abscission of Aborting Ovaries
C.D. DYBING, H. Ghiasi, and C. Paech, USDA/ARS, and South Dakota State University, USA

1650 (86)
Intraraceme Competition in Field Grown Soybeans
W.J. WIEBOLD, W.G. Spollen, and D.S. Glenn, Ohio State University and University of Maryland, USA

Poster (87)
ABA and Premature Abscission of Soybean Reproductive Structures
G.L. YARROW, W.A. Brun, and M.L. Brenner, University of Minnesota, USA

Poster (88)
Effects of SADH on Growth and Yield of Soybean
S. Campiranon, Kasetsart University, Thailand

Session 16 **1530-1600**
Contributed: Oral
Economics—Impact of Government Policies on Soybean Production, Trade, and Prices

150-154 Scheman
Presiding R.L. Hoskin, NED/ERS/USDA, USA

1530 (92)
Soybean Oil Price Fundamentals
D.K. WILLIMACK, NED, and J L Hazera, IED/ERS/USDA, USA

1540 (93)
Policy Impact on Production, Price, and Trade
Y.K. Chung, FFTC/ASPAC, Taiwan

1550 (94)
Feed Utilization in the European Community
W.H. Gardiner, IED/ERS/USDA, USA

Session 17 **1530-1730**
Contributed: Oral
Pathology—Diseases Affecting Seeds

250-252 Scheman
Presiding. H.J. Walters, University of Arkansas, USA

1530 (95)
The Use of Pod-Borne Inoculum to Predict Phomopsis Seed Decay
D C. McGee, Iowa State University, USA

1540 (96)
Environmental Factors Affecting the Movement of Phomopsis Species from Soybean Pods to Seeds
A. BALDUCCI and D.C. McGee, Iowa State University, USA

1550 (97)
Oil Thermotherapy for Control of Seedborne Soybean Pathogens
M.M. PYNDJI and J.B. Sinclair, University of Illinois, USA

1600 (98)
Soybean Seed Quality in Nepal Influenced by Maturity Group, Planting Date, and Harvest Time
J.B. MANANDHAR, S. Joshi, and M.P. Bharati, Department of Agriculture, HMG/Nepal, and University of Illinois, USA

1610 (99)
Loss From Bacterial Blight on Soybean
B.W KENNEDY and R. Denny, University of Minnesota, USA

1620 (100)
Effects of Crop Rotation and Tillage on Soybean Seed Quality
T.S. Abney and R.H. VON QUALEN, USDA/ARS, and Purdue University, USA

1630 (101)
Genotype X Environment Interactions for Seed Disease Development in Soybeans
J.A. BALLES and T.S. Abney, USDA/ARS, and Purdue University, USA

1640 (102)
Influence of Growth Regulators on Soybean Pod Maturity and Fungal Seed Infection
T.S. ABNEY, J.B. Balles, and T.L. Richards, USDA/ARS, and Purdue University, USA

1650 (104)
Viruses Infect Soybeans in Egypt
E.K. Allam, AinShams University, Egypt

1700 (105)
Vector Relationships and Host Range Studies with Soybean Dwarf Virus
V.D. DAMSTEEGT, A.D Hewings, and J.M. Snapp, USDA/ARS/PDRL, USA

1710 (106)
Isolation of a Betacarotene-Producing Coryneform Bacterium from Soybean Seeds and Leaves
J.M. Dunleavy, USDA/ARS, and Iowa State University, USA

1720 (107)
Reaction of *Vigna mungo* and *V radiata* to Cyst Nematode
S.C. ANAND and C.R. Shumway, University of Missouri, USA

Poster (108)
Predicting the Impact of Soybean Mosaic Virus in Soybean
M.E. IRWIN and W.G. Ruesink, University of Illinois, USA
Presented by G KAMPMEIER.

Poster (109)
Characterization of Resistance in Two Incompatible Soybean Cyst Nematode-Soybean Combinations
J.M HALBRENDT and V.H. Dropkin, University of Missouri, USA

Session 18 **1530-1740**
Contributed: Oral
Rhizobium

204-208 Scheman
Presiding. L.R. Frederick, USAID, Washington, D.C , USA

1530 (110)
Fast-Growing *Rhizobium japonicum* Show Unusual Nodulation Properties in Hydroponics
N.M. DuTEAU, A.G Atherly, and R.G. Palmer, Iowa State University, and USDA/ARS, USA

1540 (111)
Ecological Field Studies with Fast Growing *R. japonicum* Strains
T.J. McLOUGHLIN, S.G. Alt, and A. Owens, Agrigenetics Advanced Research Division, USA

1550 (112)
Soybean Cultivar-*Rhizobium* Strain Specificity and Inter-Strain Competition in Early-Maturing (00 and 000) Soybeans
R.J. RENNIE and S. Dubetz, Agriculture Canada, Canada

1600 (113)
Fertilizer N Levels, *Rhizobium* Strains Effect on Soybean N_2 Fixation
S.T. SANOGHO and K. Munyinda, Zambia, and J O Legg, IAEA

1610 (114)
Interaction of Soybean *Rhizobium japonicum* Strain, and Soil and Water Management
P.G. HUNT, A.G. Wollum II, and T.A. Matheny, USDA/ARS and North Carolina State University, USA

1620 (115)
Nodulation and N-Fixation of Group 000 Soybean as Influenced by Strains of *R. japonicum*
L.D. Bailey, Agriculture Canada, Canada

1630 (116)
Effect of Phosphorus on Nodulation of Soybean in the Rhodustalfs
P.B Jayamanne, Department of Agriculture, Sri Lanka

1640 (117)
Simple Technique for Production of *Rhizobium* Inoculants for Developing Countries
T.P. DUONG and L.T. Kieu-Nhan, University of Can Tho, Vietnam

1650 (118)
A High Active *Rhizobium-japonicum* Strain PRC 113-2
X.J. Zhang, Oil Crops Research Institute, CAAS, People's Republic of China

1700 (119)
Effect of Inoculation and Fertilizer Application on Soybean in Bangladesh
M.S. Hoque, BAU, Bangladesh

1710 (120)
Influence of Liming an Ultisol on Growth and Yield of Soybean
C.S. Weeraratna, Ruhuna University, Sri Lanka

1720 (121)
Fungicide Treatment and *Rhizobium* Inoculation of Soybeans Under Sub-Tropical Conditions
P.N. THAPLIYAL and K.S. Dubey, G B. Pant University, India

1730
Response of Soybean to *Rhizobium* Inoculation
T. NATARAJAN, R. Murugesan, G. Gopalaswamy, and G Thulasidass, Pudukkottai, India

Poster (122)
Response of Soybeans to Nitrogen Fertilizer and Inoculation
H.A. Al-Dulaimi, T.A. ESSA, and B.A. Al-Ithawi, University of Baghdad, Iraq

Poster (123)
Assay of Intrinsic Competition in Soybean Growing Soils by Asymbiotic *Rhizobium*
E. Joseph, J.N. DUBE, and U.K. Vaishya, J.N Agricultural University, India

Session 19 — 2000-2200
Rust Workshop

230-240 Scheman
Presiding S. SHANMUGASUNDARAM, A.T. Tschanz, and C. Yang, AVRDC, Taiwan

Tuesday Morning
14 August

Session 20 — 0830-0920
Plenary Session II

C.Y. Stephens Auditorium
Presiding: R.G. Palmer, USDA/ARS, and Iowa State University, USA

0840 (124)
World Soil Erosion. Problems and Solutions
W E. LARSON and F J Pierce, University of Minnesota, USA

Session 21 — 0920-1000
Plenary Session III

C.Y. Stephens Auditorium
Presiding R.G. Palmer, USDA/ARS, and Iowa State University, USA

0920 (125)
Integrated Pest Management in Soybean Production Systems A Holistic Viewpoint
F. Poston and S. WELCH, Kansas State University, USA, J. Jones and J. Mishoe, University of Florida, USA

Break — 1000-1020

Session 22 — 1020-1200
Invited
Utilization, Breeding, and Genetics

Benton Auditorium, Scheman
Presiding J.W. Lambert, University of Minnesota, USA

1020 (126)
Breeding Soybeans for Protein Quantity and Quality
J W. Burton, USDA/ARS, and North Carolina State University, USA

1045 (127)
Anti-Nutritional Factors in Soybeans Genetics and Breeding
T. Hymowitz, University of Illinois, USA

1110 (128)
Breeding Soybeans for Special End Uses
O.G. Carter, Hawkesbury College, Australia

1135 (129)
Breeding Soybeans for Improved Oil Quantity and Quality
J.R. Wilcox, USDA/ARS, and Purdue University, USA

Session 23 — 1020-1200
Invited
Physiology and Partition Transport of Assimilates

260-262 Scheman
Presiding: R.L. Obendorf, Cornell University, USA

1020 (130)
Carbon and Nitrogen Partitioning in Soybean Leaves During Seed Filling
R.T. GAIQUINTA, V. Wittenbach, and V. Franceschi, E I du Pont de Nemours and Co., USA

1045 (131)
Assimilate Transport and Soybean Seed Development
J.H Thorne, E I. du Pont de Nemours and Co , USA

1110 (132)
Amino Acid and Sucrose Efflux From Soybean Leaves
J. Secor, Dow Chemical; and L.E Schrader, University of Wisconsin, USA

1135 (133)
Export of Nitrogenous Compounds from Soybean Roots
J.G. Streeter, OSU/OARDC, USA

Session 24 — 1020-1200
Invited
Soybean Seed Programs in the Tropics

220 Scheman
Presiding. K.H. Knittle, DeKalb-Pfizer, USA

1020 (134)
Soybean Seed Program Objectives and Challenges
J.C. Delouche, Mississippi State University, USA

1045 (135)
Soybean Seed Programs in Latin America
F. Popinigis, EMBRAPA, Brazil

1110 (136)
Soybean Seed Programs in Southern Africa
D.M. Naik, Mount Makulu Research Station, Zambia

1135 (137)
Soybean Seed Production in Asia
P. WANNAPEE, B. Gregg, and S. Jongvanich, DOAE, Thailand

Session 25 **1020-1200**
Invited
Pathology—Fungus Diseases Affecting Leaves

250-252 Scheman
Presiding: L.E Gray, USDA/ARS, and University of Illinois, USA

1020 (138)
Soybean Anthracnose
P.R. Hepperly, University of Puerto Rico, USA

1045 (139)
Epidemiology of Soybean Downy Mildew
S.M. Lim, USDA/ARS, and University of Illinois, USA

1110 (140)
Soybean Rust Research An International Review
A.T. Tschanz and S. SHANMUGASUNDARAM, AVRDC, Taiwan

1135 (141)
Powdery Mildew A Sporadic But Potentially Damaging Disease of Soybean
C.R. Grau, University of Wisconsin, USA

Session 26 **1020-1200**
Invited
Production, Cultural Practices, and Utilization

230-240 Scheman
Presiding: L.L. Schultz, USAID, USA

1020 (142)
Soybean Production and Utilization in Sub-Saharan Africa
L E.N. JACKAI, K E. Dashiell, D.A. Shannon, and W R. Root, IITA, Nigeria

1045 (143)
Soybean Production in Asia
R.M Lantican, UPLB, College, Philippines

1110 (144)
Production, Cultural Practices, and Utilization of Soybean in Europe
R. Blanchet, INRA, France

1135 (145)
Soybean Production in South America
W.M C. Val, EMBRAPA/CNPS, Brazil

Break **1200-1330**

Tuesday Afternoon
14 August

Session 27 **1330-1445**
Invited
Biotechnology

Benton Auditorium, Scheman
Presiding. R.C. Shoemaker, University of Nebraska, USA

1330 (146)
Use of Tissue Culture as a Tool in Soybean Improvement
J. Roth and K.G. LARK, University of Utah, USA, and R.G. Palmer, USDA/ARS, and Iowa State University, USA

1355 (147)
Molecular Features of Storage Proteins in Soybeans
N.C. Nielsen, USDA/ARS, and Purdue University, USA

1420 (148)
The Organization of Genes Involved in Symbiotic Nitrogen Fixation on Indigenous Plasmids of *Rhizobium japonicum*
A.G. ATHERLY, R.K. Prakash, R.V. Masterson, N B. DuTeau, and K S. Engwall, Iowa State University, USA

Session 28 **1330-1510**
Invited
Soil—World Soil Erosion: Problems and Solutions

204-208 Scheman
Presiding: E.C. Dickey, University of Nebraska, USA

1330 (150)
Production Constraints and Soil Erosion in the Humid Tropics of Densely Populated Java
E.M. Barrau, USAID/AGR, Indonesia

1355 (151)
Soybean Production and Soil Erosion Problems and Solutions—Africa
R. Lal, IITA, Nigeria. Presented by D. Shanon, IITA, Nigeria

1420 (152)
Soybean Production and the Soil Erosion Problems and Solutions—South America
N.P. Cogo, UFRGS, Brazil

1445 (153)
World Soil Erosion—Problems and Solutions: North America
W.C. MOLDENHAUER, USDA/ARS, and Purdue University; and J.M. Laflen, USDA/ARS, and Iowa State University, USA

Session 29 **1330-1510**
Invited
Entomology—Plant Damage Syndromes, Yield Losses, and Economic Decision Indices for Soybean Insect Pests

260-262 Scheman
Presiding. D.J. Boethel, Louisiana State University, USA

1330 (154)
Damage Simulations as an Approach to Understanding Economic Losses to Insects
G.D. Thomas, USDA/ARS, and University of Nebraska, USA

1355 (155)
Effects of Insect-Pest Complexes on Soybeans
J.W. Todd, University of Georgia, USA

1420 (156)
Impact and Economics of Threecornered Alfalfa Hopper Feeding on Soybeans
A.J. Mueller, University of Arkansas, USA

1445 (157)
Approaches to Studying Interactive Stresses Caused by Insects and Weeds
R.A. Higgins, Kansas State University, USA

Session 30 1330-1510
Invited
Pathology—Fungus Diseases Affecting Roots and Stems

250-252 Scheman
Presiding T.S. Abney, USDA/ARS, and Purdue University, USA

1330 (158)
Phytophthora Root Rot of Soybean
K.L. Athow, Purdue University, USA

1355 (159)
Sclerotinia Rot of Soybeans, Its Importance and Research in Brazil
J.T. YORINORI, M. Homechin, and A.A. Henning, EMBRAPA/CNPSoja, Brazil

1420 (160)
Etiology, Epidemiology, and Control of Stem Canker
P.A. BACKMAN, D.B. Weaver, and G. Morgan-Jones, Auburn University, USA

1445 (161)
Brown Stem Rot of Soybeans
L.E. Gray, USDA/ARS, and University of Illinois, USA

Break 1510-1530

Session 31 1530-1700
Contributed: Oral
Breeding—Physiology

Benton Auditorium, Scheman
Presiding: A. Matson, Soybean Research Foundation, USA

1530 (162)
Agronomic Performance of Lines Selected for Enhanced Nitrogen-Fixing Ability
W.J. KENWORTHY, M.C. Bolgiano, and J.J. Meisinger, University of Maryland, USA

1540 (163)
Selection for High Nitrogen Fixation among Southern Soybean Lines
A.R. SOFFES, T.R. Sinclair, and K. Hinson, USDA/ARS, and University of Florida, USA

1550 (164)
Methods Used to Identify Promiscuous Soybean Lines
K.E. DASHIELL, J.H. Gibbons, E.A. Kueneman, and W.R. Root, IITA PMB, Nigeria

1600 (165)
Breeding Super-Early Soybean Cultivars for Expanding Production to High Latitude Regions
J.L. WANG and F.L. Gao, North East Agricultural College, People's Republic of China

1610 (166)
The Yield Seed-Filling Period Relationship of F5 Lines
J.R. SMITH and R.L. Nelson, USDA/ARS, and University of Illinois, USA

1620 (167)
Mode of Inheritance of the Vegetative Period of Soybean
B. BELIC and Dj. Jockovic, IFVC, Yugoslavia

1630 (170)
Reproductive Period, Photoperiod Sensitivity, and Physiological Maturity in Three Wide Soybean Crosses
G.L. METZ, Garst Seed Co.; D.E. Green, and R.M. Shibles, Iowa State University, USA

1640 (168)
Inheritance of Flower Abortion and Pod Type in Soybean Genotypes Differing in Raceme Length
K.P. SHARMA, C.D. Dybing, and C. Lay, South Dakota State University and USDA/ARS, USA

1650 (169)
Seed Yield Efficiency of Soybean Germplasm
R B. DADSON, J. Joshi, and P. Wells, University of Maryland-Eastern Shore, USA

Session 32 1530-1730
Contributed: Oral
International Breeding and Germplasm

260-262 Scheman
Presiding: C. Jennings, Pioneer Hi-Bred Int'l, USA

1530 (171)
Soybean Cultivars in the Tropics, Subtropics, and Temperate Zone
J.A. Jackobs, University of Illinois, USA

1540 (172)
Soybean Improvement Work in Madhya Pradesh, India
S.K. MEHTA, A.B.L Beohar, and C.B. Singh, J N Agricultural University, India

1550 (442)
Soybean Breeding Program of INTA in Argentina
J.C. Suarez, INTA, Argentina

1600 (173)
Soybean Breeding for Rainfed Tropics
N. Mehrotra, Haryana Agricultural University, India

1610 (174)
Soybean Combining Ability under Climatic Conditions in Poland
H. Skorupska, Academy of Agriculture, Poznań, Poland

1620 (175)
Germplasm Improvement through Early-Generation Testing
R.L. Nelson, USDA/ARS, and University of Illinois, USA

1630 (176)
Research on the Wild Soybean
WANG LIANZHENG, Wu Heli, Yao Zhenchun, and Lin Hong, HAAS, People's Republic of China

1640 (177)
Soybean Germplasm in Brazil
M.M.V.S. WETZEL, R. Godoy, E.A.V. Morales, EMBRAPA/CENARGEN, C P., Brazil, and A Dall'Agnol, EMBRAPA/CNPS, C P, Brazil

1650 (178)
Effects of Selection for Yield upon Yield Components and Other Characteristics in Soybean
P PARRINI and A.M. Olivieri, University of Padova, Italy

1700 (179)
Offseason Soybean Cultivation Possibilities under Semi-tropical Conditions
A.B.L. BEOHAR, S.K. Mehta, and C B. Singh, J.N. Agricultural University, India

1710 (180)
The Origin of Cultivated Soybean
Wang Lianzheng, HAAS, People's Republic of China

1720 (438)
A Diploid Strain of Wild Soybean (*G. soja*) with Four-Satellited Chromosomes
Zheng H.Y., Chen R.Y., and SUN H., Soybean Institute and Nankai University, People's Republic of China

Session 33 **1530-1700**
Contributed: Oral
Partition and Transport of Assimilates

150-154 Scheman
Presiding J H. Thorne, E.I. du Pont de Nemours and Co, USA

1530 (181)
Abscisic Acid Content in Different Seed-size Soybeans
J.R. SCHUSSLER, M L. Brenner, and W.A. Brun, University of Minnesota, USA

1540 (182)
Long Distance Transport of Abscisic Acid in Soybeans
W.A. BRUN and M L Brenner, University of Minnesota, USA

1550 (183)
Relationship of Cotyledon Cell Number to Seed Growth in Soybean
S. Guldan, University of Minnesota, USA

1600 (184)
Pod Set on Terminal Racemes of Soybean
C M. PETERSON, M W Folsom, L W. Dalrymple, and G. Hoogenboom, Auburn University, USA, and University of Alberta, Canada

1610 (185)
Varietal and Shade Effects on Soybean Leaf Starch Levels
E.D. Nafziger, University of Illinois, USA

1620 (186)
Soybean Seed Growth and Maturation *in vitro*
R L. Obendorf, Cornell University, USA

1630 (187)
Seed Coat Development in Soybean
R.W. YAKLICH, E.L. Vigil, and W.P. Wergin, USDA/ARS, USA

1640 (188)
Using a Mechanistic Model, GLYCIM, to Screen Hypotheses about Soybean Physiology
B. ACOCK, V.R. Reddy, H.F. Hodges, and D.N. Baker, MAFES and USDA/ARS, USA

1650 (189)
The Anatomy of Soybean Leaves at Different Nodes
MIAO YINONG and Xu Kezhang, Northeast Normal University, People's Republic of China

Session 34 **1530-1620**
Contributed: Oral
Seed Quality

254 Scheman
Presiding: J C Delouche, Mississippi State University, USA

1530 (190)
Soybean Seed Multiplication in Bangladesh
G.L. BROCKMUELLER, P.M. Shires, and H.J. Harder, MCC, Bangladesh

1540 (191)
Evaluation of Soybean Storage Conditions on Seed Production and Quality
O.H. El Bagoury, Ain Shams University, Egypt

1550 (192)
Soybean Seed Production in Argentina
V.J. Kopp and E.M. SIERRA, UBA/CONICET, Argentina

1600 (193)
Soybean Seed Quality during Conditioning
M. MISRA, Iowa State University, USA; A. Gaul, Seed and Grain Systems, USA, and O. Kayode, National Cereals Research Institute, Nigeria

1610 (194)
Soybean Crop Sequence in the Subhumid Tropics
M A. ROQUIB and B.N. Chatterjee, BCKV, India

Session 35 **1530-1620**
Contributed: Oral
Pathology—Fungus Diseases Affecting Leaves

250-252 Scheman
Presiding· C R. Grau, University of Wisconsin, USA

1530 (195)
Anthracnose Reduction and Yield Enhancement with Potassium Fertilizer and Benomyl
J.W. SIJ, F.T. Turner, and N.B. Whitney, Texas Agricultural Experiment Station, USA

1540 (196)
The Occurrence and Control of *Pyrenochaeta glycines* on Soybeans in Zambia
D.M. Naik, A. Daila, L.E. DATNOFF, and J.B. Sinclair, Mount Makulu Research Station, Zambia

1550 (197)
The Status of Soybean Rust in Brazil
J.T. YORINORI and J.A. Deslandes, EMBRAPA/CNPSoja, Brazil

1600 (198)
Rhizoctonia Web Blight of Soybean in Pakistan
M S. Mirza, Y. Ahmad, and A R. KHAN, NARC/PARC, Pakistan

1610 (199)
Factors Affecting Soybean Anthracnose
M.N. Khare, J N. Agricultural University, India

Poster (200)
Black Leaf Blight, A New Disease of Soybean
G.E. Stovold, J Walker, P.J DESBOROUGH, and A. Francis, N S W Department of Agriculture, Australia

Poster (201)
A Differential Set for Identifying Races of Soybean Leaf Rust (*Phakopsora pachyrhizi* Syd.)
J.J. Burdon, S.S. Speer, and A.H.D. BROWN, CSIRO, Australia

Session 36 1530-1640
Contributed: Oral
Entomology—Plant Damage Syndromes, Yield Losses, and Economic Decision Indices for Soybean Insect Pests

204-208 Scheman
Presiding J.E. Funderburk, Florida Agricultural Research and Education Center, USA

1530 (202)
Soybean Insect Pest Complex Evaluations
R.M. McPHERSON, Virginia Polytechnic Institute and State University, D.W. Sherrod, Virginia Truck and Ornamental Research Station, and J C. Smith, Virginia Polytechnic Institute and State University, USA

1540 (203)
Interactions between Seedcorn Maggot Damage and Subsequent Stressors on Soybeans
L G HIGLEY and L P. Pedigo, Iowa State University, USA

1550 (204)
Economic Implications of Seedcorn Maggot Damage to Soybean
S.H. HUTCHINS, L.G. Higley, L.P. Pedigo, and P.H. Calkins, Iowa State University, USA

1600 (205)
Interactions of Soybean Defoliation by Insects and Weed Competition
C.G. HELM, M. Kogan, and M.R. Jeffords, University of Illinois, USA

1610 (206)
Soybean Germplasm Evaluation for Resistance to Mexican Bean Beetles
M. RANGAPPA, P.S. Benepal, M.E. Kramer, and W.A. Gade, Virginia State University, USA

1620 (207)
Development of Economic Injury Levels for Individual and Complexes of Pest Arthropod Species on Soybean Grown on Various Row Spacings
J. YANES JR. and D.J. Boethel, Louisiana State University, USA

1630 (208)
Economic Thresholds and the Role of Pest Mortality
K.R. OSTLIE, University of Minnesota, and L.P. Pedigo, Iowa State University, USA

Poster (209)
Bean Pod Mottle Virus and Soybean Yield: Effects of Inoculation Date and Infection Rate
D.W. Ragsdale, University of Minnesota, USA

Session 37 1630-1720
Contributed: Oral
Pathology—Fungus Diseases Affecting Roots and Stems

250-252 Scheman
Presiding K.L. Athow, Purdue University, USA

1630 (210)
Infection of Soybean Roots by *Phytophthora megasperma* f sp *glycinea*. An Electron Microscopic Study
J.R. Golecki, University of Freiburg, West Germany

1640 (211)
Detection of *Macrophomina phaseolina* in Soybean Stems
C.C. MACHADO, G.L. Hartman, J.B. Manandhar, and J.B. Sinclair, University of Illinois, USA

1650 (212)
Pathogenic Specialization of *Diaporthe phaseolorum* var *caulivora* of Soybean
P.M. HIGLEY and H. Tachibana, USDA/ARS, and Iowa State University, USA

1700 (213)
Simulated Plant Loss in Soybeans Due to Pathogens
B.W. Kennedy and P.S. TENG, University of Minnesota, USA

1710 (214)
Screening Soybeans for Resistance to Charcoal Rot in Pakistan
M.S. MIRZA, A. Beg, M. Yousaf, and A.R. Khan, NARC/PARC, Pakistan

Session 38 1330-1730
Contributed: Oral
Country Reports

230-240 Scheman
Presiding: Z.R. Helsel, University of Missouri, USA

1330 (215)
Soybean Production as a Second Crop in Turkey
H. Arioglu, University of Cukurova, Turkey

1340 (218)
Soybean in Spain
A. BORRERO and M.J. Grande, INIA, Spain

1350 (445)
Climatic and Edaphic Environments for Soybean in Argentina
E. Sierra, F.A -UBA/CONICET, Argentina

1400 (217)
Soybean Production System for Germany and Central Africa
G. KAHNT and L.A. Hijazi, Hohenheim University, West Germany

1410 (216)
Report on Nationally Coordinated Research Projects on Soybeans in Nigeria
P. Oyekan, IITA, NCRI, Nigeria

1420 (220)
Agro-Climatic Potential of Northern Uganda for Extensive Cultivation of Soybean
G.S. Rajput and S.P. JAISWAL, AGRIMA Project Engineering and Consultancy Services Limited, India

1430 (221)
Soybean Production by Small Scale Farmers in Zambia
F. JAVAHERI and S. Nkumbula, FAO, Zambia

1440 (222)
Soybean Research and Production in Ethiopia
A. Belay, IAR, Ethiopia

1450 (223)
Important Advances in Soybean Breeding in China
C.C. Yee, Shenyang Agricultural College, People's Republic of China

1500 (224)
New Approach to Soybean Program through Grower's Cooperatives in India
M.D. TEDIA and M.P. Oilfed, Bhopal, India

Break **1510-1520**
Presiding: G.E. Pepper, University of Illinois, USA

1520 (225)
The Potential of Soybeans in the Cropping Patterns of Pakistan
A.H. CHAUDHRY and K. Mehraj, Agricultural Research Institute Tandojam, Pakistan

1530 (226)
Research and Development Activities on Soybean in Pakistan
A. BEG, M. Yousaf, and A.R. Khan, NARC/PARC, Pakistan

1540 (227)
Evaluation of Soybean Varieties in Pakistan
A. Beg and M. YOUSAF, NARC/PARC, Pakistan

1550 (228)
Performance of Exotic Soybean Cultivars in Bangladesh
M.A. KHALEQUE and F. Mia, BARI, Bangladesh

1600 (229)
Evaluation of Soybean Varieties in Southern Bangladesh
P.M. SHIRES, G.L. Brockmueller, and H.J. Harder, MCC, USA

1610 (230)
Soybean Extension Work in Thailand
C. Chainuvati, Department of Agricultural Extension Bangkhen, Thailand

1620 (231)
Malaysian Experience in Soybean Production
C. Mak, University of Malaya, Malaysia

1630 (232)
Agronomic Practices for Soybean Production after Lowland Rice in Indonesia
T. Adisarwanto, MARIF, Indonesia

1640 (233)
Improvement of Soybeans in the Cerrados of Central Brazil
C.R. SPEHAR, P.I.M. Souza, and G. Urben F., EMBRAPA/CPAC, Brazil

1650 (234)
New Cultural Practices and Technology for Producing and Making Use of Soybean at Domestic Level in Mexico
N.M.S. Banafunzi, CSAEG, Mexico; S.R. MARQUEZ-BERBER, UACH, Mexico; G. Perez A., DIF, Mexico; A. Alvarez, CSAEG, Mexico

1700 (235)
Soybean Development for the Irrigated Canadian Prairies
H.H. MUENDEL, R.J. Rennie, and E.H. Hobbs, Agriculture Canada, Canada

1710 (236)
Soybeans in India
R.N. Trikha, G.B Pant University, India

1720 (237)
Soybeans in Chile
P.C. PARODI and I.M. Nebreda, Catholic University of Chile, Chile

Poster (238)
A Comparative Study on Some Early Maturing Soybean Cultivars Grown under Egyptian Conditions
N.I. ASHOUR, A.O. Saad, and A.M. Abd El-Latif, National Research Centre, Egypt

Poster (239)
Production of Soybean in Egypt
M.A. Shaker, Ministry of Supply, Egypt

Poster (240)
Physiological Aspects of Soybean versus Maize in North Italy
T. Toniolo, G. MOSCA, and M. Sattin, University of Padova, Italy

Tuesday Evening
14 August

Social Hour **1830-1930**
Conference Banquet
Hilton Coliseum

Wednesday Morning
15 August

Session 39 **0830-0920**
Plenary Session IV

C.Y. Stephens Auditorium
Presiding: R.G. Palmer, USDA/ARS, and Iowa State University, USA

0840 (241)
Partitioning of Carbon and Nitrogen Within N_2-Fixing Grain Legumes
J.S. Pate, University of Western Australia, Australia

Session 40 **0920-1000**
Plenary Session V

C.Y. Stephens Auditorium
Presiding: R.G. Palmer, USDA/ARS, and Iowa State University, USA

0920 (242)
Expanding Opportunities for Utilization of Soybean Oil and Protein
A.R. BALDWIN and R W. Fulmer, Cargill Inc., USA

Break **1000-1020**

Session 41 **1020-1135**
Invited
Breeding for Nematode and Insect Resistance

Benton Auditorium, Scheman
Presiding: G. Shannon, Asgrow Seed Co., USA

1020 (243)
Breeding for Resistance to Root-Knot Nematodes
K. Hinson, USDA/ARS, and University of Florida, USA

1045 (244)
Breeding Productive Soybean Varieties with Resistance to the Soybean Cyst Nematode
E.E. Hartwig, USDA/ARS, USA

1110 (245)
Resistance to Insect Defoliators
M.J. Sullivan, Clemson University, USA

Session 42 **1020-1200**
Invited
Physiology—Carbon Assimilation

230-240 Scheman
Presiding K.R. Schubert, Monsanto Co., USA

1020 (247)
Physiological Activity of RUBP Carboxylase from Field-Grown Soybean (cv Williams 79)
D.K. McDERMITT and C.A. Zeiher, Monsanto Co., USA

1045 (248)
Potential for Controlling Photorespiration in Soybeans
W.L. Ogren, USDA/ARS, and University of Illinois, USA

1110 (249)
Factors Influencing Canopy Assimilation of Soybean
K.J. BOOTE, J.W. Jones, and J.M Bennett, University of Florida, USA

1135 (250)
Physiology of Genotypic Differences
J.D. HESKETH, J.T Woolley, and D B. Peters, USDA/ARS, and University of Illinois, USA

Session 43 **1020-1200**
Invited
Economics—Emerging Issues in Soybean Processing, Marketing, and Distribution

204-208 Scheman
Presiding K. Smith, American Soybean Association, USA

1020 (251)
Technological Issues in the Processing Industry
J.E. Heilman, Continental Grain Co , USA

1045 (252)
Importer and Exporter Processing and the Bean-Product Trade Mix
G W. Williams, Iowa State University, USA

1110 (253)
The Impact of Transportation Rates on World Soybean Trade Competition
C.P. BAUMEL and T. Lee, Iowa State University, USA

1135 (254)
Foreign Demand for U.S and Brazilian Soybeans and Soybean Meal
K.D Sisson, CMP/FAS/USDA, USA

Session 44 **1020-1200**
Invited
Soils—Tillage and Soil Management

250-252 Scheman
Presiding E. Alberts, Water Research Unit-Missouri, USA

1020 (255)
Optimizing Seed Placement to Maximize Germination and Early Growth
C.J. BAKER, New Zealand, and P.J. Desborough, N S.W Department of Agriculture, Australia

1045 (256)
Irrigation Management for Soybean Yield Enhancement
L.G. Heatherly, USDA/ARS, USA

1110 (257)
The Impact of Soybeans on Soil Physical Properties and Soil Erodibility
J.M. LAFLEN, USDA/ARS, and Iowa State University, W.C. Moldenhauer, and D.V. McCracken, USDA/ARS, and Purdue University, USA

1135 (258)
Residual Effects of Corn and Soybeans on the Subsequent Corn Crop
R.M. Cruse and I.C. ANDERSON, Iowa State University, USA

Session 45 **1020-1200**
Invited
Soybean Oil Utilization

260-262 Scheman
Presiding J Love, Iowa State University, USA

1020 (259)
New Nonfood Uses of Soybean Oil
L. BEAUREGARD and D. Erickson, American Soybean Association, USA

1045 (260)
Soya Oil Uses in Foods
S. Patel, Central Soya, USA

1110 (261)
Nutritional Considerations in Soybean Oil Usage
E.A. Emken, USDA/ARS/NRRC, USA

1135 (262)
Oxidative Flavor Deterioration in Soybean Oil
E G. Hammond, Iowa State University, USA

Break **1200-1330**

Wednesday Afternoon
15 August

Session 46 **1330-1510**
Invited
Breeding for Disease Resistance

Benton Auditorium, Scheman
Presiding B. Lawrence, Funk Seeds Intl , USA

1330 (263)
Breeding for Management of Soybean Seed Diseases
E.A. Kueneman, IITA, Nigeria

1355 (264)
Breeding for the Management of Soybean Root and Stem Diseases
A.K. Walker, Asgrow Seed Co , USA

1420 (265)
Breeding for Resistance to Leaf Diseases
R.L. Bernard, USDA/ARS, and University of Illinois, USA

1445 (266)
Breeding for Resistance to Viruses in Soybeans
G.R. BUSS and C.W. Roane, VPI and Virginia State University, USA

Session 47 **1330-1510**
Invited
Physiology—Nitrogen Metabolism

230-240 Scheman
Presiding: D. McDermitt, Monsanto Co , USA

1330 (267)
Oxygen Limitation to Nitrogen Fixation in Soybean Nodules
T.R SINCLAIR, P.R. Weisz, and D.F. Denison, USDA/ARS, and University of Florida, USA

1355 (268)
Nonphotosynthetic Carbon Dioxide Fixation in Soybean Roots and Nodules
K.R. Schubert, Monsanto Co., USA

1420 (269)
Role of Carbon and Nitrogen during Podfilling
D.R. Nelson, Monsanto Co , USA

1445 (270)
The Interaction of Oxygen with Nitrogen Fixation in Soybean Root Nodules
J.B. Peterson, Iowa State University, USA

Session 48 **1330-1510**
Invited
Economics—Microeconomics of Soybean Production and Marketing

204-208 Scheman
Presiding. L.D. Hill, University of Illinois, USA

1330 (271)
Soybeans and Cropping Patterns in China
P.H. CALKINS and J.C. Ma, Iowa State University, USA

1355 (272)
Distributive Implications of the Growth in Soybean Production in Brazil
F. Homem de Melo, IPE/USP, Brazil

1420 (273)
Risk Management in U S. Soybean Production and Marketing in the Midwest
R. WISNER and R. Jolly, Iowa State University, USA

1445 (274)
Risk Management in U.S Soybean Production
T.E. Nichols, Jr., North Carolina State University, USA

Session 49 **1330-1510**
Invited
Entomology—Sampling, Ecology, and Population Dynamics of Soybean Insects

250-252 Scheman
Presiding C.G. Helm, Illinois Natural History Survey, USA

1330 (275)
Advances in Sampling Insects in Soybeans
D.C. Herzog, University of Florida, USA

1355 (276)
Influence of Tillage Practices on Soil-Insect Population Dynamics in Soybeans
R.B. HAMMOND, OSU/OARDC, and J.E. Funderburk, IFAS-AREC, USA

1420 (277)
Ecological Effects of Double Cropping on Soybean Insect Populations
H.N. Pitre, Mississippi State University, USA

1445 (278)
Dynamics of Phytophagous Pentatomids Associated with Soybean in Brazil
A.R. Panizzi, EMBRAPA/CNPSoja, Brazil

Session 50 **1330-1510**
Invited
Utilization of Soy and Animal Feeds

260-262 Scheman
Presiding. V. Speer, Iowa State University, USA

1330 (279)
Improving Soybean Protein Utilization by Ruminants
T. Klopfenstein, University of Nebraska, USA

1355 (280)
Digestibility of Carbohydrate Fraction of Soybean Meal For Poultry
L M. Potter and M. POTCHANAKORN, Virginia Polytechnic Institute and State University, USA

1420 (281)
Effect of Processing on Utilization of Soybean Protein by the Young Pig,
T.D. TANKSLEY, Jr and D.A. Knabe, Texas A&M University, USA

1445 (282)
Utilization of Energy from Soybean Products by Young Pigs
R.C. Ewan, Iowa State University, USA

Break **1510-1530**

Session 51 **1530-1700**
Contributed: Oral
Breeding—Physiology and Management Aspects

260-262 Scheman
Presiding. W. Ellingson, North American Plant Breeders, USA

1530 (284)
Semidwarf Soybean Cultivars for High Yield Environments
R.L. Cooper, USDA/ARS and OARDC, USA

1540 (285)
Selecting for Narrow Row Performance in Wide Row Soybean Nurseries
G.B. SALEH and E.T. Gritton, University of Wisconsin, USA

1550 (286)
Breeding Soybeans for Adaptation to Double Cropping
G.R. BUSS and H.M. Camper, Jr., Virginia Polytechnic Institute and State University, USA

1600 (287)
Plant Ideotype for Stable Yield in Soybean
I.K. GARG and V.P. Gupta, Himachal Pradesh Agricultural University, India

1610 (288)
Associations between Physiological Traits and Yield of Random Soybean Genotypes
L.R. SALADO NAVARRO, T.R. Sinclair, and K. Hinson, University of Florida, and USDA/ARS, USA

1620 (289)
Physiological Basis for Grain Yield Differences in Soybean Cultivars
B.B. SINGH, L. Chand, and M.K Shrivastava, J N Agricultural University, India

1630 (290)
Photosynthetic Evaluation of Selected Soybean Genotypes and Their Parents
A.S Bhagsari, Fort Valley State College, USA

1640 (291)
Field Screening of Soybeans for Metribuzin Tolerance
P.M. HANSON and C.D. Nickell, University of Illinois, USA

1650 (292)
A Rapid Method for Screening Soybeans for Al Tolerance in Nutrient Solution
H.A.A. MASCARENHAS, C.E.O. de Camargo, and S.M.P. Falivene, Instituto Agronomico, Brazil

Session 52 **1530-1720**
Contributed: Oral
Breeding and Genetics—Isoenzymes and Induced Variability

Benton Auditorium, Scheman
Presiding· J.H. Orf, University of Minnesota, USA

1530 (293)
Observations on the Reproductive Biology of a Male-Sterile (ms_4) Mutant of Soybean
R. GRAYBOSCH and R G. Palmer, USDA/ARS, and Iowa State University, USA

1540 (294)
Chloroplast DNA Variation within the Genus *Glycine*
R.C. SHOEMAKER, R.G. Palmer, and A.G. Atherly, USDA/ARS, and Iowa State University, USA

1550 (295)
Cytological Studies of Triploids and Their Progeny from Male-Sterile (ms_1) Soybean
L.F. CHEN and R.G. Palmer, USDA/ARS, and Iowa State University, USA

1600 (296)
Genetics and Cytological Studies of Chromosome Interchanges in Soybean (*Glycine max* [L.] Merr.) and Related Species
L.G. Forrai and R.G. PALMER, USDA/ARS, and Iowa State University, USA

1610 (297)
Isozymic Variability in Soybeans. I. Commercial Varieties and Historically Important Lines
B.J. CARDY, B.R. Hedges, and W.D. Beversdorf, University of Guelph, Canada

1620 (298)
Isozymic Variability in Soybeans. II. Germplasm Resources versus Utilization
B.R. HEDGES, B.J. Cardy, and W.D. Beversdorf, University of Guelph, Canada

1630 (299)
Use of Isoenzymes as Markers in Qualitative Genetic Studies
J.D. GRIFFIN and R.G. Palmer, USDA/ARS, and Iowa State University, USA

1640 (300)
The Use of Experimental Mutations in Soybean Breeding
V.I. Sichkar, All-Union Institute of Plant Breeding and Genetics, USSR

1650 (301)
Induced Variations in Soybean Variety Kalitur
V.P. PATIL, V.M. Raut, and G.B. Halwankar, MACS Research Institute, India

1700 (302)
Establishment of T-DNA Cell Lines of Soybean
Shao Qiquan, JIANG XINGCUN, Yin Guangchu, and Wang Lianzheng, Academia Sinica and HAAS, People's Republic of China

1710 (303)
Seed Protein Electrophoresis Profiles of Wild Soybean (*G. soja*) in China
XU B., Zhao S.W., Zou S.H., and Zheng H.Y., Soybean Institute and Institute of Botany, People's Republic of China

Poster (89)
Influence of Male-Sterile Soybean Gene (ms_1) on Female Gametophyte. Microscopy
J.C. KENNELL and H.T. Horner, Iowa State University, USA

Poster (90)
Gynoecial Development and the ms_1 Male-Sterile Gene in Soybean, *Glycine max* (L.) Merr.
V.R. Tilton, Agrigenetics Advanced Research, and R.G. PALMER, USDA/ARS, and Iowa State University, USA

Poster (91)
Frequency of Polyembryonic Seedlings and Polyploids from Male-Sterile (ms_1) Soybean. Cytology
L.F. CHEN and R.G. Palmer, USDA/ARS, and Iowa State University, USA

Poster (433)
Structure of the TGM1 Soybean Insertion Element
P.R. RHODES and L.O. Vodkin, USDA/ARS, USA

Poster (436)
Studies on Spermatogenesis and Fertilization of *Glycine max* L.
Luo Ximing, He Mengyuan, and Hao Shui, Northeastern Normal University, People's Republic of China. Presented by SUN HUAN, Soybean Institute, People's Republic of China

Session 53 — 1530-1720
Contributed: Oral
Carbon Assimilation and Nitrogen Metabolism

230-240 Scheman
Presiding: J. Secor, Dow Chemical, USA

1530 (304)
Influence of Root Distribution upon Diurnal Carbon Fixation
M.G. HUCK, C.M. Peterson, G. Hoogenboom, USDA/ARS, and Auburn University, USA, and K. Ishihara, Tokyo Noko University, Japan

1540 (305)
Respiratory Carbon Losses in Soybean Cultivars
S. KISHITANI and R. Shibles, Iowa State University, USA

1550 (306)
Responses to Population Variation in Soybeans
A.S. CHANDEL, A.K. Bishnoi, and S.C. Saxena, G.B. Pant University, India

1600 (307)
Leghemoglobins from *Glycine max* and *Glycine soja*
W.H. FUCHSMAN, Oberlin College, and R.G. Palmer, USDA/ARS, and Iowa State University, USA

1610 (308)
Metabolic Cost of Nitrogen Fixation by Calorimetry on Detached Nodules
P.G. HEYTLER and R.W.F. Hardy, E.I. du Pont de Nemours & Co., USA

1620 (309)
Partitioning of Nitrogen in Soybeans as Affected by Strain of Rhizobia
R.W. WEAVER and D.R. Morris, Texas A&M University, USA

1630 (310)
Nitrogen Nutrition in Soybean: Effects of Water-Stress, N-Fertilization and N-Soil Residues
A. BOUNIOLS, J. Puech, and J-R. Marty, INRA, France

1640 (311)
Soybeans in Saturated Soil—A New Way to Higher Yields
R.J. LAWN, R.J. Troedson, A.L. Garside, and D.E. Byth, CSIRO, Australia

1650 (312)
Increase of Symbiotic Nitrogen Fixation Potential in Soybeans
A.P. RUSCHEL and J.R. Freitas, CENA/USP, Brazil

1700 (313)
The Interaction between Soil N Availability, Rhizobial Strain Effectiveness and Nitrogen Fixation by Soybean
P.W. SINGLETON, H M. Abdelmagid, and J.W Tavares, NifTal Project, USA

1710 (444)
Photosynthesis in Relation to Chloroplast Number and Quality
D.M. FORD and R.M. Shibles, Iowa State University, USA

Poster (314)
Study on the Photosynthetic Characters of the High Photosynthetic Efficiency Soybean Strain "HA 79-9440"
Hao Naibin, Tan Kehui, Zhang Yuzho, Academia Sinica; DU WEIGUANG, and Wang Yumin, Agricultural Academy of Heilonjiang Province, People's Republic of China

Poster (315)
Photosynthetic Carbon Metabolism during Ontogenesis of Soybean Leaves and Pods
J.C. Latche, G. Bailly-Fenech, J. Pettenati-Grima, A. BOUNIOLS, and G. Cavalie, Universite Paul Sabatier, France

Poster
Nitrate-Tolerant Soybean Produced by Induced Vitrogenesis
P. Gresshoff, Australian National University, Australia

Session 54 **1530-1550**
Contributed: Oral
Microeconomics of Soybean Production and Marketing

254 Scheman
Presiding S.V. Langley, NED/ERS/USDA, USA

1530 (316)
Soybean/Rice Cropping Strategies in Upper Gulf Coast of Texas
G. PERRY, E. Rister, J. Richardson, and J Sij, Texas Agricultural Experiment Station, USA

1540 (317)
The Present State of Oilseed's Production in Mexico
A. Palafox de la B., Universidad Autonoma Chapingo, Mexico

Session 55 **1530-1700**
Contributed: Oral
Soil Tillage and Management

204-208 Scheman
Presiding· A.J.M. Smucker, Michigan State University, USA

1530 (318)
Effectiveness of Watering Methods on Soybean
T.T. Tuan, University of Cantho, Vietnam

1540 (319)
Soybean Root Growth under Water Stress
G. HOOGENBOOM, M.G. Huck, and C.M. Peterson, Alabama Agriculture Experiment Station, USDA/ARS, and Auburn University, USA

1550 (320)
Genotypic Responses of Soybeans to Population Densities and Furrowing
M.M. ELSAHOOKIE and N O. Sarkies, College of Agriculture, Abu-Ghraib, Iraq

1600 (321)
Management of No-Tillage Soybean Production in Virginia
E.S. SMITH, G.H. Hetzel, and P.H. Reid, Virginia Tech, USA

1610 (322)
Available Water and Place of Soybean in Cropping Systems
J-R. Marty, J. Puech, J-M Boussard, R. BLANCHET, INRA, France

1620 (323)
Growth and Yield of Soybean under Water Stress
A. SAJJAPONGSE and M.H Wu, AVRDC, Taiwan

1630 (324)
Soil Erosion in Relation to Soybean Production
E.C. DICKEY, D.P. Shelton, P.J. Jasa, and T.R. Peterson, University of Nebraska, USA

1640 (325)
Effect of Minimum Tillage and Crop Rotation on Soybean Production in the Southeastern Coastal Plain
J.H. PALMER, H.L. Musen, and V.L Quisenberry, Clemson University, USA

1650
Tillage Systems for Soil Conservation in Argentina
A. Lattanzi, INTA, Argentina

Session 56 **1530-1550**
Contributed: Oral
Soybean Oil Utilization

150-154 Scheman
Presiding J. Love, Iowa State University, USA

1530 (326)
End Uses of U.S Soybean Oil
D. Hacklander, USDA/ERS/NED, USA

1540 (327)
Hexane-Ethanol Mixed Solvent Extracting Soybean Oil and Removing Flavors
FU-KUANG LIU, and Jing-Feng Yao, Wuxi Light Industry Institute, People's Republic of China

Session 57 **1550-1600**
Contributed: Oral
Utilization of Soy and Animal Feeds

150-154 Scheman
Presiding V. Speer, Iowa State University, USA

1550 (328)
A Comparison of Feeding Value of Local Oil Meals for Milking Cows
IN K. HAN and H.S. Park, Seoul National University, Korea

Poster (329)
Effect of Level of Soybean Oil Meal on the Ration Digestibility, Milk Production, and Milk Composition
IN K HAN and H S. Park, Seoul National University, Korea

Session 58 **1530-1620**
Contributed: Oral
Sampling, Ecology, and Population Dynamics of Soybean Insects

250-252 Scheman
Presiding. K.R. Ostlie, University of Minnesota, USA

1530 (330)
Arthropod Fauna and the Population of *Spilarctia casignata* in Soybeans
M.K. Giri, Tribhuvan University, Nepal

1540 (331)
Effect of Wild Parsnip on Soybean Pest Parasitism in Iowa
L.A Buntin, Iowa State University, USA

1550 (332)
Adaptations of Agromyzid Stem Miners to Soybeans Involve Resource Partitioning
H.S. CHIANG and D.M. Norris, University of Wisconsin, USA; and N.S. Talekar, AVRDC, Taiwan

1600 (333)
Population Dynamics Model for the Bean Leaf Beetle on Soybeans
L. Zavaleta, M. KOGAN and E. Brewer, University of Illinois, USA

1610 (334)
A Bibliographic Analysis of the World Literature of Soybean Entomology
J. KOGAN, M. Kogan, and E. Brewer, University of Illinois, USA

Poster (335)
Computerization of the World Literature of Soybean Entomology
E. BREWER, J. Kogan, and M. Kogan, University of Illinois, USA

Wednesday Evening
15 August

Tour of ALMACO at Nevada, Iowa **1730-2130**

Open House to visit Soybean Research Facilities at Iowa State University **1830-2130**

Thursday Morning
16 August

Session 59 **0830-0920**
Plenary Session VI

C.Y. Stephens Auditorium
Presiding: R.G. Palmer, USDA/ARS, and Iowa State University, USA

0840 (336)
Soybean Germplasm Preservation
Q. Jones, USDA/ARS, USA

Session 60 **0920-1000**
Plenary Session VII

C.Y. Stephens Auditorium
Presiding. R.G. Palmer, USDA/ARS, and Iowa State University, USA

0920 (337)
Towards an Appreciation of Biotechnology and Its Impact on Future Developments in Soybean Production and Uses
R.M. GOODMAN and J. Kiser, Calgene Inc , USA

Break **1000-1020**

Session 61 **1020-1200**
Invited
Physiology, Breeding, and Genetics

Benton Auditorium, Scheman
Presiding R.C. Leffel, USDA/ARS, USA

1020 (338)
Use of Morphological and Physiological Traits in Breeding
JINLING WANG, North East Agricultural College, People's Republic of China

1045 (339)
Breeding for Improved Photosynthetic Capacity
R.I. BUZZELL and B.R. Buttery, Agriculture Canada, Canada

1110 (340)
Breeding. Mineral Deficiencies and Toxicities
R Chaney, AEQI, USA

1135 (341)
Soybeans Adapted to Cooler Regions?
A. SOLDATI and E.R. Keller, Swiss Federal Institute of Technology, Switzerland

Session 62 **1020-1200**
Invited
Production—Cropping Systems and Management

230-240 Scheman
Presiding: E.D. Nafziger, University of Illinois, USA

1020 (342)
Intercropping Competition and Yield Advantages
C.A Francis, University of Nebraska, USA

1045 (343)
Strip and Relay Intercropping of Soybeans
D K. Whigham, Iowa State University, USA

1110 (344)
Double Cropping
C E. CAVINESS and F.C. Collins, University of Arkansas, USA

Thursday Morning
16 August

1135 (345)
Economics of Intercropping
L NAVARRO, CATIE, Costa Rica; E. Price, IRRI, Philippines, and D. Kass, CATIE, Costa Rica

Session 63 **1020-1135**
Invited
Soils—Nutrient Uptake and Utilization

260-262 Scheman
Presiding· L. Heatherly, USDA/ARS, USA

1020 (346)
Soybean Root Growth in Reponse to Soil Environmental Conditions
H M. TAYLOR, Texas Tech University; and T.C. Kaspar, USDA/ARS, and Iowa State University, USA

1045 (347)
Soybean Crop Responses to Soil Environmental Stresses
A.J.M. Smucker, Michigan State University, USA

1110 (348)
Fertilizer Rate and Placement Effects on Nutrient Uptake by Soybeans
S.A. Barber, Purdue University, USA

Session 64 **1020-1200**
Invited
Soy Protein Chemistry

204-208 Scheman
Presiding E.G. Hammond, Iowa State University, USA

1020 (349)
Structural Characteristics of Soybean Glycinin and Beta-Conglycinin
P.A. Murphy, Iowa State University, USA

1045 (350)
Structure and Functional Properties of Soy Proteins
J.E. KINSELLA and B. German, Cornell University, USA

1110 (351)
Flavor-binding and the Removal of Flavors from Soy Protein
L. Wilson, Iowa State University, USA

1135 (352)
Chemical, Functional and Nutritional Properties of Phytate-Reduced Soy Proteins
C.V Morr, Clemson University, USA

Session 65 **1020-1200**
Invited
Weeds—Soybean Herbicide Technology

250 Scheman
Presiding L.M. Wax, USDA/ARS, and University of Illinois, USA

1020 (353)
Soybean Herbicide Development
D.L. Barnes, Monsanto Co , USA

1045 (354)
Herbicide-Soil Interactions
D.D. Kaufman, USDA/ARS, USA

1110 (355)
Recent Developments in Postemergence Soybean Herbicides
H vonAMSBERG, B. Menck, and W. McAvoy, BASF Wyandotte and BASF AG, West Germany and USA

1135 (356)
Low Volume Applications of Postemergence Herbicides Using Electrostatics, CDA's, and Soybean Oil
L.E. BODE and L.M. Wax, USDA/ARS, and University of Illinois, USA

Break **1200-1330**

Thursday Afternoon
16 August

Session 66 **1330-1510**
Invited
Physiology, Breeding, and Genetics

Benton Auditorium, Scheman
Presiding D. Helsel, University of Missouri, USA

1330 (357)
Breeding for Drought and Heat Resistance—Prerequisites and Examples
J.E. SPECHT and J H Williams, University of Nebraska, USA

1355 (358)
Nitrate Metabolism of Soybean—Physiology and Genetics
J.E. Harper, USDA/ARS, and University of Illinois, USA

1420 (359) Herbicide Tolerance in Soybeans
H.M. LeBaron, CIBA-GEIGY Corp , USA

1445 (360)
Phylogenetic Relationships and Host Strain Interaction in Symbiotic Nitrogen Fixation
T.E. Devine, USDA/ARS, USA

Session 67 **1330-1510**
Invited
Production—Cropping Systems and Management

234-240 Scheman
Presiding J.D. Holmes, Iowa State University, USA

1330 (361)
Machinery for Cropping Systems
R.R. Johnson, Deere & Company Tech. Center, USA

1355 (362)
Rotational Benefits to Soybeans and Following Crops
L.F. Welch, University of Illinois, USA

1420 (363)
Irrigation Water Management of Soybeans
H.D. Scott, University of Arkansas, USA

1445 (364)
Soybean Crop Modeling for Production System Analysis
J.W. JONES, K J Boote, and J.W. Mishoe, University of Florida, USA

Session 68 **1330-1510**
Invited
Entomology—Management Tactics for Soybean Insects

260-262 Scheman
Presiding. R.M. McPherson, Virginia Polytechnic Institute and State University, USA

1330 (365)
Deposition and Efficacy Characteristics of Oil Applied Pyrethroids
S.G. McDANIEL and L.D. Hatfield, FMC Corporation, USA

1355 (366)
Evaluation of Inoculative Releases of *Pediobius foveolatus* against the Mexican Bean Beetle in Midwestern Soybeans
R.V. Flanders, Purdue University, USA

1420 (367)
Pesticide Compatibility in Soybean Pest Management
K.V. Yeargan, University of Kentucky, USA

1445 (368)
Biological Control of Soybean Lepidopterous Insects in Brazil
F MOSCARDI and B.S. Correa Ferreira, EMBRAPA/CNPSoja, Brazil

Session 69 **1330-1510**
Invited
Utilization of Soy Protein

204-208 Scheman
Presiding E.G. Hammond, Iowa State University, USA

1330 (369)
Nonfood Use of Soy Protein Products
D.W. Johnson, Food Ingredients Inc , USA

1355 (370)
Soy Protein Products in Processed Meat and Dairy Foods
J. Brown, Archer-Daniels-Midland Co., USA

1420 (371)
Feasibility for a Shelf-Stable Soybean Beverage
L S WEI, G.E. Urbanski, M.P. Steinberg, and A.I. Nelson, INTSOY, University of Illinois, USA

1445 (372)
Economical Processed Blends of Soybean and Cereal as Human Foods
J.M. Harper, Colorado State University, USA

Session 70 **1330-1510**
Invited
Weeds—Weed Biology and Ecology

250-252 Scheman
Presiding R.H. Schieferstein, Shell Development Co , USA

1330 (373)
The Role of Seed Dormancy and Germination in Devising Weed Control Methods
R Taylorson, USDA/ARS, USA

1355 (374)
Tillage Effects on Annual Weed Germination
R J. Chancellor, AFRC Weed Research Organization, England

1420 (375)
Methods for Crop-Weed Competition Research
M.M. Schreiber, USDA/ARS, USA

1445 (376)
Aspects of Weed-Crop Interference Related to Weed Control Practices
L.M. WAX and E.W. Stoller, USDA/ARS, and University of Illinois, USA

Break **1510-1530**

Session 71 **1530-1710**
Contributed: Oral
Breeding for Climatic Adaptation

Benton Auditorium, Scheman
Presiding: M.L. Garland, Callahan Enterprises, USA

1530 (377)
Selection for Cold Tolerance during the Reproductive Phase
H. VOLDENG, Agriculture Canada, Canada; P. Gayraud, RAGT, France; and J. Seitzer, KWS, West Germany

1540 (378)
Selection for Low Temperature Germination in Soybeans
E.E. VEITENHEIMER, E.T. Gritton, K.J. Hillsman, C.R. Spehar, and Y Hwang, University of Wisconsin, USA

1550 (379)
Heritability of Cold Germination Response in Two Soybean Populations
D.W. Unander and J.H. ORF, University of Minnesota, USA

1600 (380)
Heritability of Cold Temperature Emergence and Its Relationship to Seed Yield in Soybeans
S A. Harrison and C.D. Nickell, University of Illinois, USA. Presented by C. MOOTS

1610 (381)
Developing Daylength-Neutral Soybeans—A Method of Obtaining Heat Tolerance
D.D. Rubis, University of Arizona, USA

1620 (382)
Soybean Genotype Selection for Dry and Wet Seasons in the Tropics
Sumarno, Institute for Food Crops, Indonesia

1630 (383)
Investigations of Breeding Criteria for Drought Tolerance in Soybeans
A. VIDAL, D. Arnaudo, J.C. Pognonec, and M. Arnoux, INRA, France

1640 (384)
Agronomic Responses of Soybean Lines to Drought Stress
K.S. McWHIRTER, D.L. Chase, and J A. Thompson, University of Sydney and ARS, Australia

1650 (385)
Heritability of Proline Accumulation in Water-Stressed Soybeans
J.M. MULILA, O. Myers, Jr., J.H. Yopp, and M.R.S. Krishnamani, Southern Illinois University, USA

1700 (386)
Screening of Soybean Genotypes for Cold-Tolerance during Flowering
J. SZYRMER and M. Janicka, Radzików, Poland

Poster (387)
Seasonal Adaptability of Soybean Strains Newly Selected at Taichung
Y.C. LU and C.N. Fan, National Chung Hsing University, Taiwan

Poster (440)
Genotypic Differences in Potassium Accumulation in Soybean (*Glycine max*) under Water Stress
B.B. SINGH and M.K. Shrivastava, J.N. Agricultural University, India

Poster (388)
Physiological Criteria for Better Climatic Adaptation in Soybeans
C. Planchon, Polytechnic University of Toulouse, France

Session 72 1530-1630
Contributed: Oral
Breeding—Utilization

250-252 Scheman
Presiding: D. Ivers, Land O'Lakes Inc , USA

1530 (389)
Study of Variance in Oil and Protein in Soybean (*Glycine max*)
E. SEVILLA, H. Azprioz, M. Espinosa, and J. Neito, INIA, Mexico

1540 (390)
Variation in Content of Sucrose, Stachyose and Raffinose in Soybean
O.D. MWANDEMELE, University of Dar es Salaam, Tanzania; and K.S. McWhirter, University of Sydney, Australia

1550 (391)
Radiation Induced Alteration in Seed Quality of Soybean (*Glycine max* [L.] Merr)
S.S. Banga and S.K. BANGA, Birsa Agricultural University, India

1600 (392)
Genetic Elimination of Soybean Lipoxygenases
K. Kitamura, Iwate University, Japan

1610 (393)
Potential for Narrow Leaves in Vegetable Soybeans
M.C.C PANIZZI and K Hinson, University of Florida and USDA/ARS, USA

1620 (394)
Studies on the Characteristics of Soybean Varieties for Cooking with Rice
HONG SUK LEE, Eui Ho Park, and Eun Hi Hong, Seoul National University, Korea

Session 73 1530-1740
Contributed: Oral
Cropping Systems and Management

230-240 Scheman
Presiding. J.P. Shroyer, Kansas State University, USA

1530 (395)
Soybean Yield Response to Reduced Inter-Row Competition
S.J. HERBERT, G.V. Litchfield, and L. Marcus-Wyner, University of Massachusetts, USA

1540 (396)
Agronomic Performance of Ultra-Short Season Soybean Cultivars in Missouri
Z R. HELSEL, H.C. Minor, and D G. Helsel, University of Missouri, USA

1550 (397)
An Evaluation of Continuous Wheat-Soybean Double Cropping Production Systems on Clay Soils
R.A. WESLEY and C.D. Elmore, USDA/ARS; and F.T. Cooke, USDA/ERS, USA

1600 (398)
Double Cropping Soybeans after Peas in Wisconsin
E.T. GRITTON, J R. Settimi, and G.C. Wegner, University of Wisconsin, USA

1610 (399)
Effect of Cultural Practices on Soybean Establishment in Rice-Soybean Cropping System
A. Pookpakdi, Kasetsart University, Thailand

1620 (400)
Autumn Planting Soybean in Multiple Cropping Systems
Ling Yi-Lu, Jiangsu Academy of Agricultural Sciences; GAI JUN-YI, Nanjing Agricultural College, People's Republic of China

1630 (401)
A Step Forward in Identifying Other Soybean Cultivars Suitable for Intercropping with Corn
S. GALAL, JR., M.M.F. Abdalla, and A.A. Metwally, University of Cairo, Egypt

1640 (402)
Effect of Maize Intercropping on Soybean
S.C. SAXENA and A.S. Chandel, G.B. Pant University, India

1650 (434)
Response of Maize and Soybeans Grown in Monoculture and in Association
O.T. Edje, Bunda College of Agriculture, Malawi

1700 (403)
Soybean· An Intercrop in Rubber and Oil Palm Plantations
T.C Yap, University of Agriculture, Malaysia

1710 (404)
Soybeans as Green Manure in a Corn Intercropping System
R.K. Pandey and J W. PENDLETON, IRRI, Philippines

1720 (405)
Effect of Planting Date, Density, and Distribution Pattern on Soybean Yield in Subtropical Regions of Mexico
N.M.S. BANAFUNZI, CSAEG, S.R. Marquez-Berber, UACH, M. Giles, A.A Mastache, M. Molina M., V.M. Olalde, E. Carreno, and M.A. Otero, CSAEG, Mexico

1730 (406)
Interaction of Determinate Varieties with Row Width Response
E J. Dunphy, North Carolina State University, USA

Poster (407)
Soybean Cultivar Response to Irrigation Timing
J E. SPECHT, J.H. Williams, C.J. Weidenbenner, and R.L. Hummel, University of Nebraska, USA

Poster (408)
Soybean in Cropping Systems in India
R N. Trikha, G B Pant University, India

Poster (409)
Cultivar X Tillage Responses in Soybeans in Eastern Australia
P.J Desborough, N.S W Department of Agriculture, Australia

Session 74 1530-1620
Contributed: Oral
Nutrient Uptake and Utilization

220 Scheman
Presiding: S A. Barber, Purdue University, USA

1530 (418)
Factors Responsible for Variable Growth of Soybeans in the Nigerian Guinea Savanna
D.A. SHANNON, E.A Kueneman, and M.J. Wright, IITA, Nigeria

1540 (411)
Soil Acidity, N, P, and K Effect on Soybean Cyst Nematode Population, Soybean Yield, and Nutrient Composition
R.G. HANSON, J.H Muir, P.M. Sims, J.K. Smith, and M.J. Barton, University of Missouri, USA

1550 (412)
Soybean Response to Nutrient Stress
Soetarso, Gadjah Mada University, Indonesia

1600 (413)
Chlorine in KCl Fertilizer Causes Phytotoxicity in Soybean
M.B. PARKER, T.P. Gaines, and G J. Gascho, University of Georgia, USA

1610 (414)
Effect of Microelement Fertilizers on Three Soybean Cultivars in Egypt
S.A. KHADRAH and M. Zahran, Tanta University, Egypt

Poster (415)
Response of Soybeans to Combined Foliar and Soil Fertilization
G.M. Yakout, A.M. Saad, N.I. ASHOUR, and A T. Thalooth, National Research Centre, Egypt

Poster (416)
Nutrient Uptake by Soybean under Relay Cropping System
K.N. Bansal and J.N. DUBE, J N Agricultural University, India

Poster (439)
Population Densities and Fertilization in Maize-Soybean Mixed-Cropping Systems
P. Salez, IRAT/IRA, Cameroon

Session 75 1530-1650
Contributed: Oral
Utilization of Soy Protein

150-154 Scheman
Presiding E G. Hammond, Iowa State University, USA

1530 (417)
Acceptability of Soy-Fortified Pozol
P. Artiga Soto, H. Avila Garcia, C. Lopez Garcia, G. Perez Garcia, Ma A. Cadena, and J. TELFORD, UNACH, Mexico

1540 (418)
Effects of Proteolysis on Functionalities of Soy Proteins
K C. RHEE, Y.R. Choi, and E.W. Lusas, Texas A&M University, USA

1550 (419)
Kalibur (Black Soybean) Protein and Prospects of Utilization Technology in India
Y.K. SHARMA and N. Subramanayan, J N Agricultural University and CFTRI, India

1600 (420)
The Use of Soya Beans in Weaning Diets in Nigeria
S.L. Mohammed, A B U , Nigeria

1610 (437)
Soybean Meal Tempeh
E. NAHAS and R. de Camargo, Agrarias e Veterinarias de Jaboticabal, Brazil

1620 (441)
Use of Soy Protein in Staple Foods
C.C. Tsen, Kansas State University, USA

1630 (443)
Effect of Autoclaving on the Nutritive Value of Soybean Seed and Meal
M.M. Mostafa, Agricultural Menoufeia University, Egypt

1640 (446)
Utilization of Various Soybean Products in Fortifying Egyptian Balady Bread
A.A. El-Farra, A.M. Khorshid, A.N. Elias, M.S. GALAL, and S.M. Mansour, Cairo University, Egypt

Poster (421)
A Direct Use of Soybean in Enriching the Egyptian Corn Bread
S. GALAL, JR., M.M.F. Abdalla, A A. Metwally, and S A. Zaki, University of Cairo, Egypt

Session 76 **1530-1620**
Contributed: Oral
Herbicide Technology

204-208 Scheman
Presiding: C.L. Kern, CIBA GEIGY, USA

1530 (422)
Fluazifop-Butyl and Fomesafen for Selective Postemergence Weed Control in Soybeans
C.H. DOTY, R.P. Rose, and J.W. Barnes III, ICI Americas, Inc , USA

1540 (423)
SCEPTER® Herbicide. A New Broad-Spectrum Compound for Soybeans
R.R FINE, and P.K. Martin, American Cyanamid Company, USA; R.G Rowcotsky, Cyanamid Quimica do Brasil Ltda., Brazil

1550 (424)
Physiological Basis for Herbicidal Activity and Selectivity of SCEPTER®
D.L. SHANER, P A. Robson, M.A. Stidham, and M.L. Reider, American Cyanamid Company, USA

1600 (425)
SD95481—A New Preemergence Herbicide for Use in Soybeans—Performance in Brazilian Field Trials
J.R. GOSS, J.W. May, and W.W. John, Shell Development Company, USA

1610 (426)
Soil Organic Matter Sensing for Herbicide Rate Control
J.W. HUMMEL, USDA/ARS, and University of Illinois, E.J. Matthews, University of Arkansas, L.E. Bode, University of Illinois, and C.L. Griffis, University of Arkansas, USA

Session 77 **1530-1620**
Contributed: Oral
Entomology—Management Tactics for Soybean Insects

260-262 Scheman
Presiding: M. Kogan, Illinois Natural History Survey, USA

1530 (435)
Insect Pests Constraint for Indonesian Soybean Production and Management
D. Soekarna, Bogor Research Institute Food Crops, Indonesia

1540 (427)
Effects of Temperature and Humidity on Development and Emergence of *Telenomus chloropus*
D.B ORR and D.J Boethel, Louisiana State University, and W.A. Jones, USDA/ARS, USA

1550 (428)
Larvin® Thiodicarb Insecticide Performance on Soybean
J L. ALLEN and J D. Palmer, Union Carbide Agricultural Products Company, USA

1600 (429)
AMBUSH® Insecticide as a Soybean Insect Management Tool
T.L. Steepy, R.J. GOUGER, and T S. Gallo, ICI Americas Inc , USA

1610 (430)
A Guide to Increase Soybean Yield through Pest Management
P. SEPSWASDI and V. Thanomthin, Department of Agriculture, Thailand

Session 78
Contributed
Soy Protein Chemistry

Poster (431)
Effect of Ionic Strength on Thermal Denaturation of Glycinin and Beta-Conglycinin
G. Guzman, Iowa State University, USA

Poster (432)
Tofu Flavor Differences Due to Soybean Variety and Processing Method
L. WILSON, J. Love, and L Johnson, Iowa State University, USA

Thursday Evening
16 August

Conference Barbecue **1830-**

Friday Morning
17 August

Tours of Field Research at Iowa State University **0800-1130**

World Soybean Research Conference—III Abstracts

Edited by
Richard Shibles

Preface

On the following pages are printed the camera-ready abstracts prepared by the authors for almost all of the nearly 450 papers presented at World Soybean Research Conference III. About 160 of these are for invited papers The organizers, not to mention the editor, were overwhelmed by the submission of nearly 300 volunteer papers and posters Clearly, the soybean is the object of intense interest and investigation.

Missing abstracts for invited papers include those of speakers recruited late to fill a vacancy resulting from a withdrawal, and those of persons who, for reasons known only to themselves, declined to file an abstract despite repeated pleas and extensions of the publishing deadlines We thank the former for stepping into harness on very short notice

An enterprise such as this does not prosper without the concern and energy of able people. Susan Yost worked diligently and tirelessly, sometimes on nights and weekends in the final phase of program preparation Without her dedicated effort this booklet could not have been produced Karen Osborn retyped many abstracts, some of which showed signs of having been chewed upon by hungry letter-sorting robots Others had been badly scrunched in transit and refused to lie flat. A third category included those not typed on the camera-ready form, probably because the authors believed they didn't have time to request one. Their fears seem justified Envelopes of several abstracts betrayed the fact they had been circulated around the world for up to three months before reaching their intended destination! Thanks are extended to those authors who put forth the effort to provide us good copy. Others will note that, as promised, the camera faithfully reproduced all mistakes. Thanks to Stephen Asiama-Kisiedu for his diligent efforts in page composition, and for preparation of the Author Index

19 June 1984
Ames, Iowa

Richard Shibles, Editor

001

WORLD SUPPLY, DEMAND AND COMPETITION FOR SOYBEANS AND PRODUCTS

S. Mielke, OIL WORLD, Hamburg, West Germany

In the eighties and nineties the world soya economy will continue to be dependent on the political, economical and technological conditions in general and the markets of the competing oilseeds, oils, fats and meals in particular, in which soybeans and products are "residual suppliers". With GNP growth slowing and food oils and fats usage in the developed countries already near the saturation point, the increase in world per caput disappearance of oils and fats is expected to slow compared with the past two decades. Slower population growth is likely to further reduce the growth rates of total disappearance of oils and fats. Also world demand for livestock products and thus for meals is expected to slow appreciably as the prices for meals are likely to be relatively stronger than for oils, thus raising the costs and prices for livestock products. In addition the supplies of oil palm products and rapeseed will probably grow more rapidly than the total demand for oils/fats and meals. As a result the increase rates in world production and usage of soybeans and products are expected to slow materially compared with the past two decades. The expansion of soybean crushing capacities will probably slow more than the crushings, considering the present excess capacities.

002

FOOD AND AGRICULTURE ORGANIZATION'S SOYBEAN PROGRAM

H. A. Al-Jibouri, FAO of the U.N., Rome, Italy

Because of its social, economic and agriculture significance as a source of food, vegetable protein, oil, calories and industrial uses FAO is giving great emphasis to the improvement and production of soybean. Support to national, regional and international programs is being extended. FAO's global program to improve soybean falls into three major categories; the first relates to general agronomy which implies variety testing, crop management, cropping systems and seed production; the second concerns research and training; while the third deals with liaison and supply of technical information. Several FAO operated field projects deal mainly with soybean while many others include this crop as a component. FAO's assistance is available to assist governments to implement their soybean programs.

003

INTSOY - Participant in an International Soybean Research Network, - H.E. Kauffman, Dir., INTSOY, UIUC.

Although there is no disagreement about the need to utilize soy products to meet chronic protein and edible oil deficits in the tropics and subtropics, some have thought that soybeans cannot or should not be grown in the tropics. They raise questions about low yield potential, pest problems, production practices on small unmechanized farms, the displacement of food crops by soybeans for export and complex processing needs. Production and utilization programs established during the past decade in countries as disparate as Brazil, India, Sri Lanka, and Zimbabwe clearly demonstrate that soybean industries can be successful in the tropics and subtropics of Latin America, Asia, and Africa. The International Soybean Program (INTSOY) of the University of Illinois has played a role in soybean research and development in a number of countries. The INTSOY variety trials have been conducted in 118 countries with more than 20 countries releasing test varieties to be grown commercially. Other INTSOY research and information dissemination have provided some appropriate production, marketing and utilization techniques to interested countries. INTSOY is now working with other international organizations and countries like Brazil, China, India, and the U.S. to strengthen an international soybean research network which can help developing countries meet their rapidly increasing needs for edible oil and protein from soybeans. An International Soybean Research Network can be the catalyst for a "green revolution" in soybeans for the tropics which will improve nutrition and economic conditions for millions of people.

004

THE ASIAN VEGETABLE RESEARCH AND DEVELOPMENT CENTER'S SOYBEAN PROGRAM

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The goal of the Asian Vegetable Research and Development Center's (AVRDC) soybean program is to develop widely adapted, stable, higher yielding, disease and pest resistant soybean lines with good seed quality and associated economical management technology for the tropics and subtropics. Resistance or tolerance to soybean rust, beanflies, soybean mosaic virus, downy mildew and bacterial pustule, as well as insensitivity to photoperiod and temperature have been identified from AVRDC's 10,500 accession germplasm collection. AVRDC *Glycine* selections have yield potentials of more than 4,000 kg/ha and can be grown in 100 days. Management inputs is a major production constraint in the tropics. Therefore, suitable location- and season-specific management techniques are needed to obtain maximum economic yield. Since maturity duration is usually shorter in the tropics, higher plant population densities and appropriate planting patterns need to be designed to obtain optimum yield. The popularity of vegetable-type soybeans is increasing. AVRDC cooperates with national programs and international agencies in organizing networks for varietal trials and disease and insect resistance nurseries. The Center has also organized symposia and workshops to facilitate the exchange of materials and communication. AVRDC proposes the development of an Asian Soybean Improvement Network to bring together expertise and fragmented resources, and consolidate efforts to improve soybean production in the region.

005

THE EUROPEAN COOPERATIVE RESEARCH NETWORK ON SOYBEAN

M. Arnoux, INRA, Montpellier, France

Established in 1976 on the initiative of FAO, this Network today groups 30 Institutes belonging to 20 countries. Six sub-networks and three working groups undertake joint research on the European regions suitable for soybean, on diseases and pests, on symbiotic

fixation with special emphasis on the genetic, physiological and methodological bases of varietal improvement. The creation of varieties better adapted to the different European habitats, better performing and more stable, is, indeed, one of the main factors which can promote soybean cultivation in Europe, where the problems are very different between the Northern cold regions with long days and the Southern regions which are warmer, but dryer and with irregular climates. As a result of the Network being established, the cooperating countries have at their disposal informations on the germplasm available in Europe, collaborate on enlarging the genetic variability of this germplasm, jointly compare the efficiency of different breeding methods, test the quality of new varieties and, in addition, undertake certain fundamental studies on genetics and physiology the results of which could stimulate the expansion of soybean culture, notably in the Northern and cold areas of Europe. This international cooperation also benefits from the collaboration of Institutions from North America as well of different international organizations. Finally, an information bulletin is published by the Network : EUROSOYA.

006

THE SOYBEAN IMPROVEMENT PROGRAM AT THE INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE

E.A. Kueneman, W.R. Root, K.E. Dashiell, S.R. Singh; Ibadan, Nigeria.

Scientists at the International Institute of Tropical Agriculture determined that poor seed longevity and 'non-promiscuity' (the inability of most soybeans to nodulate effectively with indigenous cowpea-type rhizobia) were two major constraints limiting expansion of soybean production into the humid tropics. Germplasm lines with good seed longevity and others that are promiscuous were identified, but these collections are agronomically unacceptable. In 1978 a program was initiated to incorporate these traits into high yielding backgrounds by crossing the exotic germplasm with varieties from the southern USA and elsewhere and procedures were developed to screen for seed longevity and promiscuity. High yielding, agronomically superior lines adapted to the lowland tropics are now available which incorporate an improved level of seed longevity and are capable of nodulating without application of inoculants.

007

SOYBEANS IN BRAZIL: PRODUCTION AND RESEARCH

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Although soybeans were introduced in Brazil a century ago, it took about 80 years to become an economically important crop. Total soybean production was around 200.000 m.t. in 1960, 1.5 million m.t. in 1970 and 15 million m.t. in 1980. From 1970 to 1977 the rate of annual increase was 32%. Soybean hectarage stabilized in Southern Brazil but new land put into soybeans in Central and Central West Brazil is continuously increasing. The vegetation in these areas is mostly the "cerrado" (savana) type and the soils are usually chemically poor but physically good. Topography is favorable, land is abundant and cheap, but transportation is the main problem, besides the general high cost of farm inputs. Research programs were started in the 60's, as soybeans became an important crop in Southern Brazil, and are now been further implemented in the Central and Northern regions. The first effort to integrate the state soybean research programs into a national program was made in 1964 with the establishment of the National Soybean Comission which evolved to the National Soybean Research Project in 1972. These events established the basis for the present National Soybean Research Program (NSRP) organized in 1976 after the criation of the National Soybean Research Center (NSRC). The NSRP involves 29 research institutions and more than 100 full-time researchers conducting over 180 soybean research projects. The NSRC is responsible for coordinating the NSRP.

009

STRATEGIES FOR CULTIVAR DEVELOPMENT IN TEMPERATE CLIMATES

J. A. Schillinger, Asgrow Seed Co., Ames, IA, USA

Requirements for acceptable cultivars of soybeans [Glycine max (L.) Merrill] are consistently changing. Pronounced shifts in yield limiting pest populations require attention in incorporating new sources of resistance or tolerance. Management practices that are enhancing higher yields require rapid emerging and lodging resistant cultivars. Modern breeding strategies designed to keep pace with the dynamic changes in production needs must be multi-objective oriented. Yield improvement is essential to maintain the soybean crop's competitive edge in world grain markets. Early generation testing for yield in F_3 derived lines has been effectively adopted in two commercial breeding programs with significant improvement in selection for yield. Less than 1% of breeding populations used produced an improved cultivar. Gains in soybean yield potential will come from utilization of better parental germplasm and the capability of handling larger nurseries and yield testing programs. New biotechnological techniques promise to enhance the ability to transfer simply inherited factors into adapted germplasm. New breeding strategies will shorten the response time for development of new cultivars to meet new production demands. Cultivar development time has now been reduced to six years and can be reduced more.

010

THE APPLICATION OF QUANTITATIVE GENETICS THEORY TO PLANT BREEDING PROBLEMS

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The objective of this paper is to discuss research topics in quantitative genetics that are suggested by practical questions arising in breeding programs. The partition of genotypic variance into components (additive, dominance, and epistatic) is relevant to the prediction of genetic gain. Only the additive component contributes to genetic gain when selections are intercrossed, while additive gene action and additive x additive types of epistasis contribute to progress in selection among pure lines for cultivar development. Prediction of genetic gain is only approximate because of the nature of the underlying assumptions and the difficulty of obtaining precise and unbiased estimates of the necessary parameters. Additional topics related to improving the efficiency of breeders' efforts in hybridization and evaluation of genotypes include (1) the limitations of the bi-

parental cross as a source of genetic variation, (2) a simple scheme for using genetic male sterility to increase the amount of genetic recombination, (3) the questions as to the optimum number of lines to be tested per cross, (4) increasing the effectiveness of line selection by using cross mean information, (5) allocation of resources in yield testing, and (6) the development of probability statements for use in making selection decisions. Answers to the questions implied in these topics would be helpful in increasing efficiency of breeding programs and should be sought in future quantitative genetics research.

011

EQUIPMENT AND TECHNIQUES FOR FIELD RESEARCH IN SOYBEANS

J.C. Thorne, Northrup King Co, Washington, IA, USA

Major advancements in mechanization of field research in the last two decades have allowed agronomists to dramatically improve their management of time and resources. Improvements in plot planters include seed dividers which assure even seed distribution when planting two or more rows from one packet, variable reduction gearboxes in the cone drive which allow for easy row length adjustment, and automatic trip devices which can eliminate the need to crossmark aisles. Planters have been equipped to plant both wide and narrow rows and to plant in untilled soil. Various systems for at least partially mechanizing the process of end-trimming plots to harvest length have been developed. Studies on the use of hill plots have shown that they are suitable for preliminary evaluation of yield and other characteristics. Planting and harvesting equipment have been developed to mechanize the handling of hill plots. The first plot combines used for soybeans lacked capacity, speed, and durability. Field loss and seed damage was unacceptably high; cleanout between plots was incomplete. Improvements in all these areas have resulted in acceptable combines for mechanized plot harvest. Equipping combines with scales and moisture testers has facilitated collection of yield data. Use of portable data recorders linked to computers has resulted in faster and more accurate data collection and handling. Continuing developments in this area hold great promise for the future.

012

CORRELATIVE EFFECTS OF PODS ON PLANT DEVELOPMENT

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The role of indoleacetic acid (IAA) in the correlative effects of fruits was investigated in beans (Phaseolus vulgaris L., cv Redkloud) and soybeans (Glycine max [L.] Merr. cv Clark). Mature bean plants imposed dormancy on axillary buds at the time of rapid pod growth. When plants were defruited, bud growth resumed causing a doubling in the number of axillary shoots. Deseeding of pods similarly increased bud growth, but the application of 0.1% indoleacetic acid (IAA) in lanolin inside the pod cavity reestablished inhibition. Treatment of the peduncles of intact fruits with 1% naphthylphthalamic acid, NPA, (an IAA transport inhibitor) in lanolin relieved bud growth inhibition. Bud growth stimulation in these plants was not the result of diminished competition for nutrients because the growth of treated fruits was also increased. The foregoing results suggest that fruits may control bud growth through the release of IAA as a correlative signal. Experiments with 2-^{14}C-IAA--testing IAA export from fruits in beans and soybeans--found that substantial amounts of ^{14}C were transported to buds, leaves and fruits adjacent to the donor fruit. More distant organs received less radioactivity. Results also showed that developing fruits can cause leaf senescence, reduced rate of photosynthesis and abortion of younger fruits. These effects, like bud inhibition, may also involve IAA as the correlative signal. How beans and soybeans differ in their response to the correlative effects of fruits will be examined.

013

SOYBEAN SEEDLING GROWTH AND VIGOR

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The initiation of the germination processes is characterized by the massive hydration and reorganization of the organelles into a physiologically and morphologically functional entity. Seedling growth is maintained by the rapid conversion of stored reserves and their utilization by the embryo. These transformations are in large part controlled by embryo demand. The development of the soybean hypocotyl is regulated by ethylene which is quantitatively controlled by temperature, seed quality and soil resistance. The normal development of the hypocotyl is critical to the successful emergence of the soybean seedling. Seed lots often exhibit differences in seedling growth rate which is generally referred to as seedling vigor. The measurement of seed vigor has received considerable coverage in the recent literature. However, a unanimously accepted standard test is not presently available. Seed/seedling vigor is influenced by a number of causes and its expression is most often greatest during emergence and initial growth. Although vegetative development is often effected by differences in seedling vigor these differences seldom carry-over to yield.

014

GROWTH AND DEVELOPMENT OF SOYBEAN ROOT SYSTEMS

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Principal components of a soybean root system are a taproot, secondary roots, tertiary and other higher-order roots, adventitious roots originating from the hypocotyl and root hairs. Large secondary roots originating from the upper 0.15 m of a taproot usually determine the limits of the soil volume penetrated by a root system. Small higher-order roots and root hairs provide most of the root surface area. Root growth is strongly linked to shoot growth and development. Growth of soybean root systems accelerates throughout the vegetative stages of development and attains maximum growth rates during flowering. Maximum rates of root growth also coincide with establishment of near maximum levels of light interception and vegetative shoot growth. After pod-set and seed-fill begin, root growth rates usually decline and cease altogether at physiological maturity. Under some conditions carbohydrate supply limits root growth. Any condition or treatment that increases photosynthesis or decreases sink demand of shoots increases root growth. Root growth and development are also influenced by genetically determined characteristics. Soybean genotypes demonstrate great diversity for root characteristics.

015

PHOTO-THERMAL REGULATION OF FLOWERING IN SOYBEAN

R. J. Summerfield and E. H. Roberts, University of Reading, England

Soybean crops are now cultivated in a remarkably diverse range of climates: from the equator to latitudes 55°N or S and at altitudes which range from below sea level to about 2000m. The timing of developmental events, particularly the initiation of floral primordia and their subsequent expansion into open flowers, differs markedly throughout this wide range of environments depending on the genotype grown and the date on which it is planted. Differences between genotypes in relative sensitivity to both photoperiod and temperature modulate rate of progress towards flowering in different regions and growing seasons. Recent data on (a) responsiveness to dim light (illuminance values such as those which prevail during twilight) and (b) factorial combinations of wide ranges of each of photoperiod and temperature are described, and alternative interpretations of data published in different countries during the past 25 years are suggested. The implications of these recent findings for breeding soybeans and screening them for photo-thermal responsiveness in the field are discussed, and alternative strategies to traditional approaches are suggested.

016

POTENTIAL PROTEIN DEMAND: SOYBEAN MEAL AND COMPETING PRODUCTS

V. McMinimy, A. E. Staley, Decatur, Ill., U.S.A.

(declined to provide abstract)

017

POTENTIAL VEGETABLE OIL DEMAND: SOYBEAN OIL AND COMPETING PRODUCTS

D. Gustafson, Drexel-Burnham-Lambert, Chicago, U.S.A.

(declined to provide abstract)

018

PROJECT 2002: THE LONG-RANGE FUTURE FOR SOYBEANS FROM A U.S. PERSPECTIVE

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A modified Delphi technique (systematic interrogation of experts) was used to identify key issues and assess key variables expected to affect the future world demand and supply of soybeans. Emphasis was on the future of U.S. soybeans as a component of the world demand for vegetable protein meal and oil. Alternative projections based on three different world economic scenarios were developed. The "most likely" scenario depicts world economic growth averaging only 3% per annum over the 1983-2002 period. Competition for traditional soybean markets is expected to become more intense, especially with respect to increased production of palm, rapeseed, and sunflower crops. Soybean oilmeal consumption will remain the driving force behind demand for soybeans, and will grow more slowly, averaging 4.6% per annum for 1983-2002 versus 6.7% in the most recent 10 years ending 1982. Despite slower growth in demand, total world production of soybeans by 2002 is expected to approach 7 billion bushels, double recent levels. Soybean yields are projected to increase at a faster rate, averaging 46 bushels per acre in the United States by the year 2002. Total planted acreage of soybeans in the U.S. is projected to approach 100 million by 2002.

019

SUPPLY, USE AND PRICE PROSPECTS FOR SOYBEANS AND OTHER OILSEEDS

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Growth in the United States and World oilseeds economies is likely to experience some slowing in the decade ahead compared to the very robust growth experienced in the 1960's and for most of the 1970's. More modest growth in general economic activity and slowed gains in population provide the general setting for oilseed demand growth prospects. Supply gains are also expected to slow perceptibly for some oilseeds, particularly outside of the United States providing the basis for modest price rises in the decade ahead. Supply growth for crops like soybeans outside the United States has significant implications for the level of U.S. exports and price prospects which are discussed in this paper. Supply developments for Malaysian palm oil are likely to keep vegetable oil supplies growing somewhat faster than demand with prices for vegetable oil continuing their long term decline relative to protein meals. Some of the implications of these and other developments for soybeans and other oilseeds are explored.

020

FACTORS INFLUENCING THE INCIDENCE AND SEVERITY OF PHOMOPSIS SEED DECAY

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Seed decay caused by the seedborne fungi, Phomopsis sp. and Diaporthe phaseolorum, (Cke. and Ell.) Sacc., adversely affects both the seed and market quality of soybeans. The incidence and severity of Phomopsis seed infection is strongly influenced by environmental conditions during and after crop maturation. Frequent rain and warm, humid weather provide optimal conditions for Phomopsis invasion of seed. Point systems based on weather variables, cultivar selection, cropping history and planting dates are used to determine if spraying with foliar fungicides is necessary. Desiccant-type herbicides which stimulate Phomopsis development in soybean tissue allow early detection of latent Phomopsis infection. Factors which stress plant growth may predispose soybeans to greater Phomopsis damage. Potassium deficiencies can increase the severity of Phomopsis infection and reduce seed germinability. Soybeans infected with soybean mosaic virus and bean pod mottle virus exhibit increased susceptibility to seed infection by Phomopsis. Changes in the nutrient content of soybean plants during senescence coincide with increased Phomopsis seed infection. Greater Phomopsis infection of soybean seed in the lower halves of plants (vs. the upper halves) may be related to differences in the nutrient composition of pods from the upper and lower nodes. Treatments such as high soil moisture and pod removal which delay pod maturation and slow seed dry-down also reduce germination and increase Phomopsis infection of soybean seed.

021

PURPLE SEED STAIN AND CERCOSPORA LEAF BLIGHT CAUSED BY CERCOSPORA KIKUCHII

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Purple seed stain (PSS) affects the quality of seed and may cause seedling damage. The disease does not reduce yields, but may reduce stands. Cercospora leaf blight (CBL) is a disease of economic importance in Southern United States, causing high yield losses in years with favorable conditions for its development. The pathogen may infect leaves, petioles, stems and pods, and causes a rapid defoliation beginning at the top of plants in the R6 growth stage. The use of foliar fungicides has emphasized the importance of CBL. Conidia of C. kikuchii were readily produced on cleared V-8 juice agar. Fungus overwinters on soybean debris and increases on abscissed petioles of growing soybeans. Most PSS resulted from inoculations at the R4 growth stage. Seedlings inoculated with C. kikuchii at the V1 growth stage and allowed a dew period of 24, 48 or 72 hours showed good infection at 16°C with optimum infection from 20° to 24°C. Infection increased as length of dew period increased. A cycle of 12 hours darkness followed by 12 hours light in the dew chamber resulted in significant more infection than in continuous dark. Inoculated seedlings required at least 8 hours of dew to establish a significant amount of infection when exposed to 1, 2 or 3 dew periods (24°C) followed by a dry period, except the 24-hour dew periods. Disease ratings increased as exposure to a given dew period increased. Greatest amount of infection occurred with 24-hour dew periods. Conidia may be carried for relatively long distance by wind. Cultivars very susceptible to CBL were severely affected with PSS. Cultivars resistant to PSS may be moderately susceptible to CBL. Tracy possessed a high degree of resistance to both PSS and CBL.

022

SOYBEAN MOSAIC VIRUS

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Knowledge on Soybean mosaic virus has considerably progressed. A large range of strains has been found in germplasm collections which improves the efficiency of resistance studies. Several resistance genes are known which, when combined, might now give a better chance of resistance to additional strains of SMV. In the epidemiology of this virus, transmission through seed has been shown to play a central role ; then virus is spread by aphids. Epidemiological parameters are being used as the basis for a computer model that would help analyzing epidemics over a wide range of environmental and agroclimatic conditions and defining critical factors : efficiency of aphids, timing of flights, primary inoculum. Concerning the virus carried with seed lots, methods are now available for a certification ; breeding can also potentially reduce the level of seed transmission in improved cultivars. Several approaches are thus available for controlling this disease where it does damage. The intensity of the damage would however require better determinations taking into account compensation effects of non infected plants.

023

SOYBEAN BUD BLIGHT: SEED TRANSMISSION OF THE CAUSAL VIRUS

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Soybean bud blight, caused by tobacco ringspot virus (TRSV), is probably the most severe virus disease of this crop. The epidemiology of the disease is complex. Although TRSV is transmissible by nematodes (Xiphinema americanum), several arthropods and seed, circumstantial evidence suggests that infected reservoir hosts and aerial vectors are the major factors leading to epiphytotics. Seed transmission of TRSV may play an important role in maintaining inoculum in reservoir hosts and in the long distance transport of the virus in germ plasm. Cross pollination experiments established that transmission depended upon infection of the egg. Infected pollen germinated poorly and germ tubes were severely stunted, rendering its participation in fertilization and transmission negligible. Virions of TRSV were detected by electron microscopy in thin sections of the intine of the pollen wall, the wall and cytoplasm of the generative cell, the integuments, nucellus, embryo sac wall, and megagametophytic cells. The process of seed transmission is examined in the light of recent research on the molecular biology of viruses, and the role of non-virion, viral nucleic acid e.g. replicative RNA and specialized ribonucleoproteins in seed transmission is discussed.

024

EFFECT OF SOIL ENVIRONMENTAL FACTORS ON RHIZOBIA

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Considering the widespread interest in the root nodule bacteria surprisingly little is known about their free-living phase in soil. This may be attributed to their rather nondescript characteristics which lead in turn to difficulties in studying their population dynamics in response to changing environmental factors. There is still no selective medium suitable for their enumeration, which remains largely dependent on estimates by the most probable number soil-dilution technique. Strains inoculated into the soil may, if suitably marked, be counted on medium containing a number of antibiotics. The results by both methods are subject to considerable error. This review deals with rhizobia as soil saprophytes which reach their highest numbers in the rhizosphere. In many soils and in any particular rhizosphere the population should be viewed as a diverse mixture of species and strains. The response of rhizobia to the physical, chemical and biological components of the soil environment are considered. For any particular adverse environmental factor it is important to determine the sensitive step in the chain of events leading to effective nodulation. This must be identified for each symbiotic system; frequently the greater need is for better adapted hosts rather than more tolerant rhizobia. Where possible their interactions are described by reference to recent literature on soybean rhizobia but other groups are introduced where information is lacking. The implications of these interactions, as they affect strain selection or genetic construction for commercial inoculants, will be discussed.

025

RHIZOBIUM STRAIN COMPETITION FOR NODULATION

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Successful inoculum strains of rhizobia depend on their ability to establish in the host rhizosphere, to compete with resident soil rhizobia for nodule sites and to establish themselves in the new soil environment as a major component of the rhizobial

population. The outcome of competition for nodule sites is the summation of the influences of many microbiological, plant and environmental factors and include: 1) Host species and cultivar influences 2) Inherent characteristics of the Rhizobium, 3) Relative strain representation in host rhizosphere, resulting from inoculation and the resident soil population, 4) Relative growth rates of competing strains in host rhizosphere, 5) Physiological state of the inoculum, 6) Influence of the rhizosphere/soil microflora on the competing rhizobia, 7) Temperature, pH, soil characteristics, moisture, oxygen, nutritional levels, 8) Compatibility or the time taken for the host infection and effectiveness of the symbiosis. The mechanisms determining competitive ability of rhizobia are not well understood and appear to vary greatly amongst individual legume-Rhizobium associations. There are no definite guidelines that can be given to predict the outcome of competition. The factors listed and discussed should be considered when selecting new strains of Rhizobium that will be better able to compete with resident soil rhizobia.

026

BACTEROIDS IN THE SOYBEAN: BRADYRHIZOBIUM JAPONICUM SYMBIOSIS

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Our study of soybean bacteroids has shown that techniques used in the past to study the biology of bacteroids needs improving. New techniques, including monoclonal antibody methods, are now available to isolate bacteroids at different stages of transformation and to study their biology. These findings would have significant implications in genetic, cytochemical and agricultural investigation.

027

FAST-GROWING SOYBEAN RHIZOBIA

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Fast-growing soybean rhizobia from China are distinct in their microbiological and symbiotic properties from the 'typical' slow-growing type. In addition to their generation times, the fast growers differ from slow growers in their pH tolerance, NaCl sensitivity, carbohydrate utilization, ethanol utilization, 6-phosphogluconate dehydrogenase activity, sensitivity to antibiotics, litmus milk reactions, and serological affinities. These criteria logically place the fast growers in the genus Rhizobium, whereas, the 'typical' slow-growing soybean rhizobia are in the new genus Bradyrhizobium. The general legume host range of the two groups of soybean rhizobia is similar, with marked differences in N_2-fixing effectiveness found with several Glycine genotypes. While the fast growers are generally ineffective with several N. American adapted soybeans, they are effective with certain genotypes from Asia. Wild soybean (G. soja) genotypes have been identified which exhibit specificity for effectiveness with the fast growers as opposed to the slow growers, and vice versa.

028

OFF-SEASON NURSERIES ENHANCE SOYBEAN BREEDING AND GENETICS PROGRAMS

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Breeding and genetics programs use off-season nurseries for hybridization, generation advance, and seed increase during the winter when the crop cannot be planted in its area of adaptation. An effective off-season nursery reduces the number of years from the time selected parents are crossed to form a population until a superior segregate from the population is released as a cultivar. The efficiency of these programs may be increased further if selection for important characters can be practiced during the winter. The objective of this paper is to discuss the role of an off-season nursery in a breeding and genetics program. Research conducted at the Iowa State University Soybean Breeding Nursery located at the Isabela Substation of the University of Puerto Rico and at Iowa State University, Ames will be the primary source of information to be discussed. Our results indicate that a more efficient use of the resources allocated to an off-season nursery is possible. Breeding for quantitative traits and basic genetic studies on qualitative characters may be conducted at the nursery location. Handling of the material may be improved to increase the efficiency of the operation.

029

SOYBEAN CYTOGENETICS

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The study of soybean cytogenetics has been hindered because of the large number, small size, and similar morphology of the chromosomes. Adequate techniques are now available for mitotic chromosome preparations but techniques for meiotic chromosomes are not completely satisfactory. Aneuploids have been found among progeny from synaptic mutants, male-sterile female-fertile mutants, triploids, and irradiated plants. Aneuploids have been suspected among progeny of tetraploids and may occur spontaneously among diploid plants. Most aneuploids are primary trisomics but one tertiary trisomic has been confirmed. Deficiency aneuploids occur but so far can not be maintained. Trisomic inheritance has been shown for several traits. Chromosome interchanges or translocations have been found among accessions of the annual species, and from irradiated plants. Six different interchanges are known and have been used to locate genes to chromosomes. Inversions are known but very little work has been done with them. Duplications are suspected and one deficiency has been suggested based on the inheritance of two classes by recombination. Thirteen linkage groups are known but most contain only two genes per linkage group. In linkage groups with several mutants the gene order has not been determined in all cases.

030

COLLECTION AND UTILIZATION OF WILD PERENNIAL GLYCINE

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The perennial species of Glycine, distant evolutionary relatives of soybean, represent valuable genetic resources needed to supplement the variation in the annual species. The bulk of interspecific and intraspecific diversity occurs in Australia. At least seven species are recognized, two of which form polyploid complexes, the remainder being diploids. Recent efforts to build a representative collection have yielded over 700 accessions in the CSIRO Glycine collection. As a group, the species show great morphological diversity, and an impressive range of adaptation from the monsoonal tropics, through the semi-arid inland, to the southern alps and temperate zones. Among the many potentially useful characters present in the wild species, resistance to soybean leaf rust is widespread. A key step in exploiting these resources is the obtaining of interspecific hybrids between the wild species and soybean. This was achieved by in vitro culture of hybrid embryos. Fertility of the hybrids has yet to be restored, but the hybrid plants can express the resistance to leaf rust derived from the wild parent. Crosses among the perennial species have identified one accession which may act as a bridge in the hybridizations likely to yield fertile derivatives with G. max.

031

UTILIZING THE GENETIC DIVERSITY OF ANNUAL SOYBEAN SPECIES

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All the sources of breeding progress were from the annual species, Glycine max (L.) Merr. The ancestors of the U.S. cultivars were introductions mainly from China, and some from Japan and Korea. The ancestors of cultivars in eastern Asia were mainly the land cultivars. The early emphasis of genetic diversity was on maturity and a series of morphological, physiological, and ecological traits. It was also on resistance to pests. In countries where exists native germplasm, it was on a population of land cultivar level, while in countries without own land cultivars, it was on an entry level. Genetic diversity of yield most concerned breeders and should be evaluated in a well-designed test. Backcrossing is suitable in transferring some major gene(s) to a cultivar. When a polygenic inherited trait is to be transferred, a double backcrossing procedure may be useful. In case of transferring more than two traits, stepwise accumulation is recommended. When breeding effort towards high yield, recurrent selection is one of the choices. One approach to further explore the diversity of soybean germplasm is to expose the diversity in the present world collection. Another is to make further exploration to enlarge the world soybean germplasm collection. In addition, new germplasm may be developed through mutation and recombination. The conservation strategy and sample size of a population entry and a pure line entry are considered to be different from each other.

032

THE PHYSIOLOGY OF REPRODUCTIVE ABSCISSION IN SOYBEANS

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The mechanism of reproductive abscission in soybeans [Glycine max (L.) Merr.] is poorly understood. The objectives of this work were to examine effects of light on such abscission, and to examine sink relations of setting and abscising flowers. The effect of light was examined in field-grown 'Evans' soybeans, and sink relations were examined in growth chamber grown 'Clark', isoline E_1t plants. In the field, white and red supplemental fluorescent light was provided in the bottom of the canopy. On half of the plants, flowers were shaded from the lights with aluminum foil. Both red and white light, when striking the flowers, reduced abscission and increased the partitioning of ^{14}C-assimilates to them. The partitioning of ^{14}C-assimilates to setting and abscising flowers within axillary racemes was examined as a function of time after anthesis of individual flowers. Sink intensity (% dpm/ g fr.wt.) of both setting and abscising flowers was very high prior to anthesis; it then became very low for two or three days after which it recovered in setting flowers, but not in abscising flowers. It is concluded that reproductive abscission is sensitive to light striking the flowers at or very near the date of anthesis. Abscission appears to be associated with a failure of sink intensity to recover after its temporary decline just after anthesis. Whether there is a cause and effect relationship between the lack of sink intensity and abscission remains to be determined as does the question of hormonal mediation.

033

INFLUENCE OF SEED FILL DURATION ON SOYBEAN GROWTH AND DEVELOPMENT

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Duration of seed-filling period is influenced by the effects of photoperiod and temperature on growth rate of seed, as well as by effects of water stress on availability of photosynthate for support of seed growth. Seed growth rate in vivo is slowed as photoperiod is lengthened and temperature is lowered. Water stress during seed filling reduced both seed-fill duration and seed yield when the rate of seed growth was stimulated by a short-day photoperiod. When the water stress was applied under a long-day photoperiod, the duration of seed fill was lengthened by the reduced rate of seed growth, and final seed yield was greater than for stressed plants under the short-day photoperiod. The effect of photoperiod on rate and duration of seed fill may involve alterations in the source activity of leaves as well as sink activity of seed. There is evidence that genotypic variability for response of seed growth rate and duration to photoperiod exists. Genotypic distinctions in sensitivity to photoperiodic regulation of seed growth present a possibility for genetic manipulation to reduce effects of stress on abbreviating seed-fill duration and reducing seed yields.

034

NITROGEN MOBILIZATION DURING SEEDFILL IN SOYBEANS

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A portion of the N in soybean seed at maturity comes from N that is mobilized or redistributed from non-seed plant parts and not from NO_3^- accumulated or N_2 fixed during seed filling. The concentration of N in the vegetative plant parts and pod walls declines during seed filling and the N lost from these tissues is translocated to the seed. Leaf photosynthetic activity is closely associated with leaf N status during this period. The proportion of the N in the seed at maturity coming from redistribution has been reported to range from 20 to 100%. The contribution that redistributed N makes to the seed N at maturity varies among cultivars and is influenced by environmental conditions. It has been shown that a relatively constant proportion of the N in the plant at beginning seed fill (growth stage R5) is redistributed to the seed. Nitrogen redistribution is associated with senescence, but the role that N redistribution plays in determining yield is not clearly understood.

035

REGULATION OF SENESCENCE: CYTOKININ AND MINERALS

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Late in podfill, the seeds induce foliar senescence which causes death of the soybean plant. Early depodding prevents senescence (e.g. loss of N and chlorophyll from the leaves) and increases the root N content. Root functions (e.g. mineral uptake) decline in senescing plants. Likewise, root exudate cytokinin content and the foliar cytokinin titer have been reported to decrease about the time of N loss. Explants (stem cuttings with pods and a leaf) offer a direct method to probe the role of the roots in whole plant and foliar senescence by substituting defined solutions for the roots. Explants cultured on water show accelerated pod development and leaf senescence compared to intact plants, but depodding still prevents the rapid leaf yellowing. Mineral nutrients or cytokinin (Z, ZR, etc.) alone will delay (normalize) leaf senescence and pod development, but a combination is more effective than either. With or without the supply of mineral nutrients, cytokinin retards the redistribution of N from the leaves to the pods. ^{3}H-cytokinin (Z or ZR) supplied via the transpiration stream travels mainly to the leaves and much less to the carpels, with very small amounts to the seed coats and no detectable amounts to the embryos. Very rapid metabolism occurs not only in the leaf blades but in the stem and petiole. A deficiency in the cytokinin or mineral flux from the roots does not by itself cause senescence of the leaf; the pods are still needed. The developing pods do not divert the flux of cytokinin in the xylem away from the leaves.

036

TRADE POLICY ISSUES IN THE SOYBEAN SECTOR

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International trade is crucial to the present and future economic health of the world soybean sector. Between 35% and 50% of the value of sales of soybeans and their products is generated by international commerce. Soybeans and products may cross international boundaries two, three, or more times on their way from growers to end product users. Consequently, trade policy decisions taken by both importing and exporting nations are and will be very important to farmers, processors, and product users. Most deliberate trade policy interventions in the soybean sector are designed to protect or shield some favored group from the full force of international competition. They may be soybean farmers, oilseed processors, producers of substitute fats, oils, and protein feeds, or even a nation's users of edible oils or protein feeds. Major issues and points of controversy in 1984 and beyond will focus on topics such as (1) how the EEC adjusts its agricultural policy and excise tax policies to affect imports of soybeans and products, (2) how the 1985 U.S. Farm Bill evolves, especially in its treatment of soybean price and income support, and how the exchange value of the U.S. dollar vis a vis other currencies behaves, and (3) what direction the export policies of the major soybean exporters in South America take in coming months and years.

037

IMPACT OF GOVERNMENT PROGRAMS ON SOYBEAN PRODUCTION, TRADE AND POLICIES

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Traditionally the soybean industry in the United States has been characterized by a farm program that contains minimum government involvement. Typically this involvement is in the form of loan rate support only, modified according to a longer term moving average of market prices. In contrast, feed grains and wheat programs contain considerable government involvement including loan rates, target prices, diversion payments for land control, reduced acreage and set-aside programs, base acreage and farmer owned reserve options with storage payments, interest rate options and reserve loans. An interactive econometric model of these industries indicates strong competition between soybeans, feedgrain and wheat with corresponding indirect government program influence filtering through to the soybean industry. This analysis traces the implications in the soybean industry resulting from several alternative program designs in the feedgrain and wheat sector. Specific estimates indicate that a program design that removes an additional 100 million bushels of corn from production will increase soybean prices by 15 cents per bushel. Also, program designs that enhance soybean exports by an additional 100 million bushels strengthens soybean price by approximately 80 cents per bushel.

038

BRAZIL AND ARGENTINA POLICY IMPACTS ON SOYBEAN PRODUCTION, TRADE AND PRICES

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(declined to provide abstract)

039

EUROPEAN POLICY IMPACTS ON THE SOYBEAN SECTOR

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Several policy impacts are evaluated using a regional econometric soybean and soymeal trade model. The nonlinear dynamic model contains 7 endogenous regions, which are the major exporters and importers. The impacts are obtained by running dynamic simulations over the 1980-1989 period and comparing the average levels of endogenous variables. A 20 percent reduction of the EC corn threshold price would encourage corn use and reduce soybean and soymeal demand in the EC. Most of the reduction in imports is from soymeal. This results in a larger decline of soymeal price(less than 2 percent) than of soybean price(less than 1 percent) in world markets. Soybean and soymeal export earnings decrease by about 3 percent in the US, 1.5 percent in Brazil and less than 1 percent in Argentina. The impacts of a reduction in Spain's corn price are similar but smaller in magnitude. The price impact of a 20 percent import tariff on soybean and soymeal by the EC or Spain is mostly in the country imposing the tariff. The EC reduces soymeal imports more than soybean imports, so soymeal price declines more than soybean price in world markets. The US loses more than 3 percent in export value compared with less than 1 percent for Brazil and Argentina. The price impacts of a US dollar devaluation of 10 percent are much larger in other countries than in the US. This, as well as the relative price impacts reported above, indicate that the US faces a world excess demand which is more inelastic than the US export supply. The devaluation increases US export earnings by nearly 4 percent.

040

CHEMICAL CONTROL OF NEMATODES ATTACKING SOYBEANS

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About 50 species of plant parasitic nematodes are reported to attack soybeans [Glycines max (L.) Merrill] causing an estimated annual yield loss of 10%. Several commercial nematicides, both fumigant and non-fumigant, are recommended for control of soybean nematodes. Based on the chemical and physical properties of a given nematicide, the proper time of application and placement may be critical for optimum performance. Emphasis has been placed on the development of soybean varieties resistant to Heterodera glycines and Meloidogyne spp. Physiological races of H. glycines can hybridize, resulting in new races capable of attacking the resistant varieties. Because of new races and/or the presence of other damaging parasitic nematodes, there have been yield losses on some resistant varieties and the use of chemicals can often be beneficial. Nematicides may interact with other agrochemicals used in soybean production resulting in enhanced nematode control and yield increases or in unusually high nematode populations, phytotoxicity, or yield loss. Selection of a particular nematicide should be based on a combination of factors such as cost/benefit ratio, impact on target and non-target organisms, long and short term effects on the environment, and a comparison to alternate control measures.

041

STRATEGIES FOR RACE STABILIZATION IN SOYBEAN CYST NEMATODE, HETERODERA GLYCINES, ICHINOHE

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The soybean-cyst nematode, Heterodera glycines, has demonstrated a remarkable capability to adapt to resistant cultivars. This resulted in at least five physiological races of H. glycines with a varying capacity for reproducing on soybean cultivars with resistance to this nematode. Typically a resistant soybean cultivar, it can be planted three to six years in a field before a population which can reproduce on it builds up to detectable levels. Shifts in parasitic capability usually have not occurred when resistant cultivars are planted for two or more consecutive years. In order to prevent shifts in physiological races, the recommendation of rotations which include a soybean cultivar susceptible to H. glycines and a non-host have been proven effective. Since a number of races are already known, the rotation of cultivars with different genomes for resistance may also be necessary in order to keep field populations below damaging levels.

042

CONCEPT OF RACE IN SOYBEAN CYST NEMATODE

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Genetic variability of soybean cyst nematodes (SCN) forced adoption of a "race" classification 16 years after field damage was first reported. The U.S. concept of race corresponds to European "pathotype". Both designate populations distinguished by one phenotype: reproduction on a set of differential hosts. Zoologists consider race as a subspecific population with distinctive phenotypes and restricted exchange of genes with other populations of the species. Races of phytonematodes are known in several genera including both ecto- and endoparasites. SCN race classification is based on reproduction on four resistant soybeans in comparison with one susceptible host. This does not describe total variability of SCN as shown by use of more extensive sets of differentials. Investigation of genetics of SCN-soybean associations is in progress in Missouri. V. Luedders and I selected six SCN populations from a single infected Missouri field. Each reproduces on a resistant host. With addition of another selected population from elsewhere, we tested all possible combinations of host x population and found three different populations in this set. A second selection imposed on two of these resulted in loss of ability to reproduce on the first selecting host and gain of ability to reproduce on the second. We also produced a number of inbred populations selected on PI 209332 or on PI 89772 by serial transfers of single cysts on the selecting hosts for nine generations, followed by expansion on the selecting hosts. Differences appeared among these inbreds in a test on 11 differentials. There are blocks to nematode production at different life cycle stages in various incompatible SCN-soybean associations. We are currently moving toward controlled matings of SCN, rapid bioassays for blocks to reproduction, and methods of simplification of the handling of test plants.

043

PLANT-PARASITIC NEMATODES ASSOCIATED WITH SOYBEANS

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There are only a few taxa other than the highly virulent soybean cyst nematode (Heterodera glycines) that cause significant yield losses to soybean, even

though over 100 species are associated with this crop. The four common species of root-knot nematode (Meloidogyne incognita, M. arenaria, M. javanica, and M. hapla) are economically important pests of this crop. Other nematode pests that cause damage are: reniform (Rotylenchulus reniformis), sting (Belonolaimus longicaudatus), lesion (Pratylenchus spp.) and lance (Hoplolaimus columbus) nematodes. The root-knot and lesion nematodes are widely distributed, whereas the other species are more regional. Control tactics (nematicides, rotation, resistance) are generally species specific, thus requiring the determination of numbers and kinds of nematodes for effective crop management.

044

EFFECT OF HYDROGEN RECYCLING IN NODULES ON GROWTH AND NITROGEN FIXATION IN SOYBEANS

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Hydrogen is evolved during biological N_2 fixation. Some strains of R. japonicum synthesize a nickel-requiring hydrogenase that participates in H_2 recycling and energy conservation. Most of the genetic determinants for hydrogenase have been cloned and progress toward the transfer of hup genes has been made.

Researchers have described experiments designed to evaluate benefits of H_2 recycling but some results have been inconclusive. Most researchers have utilized poorly characterized Hup^+ and Hup^- strains as inoculants in short-term tests. Several trials have utilized Hup^+ strains that recycled a small portion of the H_2 evolved during fixation. We have compared Hup^- mutants with Hup^+ revertants of R. japonicum as inoculants for soybeans in pot cultures for 40 days. Where the efficient H_2 recycling strains were utilized, higher total weights and N contents of plants ($P \leq 0.05$) were obtained. In another short-term pot experiment, no effects could be measured. In other trials with 10 replicates, a Hup^- mutant and a Hup^+ recombinant derivative of the mutant were compared as inoculants in concrete tiles. Significant increases ($P \leq 0.05$) from use of the Hup^+ strain were obtained in seed wt (5.2%), leaf wt (14%), total wt (9%), seed N (8.6%), leaf N (27%) and total N (11%). Evaluation of Hup requires the use of appropriate strains, and well replicated experiments in which plants are grown to maturity.

045

ENVIRONMENTAL INTERACTIONS INFLUENCING INNOVATIVE PRACTICES IN LEGUME INOCULATION

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Legume inoculation invariably involves interactions with biotic and abiotic features of the environment. The host is the major interactant and the microflora, especially other rhizobia, has a significant role in determining the fate of inoculant. The nature of carriers for inoculants and the physical characteristics of the soil into which they are introduced are important also. Recent progress in these areas, with emphasis on the soybean symbiosis, is considered.

The development of alternative inoculant carriers to peat is of high priority; much promise attaches to oil-based inoculants. Now that Glycine is known to have a wider genetic base symbiotically than formerly believed, the extent and nature of that diversity requires definition; it has important implications for soybean breeders. Well-nodulated soybeans may contribute more N to the total pool of soil N than once thought; confirmation is required and progress in this area will depend on the development of accurate techniques for measuring N inputs. An understanding of the molecular basis of the pre-infection phase of the symbiosis should be sought; this knowledge might be exploited in construction of strains with improved competitive ability against populations of rhizobia established in the soil thereby leading to more effectual legume inoculants.

046

PROBLEMS OF SOYBEAN INOCULATION IN THE TROPICS

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There are many countries in the tropics and subtropics for which soybeans are a new crop species, and in which inoculation is often needed for reasonable crop yield. Fortunately, the vast majority of inoculation trials reported to date show a positive response to inoculation, though soil, plant and environmental factors can limit the degree of response. Constraints include variety strain interactions, moisture stress, soil acidity, mineral deficiencies and toxicities, soil temperature and the availability and quality of inoculants. American cultivars are extremely specific in strain requirement and rarely nodulate with native 'cowpea' type or fast-growing rhizobia from soybean. With more interest currently in widening the genetic diversity used in breeding soybeans, host-strain interaction is likely, and will need to be considered in breeding strategies. Cultivar and/or strain variation in tolerance of soil acidity, tolerance of low soil P levels and high temperature could also be important in improving inoculation response.

048

MULTIVARIATE ANALYSIS OF A COLLECTION OF SOY BEAN CULTIVARS FOR SOUTHWESTERN SPAIN.

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A collection of 125 soybean lines, sown in southwestern Spain on two planting dates in two consecutive years, was evaluated for 25 traits. Cluster, principal components, and factor analyses were employed to investigate the diversity among lines and identify sets of varieties better adapted to the specific environmental conditions. Cluster analysis identified six groups of lines which differed mainly in lateness, plant height, yield, % protein, and % oil as well as in seed quality traits. The groups were quite consistent in performance through changes in environmental conditions. Late maturing varieties belonging to standard maturity group III showed the best adaptation when sown in early planting dates. A group of experimental lines, the majority of which had semideterminate stem termination with small leaflets and intermediate maturity, were highly productive when sown in late planting dates.

Discriminant analysis confirmed the composition of the groups, with minor changes, and reduced the number of significant variables to eleven.

049

ADVANCED BIOMETRICAL TECHNIQUES USED IN THE IDENTIFICATION OF SOYBEAN GENOTYPES FOR HYBRIDIZATION PROGRAMME

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Methods of identification of soybean genotypes for hybridization programme can be classified into two distinct approaches, (i) conventional methods, and (ii) biometrical methods. Conventional methods are based on adaptability of genotypes, random selections, character compensation. Among biometrical techniques, various methods of classificatory analysis such as D^2 analysis, meteroglyph analysis, have been extensively used in identifying the soybean genotypes. Conventional regression analysis based on various models were also found to be useful. Combining ability analysis of various mating systems such as Diallel, Line x Tester have been used to identify the best genotypes for hybridization programme aimed at the genetic improvement of yield and quality of soybean.

050

GENE ACTION FOR SEED YIELD, ITS QUALITY AND OTHER TRAITS IN SOYBEAN

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Gene action was studied in F_2 generation by using North Carolina Backcross Design 111. Thirteen traits in all were studied. Results revealed mainly additive gene action for all the groups of traits studied viz., yield components (seed yield, biological yield, harvest index and number of pods), structural components (number of branches and plant height), phenological traits (days to flowering and days to maturity), seed quality traitsd (per cent germination, per cent hard seeds, 100-seed weight, specific gravity index and per cent oil content). For biological yield and specific gravity index, though the gene action was of predominantly additive type, yet, certain amount of dominance was also noticed indicating partial degree of dominance. Heritability in narrow sense ranged from 12 per cent for plant height to 65 per cent for specific gravity index.

051

GENETICS OF YIELD AND ITS ATTRIBUTES IN SOYBEAN

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Six genetically diverse genotypes of soybean with their 15 F_1's and 15 F_2's were evaluated under two different agroclimatic zones in a diallel mating design using all the three important methods of diallel analysis. Based on per se performances and general combining ability variances, the best parents were identified for specific character viz., (i) T49 (for number of pods/plant), (ii) Kalitur (for number of grains/plant and grain yield/plant), (iii) Cocker Stuart (for 100-seed weight and oil percentage) and (iv) JS75-1 (for protein percentage). Results of pooled estimates revealed that combining ability analysis and numerical analysis indicated consistent equal contribution of both additive and non-additive types of gene actions. However, additive and dominance effects were predominant in combining ability studies and numerical analysis, respectively. Graphical studies exhibited inconsistency in the expression of gene action and presence or absence of epistasis which may be due to genotype x environment interactions. Based on overall results, combining ability analysis appeared to be more consistent and reliable, though all these three approaches were supplementary to each other.

052

NC DESIGN I ANALYSIS IN TWO SOYBEAN CROSSES

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Two F_2's (UPSM-534 x PK-73-86 and UPIR-1 x Bragg) of soybean were utilized to develop NC-I progenies by crossing 8 F_2 plants as males, each male being mated to 3 different F_2 females. The progenies and parental cultivars were evaluated in a compact family block design during rainy season 1980. Over both the crosses there were only three traits viz. seeds/pod, harvest index and 100 seed weight which had substantial additive genetic variance. Seed weight had the highest heritability (13.057 per cent in UPSM-534 x PK-73-86 and 79.266 per cent in UPIR-1 x Bragg) followed by harvest index and number of seeds/pod. For other traits, most of the estimates of the additive /dominance variance were, however, negative.

053

GENETIC ANALYSIS IN SOYBEAN
(Glycine max (L.) Merrill)

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A set of 10 x 10 diallel crosses including reciprocals was studied. Analysis of combining ability indicated the importance of additive gene action in the importance of additive action in the inheritance of yield and yield components. However, the genetical and graphical analysis suggested the influence of dominance non-allelic interaction in addition to additive gene action. Parental performance seemed to be a good indicator of gca effects. The parental genotypes Improved Pelican, Nimsoy 7 and 93745 had high per se performance and also high gca effects for seed yield and most of the related characters. Parent shih shih and PK 359 are the good general combiners for short plant stature and earliness. There was a good correspondence between the estimates of gca effects made in F_1 and F_2 generations indicating the possibility of shifting the comgining ability study to the F_2 generation when the quantity of seed of F_1 will be a problem.

054

EARLY GENERATION TESTING, RESPONSE TO SELECTION AND COMPARISON OF SELECTION METHODS IN SOYBEAN

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Positive correlation for seed yield among F_2 derived lines of a cross in F_3, F_4 and F_5 indicated the effectiveness of early generation testing. Correlation of F_4, stratified bulk lines with the corresponding lines in F_5, with respect to seed yield, was high. The frequency of superior lines, for seed yield, was more in early generations, whereas, for per cent oil content it was high in later generations. The response to selection and realized heritability were high in early generations, whereas, in stratified bulk breeding method, these were high in early generation at medium selection intensity. Response to selection in different selection methods was specific to location. Prediction of superior lines in later generations based on additive genetic variance estimated throgh backcross design was more or less true. Stratified bulk breeding method was equally good to F_2 pedigree bulk or F_3 pedigree bulk method. Genetic drift was noticed in the stratified-SSD method and it was inferior to other methods.

055

STABILITY PARAMETERS OF SELECTED SOYBEAN CULTIVARS IN THE SOUTHEASTERN UNITED STATES

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Results of the South Carolina soybean variety tests were utilized to measure and compare relative stabilities of several soybean cultivars across four maturity groups for yield and plant height. Cultivars in Groups VI, VII, and VIII were analyzed for the period 1976-1978, an overall favorable period for plant growth. The mean yield was 2714 kg/ha. Separate analyses were conducted for seven early maturing cultivars (Groups V, VI, and VII) and eight later maturing cultivars (Groups VII and VIII) for the period 1980-1982. The mean yields for the early and late maturity varieties for 1980-1982 were 2427 and 2011 kg/ha, respectively. Parameters determined to compare cultivars were deviation mean squares (DMS), regression coefficients, and coefficients of determination. The cultivar having the highest DMS for yield was the earliest maturing cultivar. Several cultivars had DMS values significantly different from 0. Coefficients of determination ranged from 0.77 to 0.98 for yield and from 0.86 to 0.98 for plant height. Most regression coefficients were not different from 1. Results from a joint regression analysis indicate that genotype x environment interactions for yield were primarily due to effects other than linearity for all cultivars tested in the period 1980-1982.

056

G X E INTERACTION IN SOYBEAN ACROSS CROPPING SYSTEMS

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G x E INTERACTION ANALYSIS across cropping systems over years and locations with respect to 45 F_2 derived lines in F_4&F_5 of a cross alongwith their parents and three checks indicated sufficient genetic variability and predominantly linear portion of G x E interaction for seed yield, 100-seed weight, per cent oil content, harvest index, days to maturity, per cent germination and specific gravity index under monoculture as well as in association with maize, though an appreciable amount of non-linear G x E interactions was also present. In monoculture, however, both linear and non-linear G x E interactions were equally important for specific gravity index. Effect of cropping system was observed on variances due to genetic, linear and non-linear G x E interaction. Individual adaptability analysis revealed that more than 90 per cent of the genotypes exhibited predictable linear G x E interaction with respect to mean performance and response to changing environments for the traits studied.

057

GENETICS OF ADAPTABILITY PARAMETERS AND THEIR ASSOCIATION IN SOYBEAN ACROSS CROPPING SYSTEMS

V. P. GUPTA AND G. C. SAINI, HIMACHAL PRADESH AGRI UNIVERSITY, PALAMPUR, INDIA

Forty five F_2 derived lines in F_4 and F_5 of a cross alongwith their parents and three checks were evaluated with respect to adaptability parameters for seed yield, harvest index, days to maturity, per cent germination, 100-seed weight and specific gravity in monoculture and in association with

maize. Segregation pattern indicated that for most of the characters, mean performance, responsiveness and stability were under additive genetic control in both the cropping systems. However, genes controlling the parameters and nature of gene dispersion were influenced by cropping systems. Associations among various adaptability parameters can be incorporated in a line. Breeder can simultaneously select for high yield and high responsiveness to changing environments alongwith stability for both the cropping systems. Independent behaviour or negative association of stability with other parameters was noticed except for seed germination in both the cropping systems.

058

MECHANISM OF ADAPTABILITY IN SOYBEAN ACROSS CROPPING SYSTEMS

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Association of adaptability parameters of seed with those of other traits with respect to fifty lines in monoculture and in association with maize, and of adaptability parameters in monoculture with that of in association with maize revealed that the mechanism of adaptability was specific to cropping systems. In monoculture it was due to higher 100-seed weight, lateness in maturity, high oil content with high environmental sensitivity, better seed germinability with least environmental sensitivity and lastly through low but stable harvest index, whereas, in association with maize it was due to less 100-seed weight lateness in maturity, low but stable harvest index and unstability of high specific gravity index. Mean performance in monoculture was strongly positively correlated with that of in association with maize for the traits studied except harvest index. Stability and responsiveness of a genotype of were independent of cropping systems.

059

COMPARISON OF INTRODUCED AND INDUCED SOYBEAN VARIABILITY IN WIELKOPOLSKA REGION

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The objective of research was to obtain soybean lines for Wielkopolska Region. The favourable growing season for soybean last since 20 April to 30 September, sum of temperature - 2400°C, precipitation- 29,3 cm. We examined 38 entries, about 750 mutant M_8 lines and 900 F_3-F_6 lines for effectiveness of flowering, phenological and morphological features. The data revealed the sum of temperature during the first stage of development to strongly effect the yielding potential. Four genotypes were identified as a thermoneutral. The genetic analysis for the variation range of agronomic characteristics indicated a possibility of successful selection within material of different origin. The results pointed out that under our climatic conditions the best source of genotypes useful for plant breeding is recombinant variation.

060

MATURITY CONVERSION OF LATE TROPICAL AND EARLY TEMPERATE SOYBEAN GERM PLASM.

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Soybean germ plasm contains many lines ill-adapted for use in a particular target environment because an inherent photoperiod response results in maturity too early or too late relative to that required for maximum productivity. Such lines might be useful as cultivars or more useful as parents if converted to a maturity conferring adaptation to the target environment. Mating schemes designed to produce groups of partially converted lines for evaluation for yield potential and maturity are (i) Early temperate/Late tropical - selected early//Late tropical, and (ii) Early temperate/Late tropical - selected late//Early temperate. From type (i) matings, BC1-F6 random inbred lines from recurrent parents Jupiter, Orba, Santa Maria, Amarilla and Gilbert were tested. Lines of moderate to high yield potential and maturity similar to cv Lee were obtained in the Jupiter, Orba and Gilbert series. From the type (ii) mating scheme, with Williams as recurrent parent, a series of lines was obtained which combine high yield potential and good agronomic type with maturities ranging from a few days later than Williams to lines as late as Jupiter. Two "late Williams" lines were superior for seed yield, and the same maturity, compared with Forrest.

061

VARIATION OF SOYBEAN HYBRID POPULATION IN RESPONSE TO DIFFERENT ENVIRONMENTS

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The patterns of hybrid population are often the main factor of selecting effect in soybean breeding. The effects of natural selection on F_2 hybrid population of two crosses were investigated in four locations of Taiwan. Heritability value of vegetative traits varied in different locations, and showed an increased tendency from south towards north location. There are significant differences in four locations in the degree and direction in phenotypic correlation among agronomic traits. The pattern of distribution of F_2 hybrid populations grown in Tainan & Taichung had late flowering tendency and earlier flowering in Kaoshiung and Shinchu locations. All investigated agronomic traits expressed continuous segregation and the distribution pattern varied in different locations. The variance of plant height, number of branch, number of nodes of main stem, days to flowering and days to maturity showed an increased tendency from south toward north location. Also, some variation of other traits existed in different locations. Experimental results indicated that there are some differentiation existed in F_2 hybrid population under various locations.

062

SOYBEAN CULTIVAR SELECTION FOR TROPICAL AREAS BASED ON THE NUMBER OF INTERNODES

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Ten soybean cultivars were planted in 20 environments of the Mexican humid tropics during 1979 and 1980 in order to observe their phenological development and determine the "ideal" plant structure. The difference between an adequate ("good") environment and an inadequate ("bad", those having late rains, or drought, or excessive rainfall) environment lies in the number of days required by a given genotype to develop from germination to physiological maturity. In the Mexican humid tropics, soybeans need to reach physiological maturity in 75 days in a bad environment, but have 120 days in a good environment. Results show that bad environments for soybeans predominate over 60% of the Mexican tropics. Results show that cultivars with indeterminate habit and producing 12 internodes are unsuitable for bad environments, because when these reach the flowering stage they will have produced only 65% of their internodes, while the rest will be produced during the grain filling period. This, in turn, causes plant self-competition and shortens the grain filling period by 21 days. During grain growth the indeterminate produces three more internodes and 443 kg/ha of grain. Therefore, such environments, determinate habit cultivars producing eight internodes should be recommended, since these materials can have a 30-day grain-filling period, during which they will produce one more internode and 884 kg/ha of additional grain.

064

ALTERNATIVE METHODOLOGY FOR SCREENING FOR RESISTANCE TO SOYBEAN CYST NEMATODE

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In many soybean screening programs for resistance to soybean cyst nematode (SCN) a nearby source of infested fine sandy soil is available for inoculum in the greenhouse. Lacking this in Iowa a suitable potting mix was developed and an egg inoculation method was used. Cysts/root system of Corsoy 79 soybean grown in a 2:1 sand/soil mix of medium grain gravelly sand and black loam soil were increased by screening the mix through .16cm hardware cloth. When sand and soil were screened through hardware cloth and window screen, 3:1, 2:1, 1:1, and 1:2 ratios gave good infection while screened sand alone gave few cysts/root system. Eggs for inoculations were placed in an aerated .01M $ZnSO_4$ solution for 4-5 days. Soybeans germinated in flats of vermiculite for 4 days were transplanted 1 plant/10cm pot. Ten thousand eggs and larvae applied with an automatic pipette generally resulted in over 100 cysts/root system on checks. Six hundred F2 plants and 300 F3 progeny were screened with SCN race 3. Soybean cultivars were pruned above the cotyledon or above the unifoliate (8 or 14 days after transplanting), or were not pruned. Pruning reduced top growth and dry root weight, eliminated the need for staking, and when pruned above the cotyledon allowed plants to grow in 7.5 cm pots without becoming pot-bound. Pruning did not affect compatability.

065

HOST PLANT RESISTANCE TO AUSTRALIAN SOYBEAN PESTS

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Resistance to Australian soybean insect pests has been found in some germplasm and breeding lines imported from USA. Field studies conducted in Queensland, Australia (latitude 26.6°S) demonstrated resistance to Nezara viridula and Piezodorus hybneri (Hemiptera: Pentatomidae) in Q15723, PI229358, ED73-371 and ED73-112. In 1982, immigrant bug populations at flowering were equal on all lines but subsequent population growth varied. Adult N. viridula populations 122 days after planting were 10.6 and 7.3/row m on cultivars Semstar and Flegler but were only 1.0 and 4.4/row m on Q15723 and ED73-371 respectively. These differences were also apparent in the magnitude and timing of nymphal population peaks. Similar results were obtained with P. hybneri. In 1983, pod sucking bug populations were 1.6 and 1.4/row m on Davis at 97 and 125 days post-planting respectively but were between 0.26 and 0.91/row m on Q15723, PI229358, ED73-371 and ED73-112. Leaf feeding resistance to Heliothis armiger and H. punctiger (Lepidoptera:Noctuidae) was identified in laboratory studies between 1979 and 1983. Larval life was extended by up to 33% and pupal weight was reduced by up to 45%. In some experiments larval mortality was increased on resistant lines. The soybean lines most resistant to H. armiger and H. punctiger were PI229358, PI171451 and Q15723. A recurrent selection breeding program commenced in 1983 using ED73-112, ED73-371, PI171451, PI229358 and Q15723 as insect resistant parents.

066

SELECTION MECHANISMS OF SOYBEANS AND OTHER GRAIN LEGUMES BY THE MEXICAN BEAN BEETLE

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The Mexican bean beetle is one of the most host-specific legume-associated insects in North America. Studies on the mechanisms that trigger its host-selection behavior are helping elucidate the bases of resistance in soybean to this and to other oligophagous arthropods. Scanning electron microscopy was used to investigate the location and ultrastructure of chemosensilla on the sensory appendages. Leaf disc preference tests were used to investigate changes in preference for cv. Williams and PI 229358 soybeans after amputation of antennae or maxillary palpi or labial palpi or foretarsi. We found that maxillary palp chemosensory organs are most critical for distinguishing between these two leaf types. This appendage bears over 425 chemosensory pegs of two types one gustatory and one apparently olfactory. The second most critical organ in food selection is the antenna. Each antenna, on the three terminal segments has a small field of olfactory hairs and 8-10 trichoid gustatory hairs. The terminus of the labial palp produces 20 chemosensory pegs of undetermined function. 12-16 chemosensory pegs were also found in the epipharynx. When antennae and maxillary palpi were both excised there was no preference between the soybean genotypes, indicating that receptors for recognizing resistant and susceptible genotypes are restricted to these organs.

067

EFFICIENT SELECTION FOR BROWN STEM ROT RESISTANCE IN SOYBEANS

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Brown stem rot (BSR), caused by Phialophora gregata, is a serious disease of soybean (Glycine max) which causes vascular discoloration of the stem and necrosis of the leaves. Due to environmental variation, field selection of BSR resistant genotypes is inefficient. Selection efficiency should improve under greenhouse conditions since environmental variation can be minimized. A study was conducted to estimate the heritability of resistance to BSR leaf and stem symptoms under greenhouse screening conditions. Heritability estimates were based on variances among and within F3 families from two crosses between susceptible and resistant soybean lines. Since leaf symptoms had a higher estimate of heritability than stem symptoms, selection based on leaf symptoms should be more effective than selection based on stem symptoms (when screening is conducted under controlled greenhouse conditions). Heritability estimates for leaf symptoms in both crosses were high enough to suggest that selection based on single plants or family means can quickly increase the level of BSR resistance in a segregating population.

068

INHERITANCE OF REACTION TYPE TO BROWN SPOT AND SENESCENCE IN SOYBEAN

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Studies on reaction type to brown spot (*Septoria glycines*) and green senescence in F_2 generation of a number of crosses involving diverse soybean cultivars were carried out. Cultivars with green and yellow cotyledons showed considerable differences in the manner of number and size of brown spot lesions and pycnidia per unit area of infected tissues. The spots on the green cotyledon varieties were without chlorotic haloes in contrast to those of yellow cotyledon types. During senescence, the leaves of green cotyledon cultivars did not turn chlorotic like yellow cotyledon types. Segragation data in F_2 at post flowering stage showed that reaction type to brown spot and senescence are governed by two recessive genes. All plants showing chlorotic lesions also showed yellow senescence. However, data recorded at pre-flowering stage showed non chlorotic lesion type to be governed by a single recessive gene indicating that one of the genes for reaction to brown spot expresses itself only at post flowering stage.

069

INDUCED MUTATIONS FOR RUST RESISTANCE IN SOYBEANS

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Seeds of 11 soybean cultivars were irradiated with gamma rays at 15 and 30 krad. Treated and control seeds of each cultivar were planted in the rainy season of 1979. In 1980, M_3-bulk, M_3-single, and M_2-bulk populations were screened for rust resistance in Nong Hoi Valley and Mae Joe Experiment Station, both in Chiang Mai. The IWGSR rust rating system was used. Based upon the slow growth of rust on soybean plants, 6 and 115 plants were selected from the total of 2,802 central and 28,824 M_2 and M_3 plants, respectively. Selection lines were established and evaluated in Nong Hoi valley in the rainy season of 1981. Sixteen selections with average good seed yield per plant and low percentage of shrivelled seeds were obtained. Eight lines with good agronomic characters were evaluated in the rainy season of 1982 and in the dry season of 1983 in Chiang Mai. The results showed that the rust disease developed slowly on plants of the selected lines. They were considered as rust tolerant mutants. Among them, Line 81-1-038 derived from S·J·4 was interesting for its seed size which was less affected by the disease. It yielded slightly lower than that of its parent but not statistically significant. This line is still on yield trial and being used for crossing with other rust tolerant lines to increase frequency of rust tolerant genes in soybeans.

070

BREEDING OF SOYBEAN CULTIVARS RESISTANT TO FROG-EYE LEAF SPOT

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Isolates of Cercospora sojina Hara, the pathogen of frog-eye leaf spot in soybean obtained from several parts of the Northeast China, can be divided into 5 races named Race NE1, NE2, NE3, NE4 and NE5 respectively by using a set of six differential cultivars, i.e., Gang 5151, Jiunong 1, Shuangyue 4, Hejiao 69-231, Ogden and huanan Green Soya. During 1976-1982, aiming at the dominant race NE1 in Sanjiang Plain of Heilongjiang province, 934 soybean cultivars were evaluated by field inoculation for the disease resistance and 113 of them proved highly resistant, then 84 hybridized or backcross combinations were made and 41 lines with excellent integrative traits and resistance to frog-eye leaf spot were obtained by means of continuous selection under the inoculative conditions and two outstanding lines, Hejiao 80-706 and Hejiao 81-1104, have been picked out in the regional testing. The results showed that the resistance of soybean to Cercospora sojina Hara Race NE1 was controlled by a pair of dominant genes.

071

INHERITANCE OF YELLOW MOSAIC VIRUS IN SOYBEAN UNDER NATURAL CONDITIONS

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The inheritance of yellow mosaic virus under natural conditions was studied through North Calolina Backcross Design 111. Analysis revealed that additive genetic variance was mainly important. Narrow sence heritability was 19.5%. The coefficient of variance at additive genetic level and expected genetic advance as per cent of mean were also high. Comparing F_1, its reciprocal with parents (Ankur and EC.16109) revealed that negative genes imparting resistance to yellow mosaic virus were partially dominant.

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072

Evaluation of soybean lines and cultivars for resistance to Sclerotinia sclerotiorum Lib de Bary.

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Sclerotinia stem rot is the most important disease of soybean in Argentina causing significant yield losses every year. The disease has been studied for the last seven years at the Pergamino Experimental Station, where the control was primarily aimed to cultural and chemical practices because of the lack of a simple and reliable method for screening for resistance to the pathogen. Having tested various methodologies for artificial inoculation it was found that chicory (Cichorium intybus) petiole pieces colonized by the fungus and in contact with the hypocotyl of 20 days old soybean plants under high humidity resulted in the best expression of symptoms. By using this technique it was possible to detect, among more than two hundred lines and cultivars tested, the following entries characterized by their outstanding response to the disease: D 71-8928 D 72-7993, D 71-4886, IAS_2, SRF 307-P, MD 70-100, Williams and TS 989.

073

SOYBEAN RPS GENES AND REACTIONS TO PHYTOPHTHORA

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Genes are being backcrossed into Harosoy in addition to Rps1 (Harosoy 63) and Rps2 (L70-6494): Rps1-b (BC6), Rps1-c (BC6), Rps1-k (BC4), Rps3 (BC5), Rps4 (BC4), Rps5 (BC7), Rps6 (BC5), and Rps-PI 103.091 (BC6). There appears to be a gene (Rps?) in Harosoy that results in resistance to races 12, 16, 18 and 19; rps susceptibility is being backcrossed into Harosoy (BC4). Lines carrying these genes individually can be distinguished by using the five races 5, 8, 17, 19 and 21. There are conflicting results in the literature for the reactions of Rps1 with race 19, for Rps1-b with race 17, and for Rps-PI 103.091 with race 12; a susceptible reaction appears to be correct in each of the three cases. Sanga, which is considered to have Rps1-b, has shown numerous killed plants in reactions to race 7, while a line carrying Rps1-b from PI 86437 has consistently shown a resistant response. Results indicate that Sanga is not very suitable as a differential host and should be replaced in a new set of differentials that would include Rps4, Rps5 and Rps1-k.

074

EFFECTS OF BLENDING SOYBEAN CYST NEMATODE RESISTANT AND SUSCEPTIBLE SOYBEANS

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Soybean cyst nematode (SCN) resistant cultivars CN290 and CN210 normally yield 10% less than SCN susceptible Corsoy 79 in the absence of SCN. Blends of these cultivars with SCN susceptible cultivars (Corsoy 79/CN290 and Hardin/CN210 in 70/30% ratio) were tested at three SCN infested locations in north central Iowa to determine if yield could be increased. Gravid cyst counts/250 cm^3 soil in July averaged 101, 57, and 36 at the three locations. CN290 and CN210 outyielded Corsoy 79 and Hardin at all locations. Yield differences were greatest where cyst counts were highest. Blends were mainly intermediate in yield between their components. At one location (lowest SCN counts) the Corsoy 79/CN290 blend outyielded both its components when treated with aldicarb. Susceptible cultivars Century and A80-149020 had the highest yields at that location. SCN population density declined on resistant cultivars. Late season cyst counts on blends were similar to their susceptible components but larval counts/100 cm^3 soil were lower on blends at two locations. In a separate study with 12 cultivars, SCN population density increased most on Corsoy 79 and Lakota. Similar results were found in a greenhouse test using inoculum increased on Corsoy 79. Blending SCN susceptible soybeans with CN290 and CN210 will probably not improve yield in a heavily infested field. Studies with more tolerant susceptible components on lightly infested fields should be conducted.

075

INTERACTIONS OF MOISTURE STRESS AND BROWN STEM ROT ON YIELD IN SOYBEAN

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The interactions of brown stem rot (BSR), moisture stress, and yield in soybean were studied under field conditions utilizing a movable weather shelter and hill plots. Artificial infestation of the area with infested soybean straw in the fall produced BSR levels significantly higher than those in nearby non-treated areas. Moisture stress was induced by limited exclusion of rainfalls after the R5 stage using the movable weather shelter. Although varietal differences in BSR occurred where there was no moisture stress, there were no statistically significant differences in yield between BSR resistant and susceptible soybeans. BSR levels were lower under moisture stress than non-stress conditions, but even so there were significant yield differences in favor of the BSR-resistant soybeans under moisture stress. The results also confirmed the general effectiveness of the hill plot method for screening for BSR resistance.

076

A STRAIN OF SOYBEANS RESISTANT TO MULTIPLE ADVERSE FACTORS

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Multiple adversity resistance (MAR) refers to the resistance of a cultivar to diverse stress conditions, which can be either biotic or abiotic. The BSR-resistant selection A80-149020 was found to have MAR to brown stem rot (BSR), Phytophthora root rot, high soil pH, and soybean cyst nematode (SCN) when grown in fields having these problems and fields where no problems were expected. The yields of A80-149020 averaged among the highest of the 12 soybeans of the experiment in all seven environments where the study was conducted. Yield of A80-149020 averaged 5.6% higher than the BSR-resistant cultivar BSR 201, 17.3%

higher than the high soil pH resistant cultivar Weber, 11.4% higher than the Phytophthora resistant cultivar Corsoy 79, and 27.7% higher than the SCN resistant soybean CN210. The location with the highest average yield (3528 kg/ha) for all 12 soybean lines tested was the field with the lowest BSR incidence of 7.9 percent plants infected; the location with the lowest average yield (2049 kg/ha) had the highest BSR incidence of 98.7 percent plants infected.

077

USE OF A COMPUTERIZED DATA BASE TO STUDY BROWN STEM ROT AND YIELD INTERACTION IN SOYBEANS

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A computer program utilizing DBASE II for personal computers was developed for rapid retrieval of information on performance of brown stem rot (BSR) resistant soybeans in tests conducted under diverse conditions and environments throughout the development of the recently released BSR 201, BSR 301, and BSR 302 soybeans. Although some of the information was published and/or used earlier to support the release of these cultivars, most of the data remained uncollated until development of the computer program. Yields relative to BSR severity for any cultivar or combination of cultivars for any particular year, location or test can be quickly obtained. The most significant additional information obtained thus far from the computer data base is that the highest yields of both resistant and susceptible cultivars are generally obtained when and where BSR is absent or occurs at a low level. This suggests that BSR is a major yield-limiting factor in Iowa and probably in much of the Midwest United States.

078

DIAGNOSIS OF SOYBEAN INJURY BY ANALYSIS OF CHLOROPHYLL AND PROTEIN.

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By measuring the levels of chlorophyll and protein in cotyledons, unifoliolated, and trifoliolated leaves, it has been possible to quantify the effects of injury to soybean plants [Glycine max (L.) Merrill] at various stages of development. In young seedlings, cotyledon chlorophyll and protein levels increase with increasing injury. A similar trend was observed for the levels of chlorophyll and protein in the unifoliolated leaves of mature plants. Utility of this assay has been demonstrated for evaluating both the effects of injury caused by chemical, mechanical, biological, or thermal agents, and the rhythmic changes in the sensitivity of plants to injury. Generally, changes in levels of chlorophyll and protein depend upon the type of foliage, time of injury, stage of development, and environment. Reduction in seed yield caused by injury to the plants is also related to the stage of development, e.g. plants in the R_2 stage appear to have a greater capacity to compensate for injury than plants in the R_5 stage of development.

079

SYNTHESIS AND BREAKDOWN OF GLYCOLIPIDS IN SENESCENT PLASTIDS

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The soybean cotyledon provides an ideal system to study the biochemical and structural changes which occur during senescence. The decrease in the levels of nucleic acids, proteins and lipids correspond to the changes which occur during leaf senescence. A fundamental question in plant senescence is concerned with the mechanism responsible for the decline of the chemical components. Much of the literature on senescence indicates an increase in breakdown. This paper reviews data which indicate that a major cause for the decline of the galactolipids in the soybean chloroplast is a decrease in synthesis. The activities of three enzymes--galactosyl transferase, acetyl CoA synthetase, and fatty acid synthetase--decline during senescence. All of these enzymes are critical for the synthesis of the galactolipids. There is a reduction in the incorporation of (2-^{14}C)acetate and UDP-(U^{14}C) glucose into the galactolipids during senescence of the cotyledons. Labeling data also indicate that there is a decline in the synthesis of these lipids. There may also be a massive breakdown of the galactolipids during senescence, but the data on this are not conclusive. We do know that there is a decreased rate of synthesis and assembly of the chloroplast galactolipids. Possible mechanisms for the crippling of galactolipid synthesis will be discussed.

080

SEED GROWTH AND YIELD AT DIFFERENT LOCATIONS IN THE SOYBEAN CANOPY

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Pod samples were taken from irrigated (I) and non-irrigated (NI) 'Braxton' soybeans (Maturity Group VII) from growth stage R4 until harvest. In 1982 plant spacings within the row were 51, 102, and 152 mm whereas in 1983 intrarow spacing was 51 mm. Main stem pods were separated into three categories based on thirds by stem height. Pods borne on branches were separated into six categories based on location of origin of the branch from the main stem and on position of the pod in the canopy. Over 50% of seed yield was from pods positioned in the middle third of the canopy. The proportion of yield borne on branches and positioned in the top third of the canopy increased with irrigation. In 1982, percent yield from branches originating in the lower third increased with intrarow spacing. The increase with spacing of percent yield on these branches was concentrated in the upper third of the canopy in I and in the middle canopy position in NI. In both years seed growth rate and single seed weight decreased in the lower third of the canopy. In 1983 seed effective filling period also decreased in the lower third. Single seed weight increased with irrigation both years and with spacing in 1982. The proportion of pods that were empty or very small decreased with irrigation and with spacing and increased in the lower third of the canopy. When only larger pods with seeds were considered, number of seeds per pod was not consistently affected by irrigation, spacing, or pod location.

081

DELAYED MATURITY IN SOYBEANS GROWN IN THE CENTRAL VALLEY OF CALIFORNIA

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In soybean variety trials conducted in 1981 at Modesto, California, vegetative growth was enhanced and crop maturity delayed in this Central Valley location. In 1982 trials, six soybean varieties (maturity groups 00 through III) required 16-31 days longer to reach maturity at Modesto than in central Illinois. The Modesto crops grew taller, developed longer internodes, ceased vegetative growth later in the season, and gave higher yields but with a lower harvest index than in Illinois. Because Modesto is located 2°40' south of the Illinois site, shorter summer daylengths would be expected to hasten soybean maturity relative to Illinois. However, cool night temperatures at Modesto apparently exerted an overriding influence on soybean reproductive development, resulting in delayed maturity.

082

SEED WATER CONTENT FLUCTUATION AND METABOLIC ACTIVITY DURING IMBIBITION OF SOYBEAN.

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The effects of water content (WC) fluctuations on seed deterioration were studied under controlled conditions to simulate delayed harvest. Seed deterioration of cultivars 'Chippewa 64', 'Tracy' and 'Tracy H-4' was rapid under high WC regimes at 32 C but was less marked at 25 C. The decline in seed germination and seedling growth was accompanied by an increase in tissue permeability and by a decrease in ATP content, dehydrogenase activity and O_2 uptake by cotyledons. During the first 8 hours of imbibition, seed subjected to high WC fluctuations (HF) at 32 C for 20 days had O_2 uptake rates comparable to undeteriorated low WC control seeds (LC), but activity of the cytochrome pathway declined. The cytochrome pathway constituted only 40% of the O_2 uptake in cotyledons of HF seeds at 2 hours imbibition compared to 70% in cotyledons of LC seeds. The cyanide-resistant disulfiram-sensitive alternative pathway was detected in cotyledons of 20-day HF seeds and cotyledons of high WC control (HC) seeds. Preharvest WC fluctuations in soybean seed may contribute to a decline in the cytochrome pathway of respiration and an increase in the alternative pathway during subsequent germination.

083

DYNAMIC SIMULATION OF PHYSIOLOGICAL PROCESSES IN SOYBEANS

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Computer simulation to study soybean growth and development offers an opportunity for analyzing various plant responses, production practices, and climatic conditions. Over the past ten years, a physiological indeterminate and determinate soybean model has been developed, verified, and validated. The model can now be run on an IBM-PC with 256K RAM and an Intel 8087 math coprocessor. Several versions have been previously reported in the literature as SOYMOD, SOYMOD/OARDC, and more recently as REALSOY. REALSOY simulates at each canopy layer the processes of photosynthesis, respiration, translocation, transpiration, fruit growth and abortion processes, leaf senescence, seed and physiological yield components. The simulator also provides stages of vegetative and reproductive development. When used with the routine S-PLOT, REALSOY provides the necessary data for a pictorial representation of the plant with high resolution graphics. The S-PLOT routine uses three-dimensional and hidden-line graphics to provide leaf overlap needed for calculating light interception. The REALSOY model requires climatic data, plant population, soil condition, weed population, and defoliation or depodding losses. The climatic data required is hourly temperature, dewpoint, rainfall, solar radiation, and wind velocity. (When not available, daily climatic summaries can be used to estimate hourly values).

084

EFFECTS OF LOW SOIL OXYGEN ON ROOT GROWTH AND PHOTOSYNTHESIS

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Soybeans [Glycine max. (L.) Merr. var. Forrest] were grown in controlled-environment, sunlit chambers (SPAR units). The soil oxygen content was changed by flushing with N_2 gas or flooding at the V2, V6 and R2 growth stages. The effects of low soil oxygen were more severe at the reproductive compared to the vegetative growth stages in terms of root growth. For example, after low soil oxygen the root growth rates recovered to the same rate of non-stressed plants at the V2 stage, while almost no recovery was observed at the R2 stage. Root growth rates were reduced after 3-4 days of flooding while photosynthesis was not reduced until after 6-8 days of flooding. After 13 days of flooding, photosynthesis rates were reduced to about 1/2 of the rates for non-stressed plants. Transpiration changed in approximately the same way as photosynthesis. Leaf length and plant height were only slightly reduced by 13 days flooding at the R2 stage. Leaf nitrogen content was also reduced by flooding. After the soil had been drained, within 12 days younger leaves recovered to the same nitrogen content as non-stressed plants, but older leaves did not fully recover their nitrogen content.

085

BIOCHEMICAL CHARACTERIZATION OF SOYBEAN OVARY GROWTH FROM ANTHESIS TO ABSCISSION OF ABORTING OVARIES

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Soybean ovary growth was measured from 5 days before to 6 days after anthesis. Purpose of the work was to establish a timetable of biochemical events that should be useful in identifying processes that initiate abortion. Two techniques developed to provide samples with either high or low percent pod set for 'IX93-100', a semi-determinate line having long racemes, gave 84 and 50% pod set for samples considered to be "setting" and 21 and 0% set for "abscising" samples. Characteristics measured were fresh and dry weight, soluble and insoluble protein, soluble carbohydrate, starch, RNA, DNA, and free amino acids. Transport of radioactive molecules into racemes, incorporation of the label into macromolecules, and ovary enzymatic activity were also studied. Because there was a daily increase in ovary weight of approximately 1.5 fold, all characteristics showed daily increases when expressed on per ovary basis. Increases were lower in abscising ovaries after anthesis, however. Statistically significant differ-

ences between setting and abscising groups were detected for most characteristics between 2 and 4 days after anthesis. When chemical composition was expressed on concentration basis, starch level was significantly higher in setting ovaries from 3 days after anthesis. Regression analysis showed that initial deviation of abscising samples from setting samples usually occurred between 1 and 2 days after anthesis. Earliest deviation as determined by regression was the day of anthesis and was observed for several amino acids measured on mole % basis.

086

INTRARACEME COMPETITION IN FIELD GROWN SOYBEANS

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Williams soybeans were grown in field plots to test the effect of the "lower" pods (positions 1 and 2 on the raceme) on the development of the "upper" pods (positions 3,4,5, etc.), of the primary raceme at nodes 8, 10 and 12). The treatment consisted of removal of pods 1 and 2 prior to seed development. The control treatment had all pods left intact. Weights per pod were greater and abscission percentages were lower for the upper pods of treated plants. When $^{14}CO_2$ was photosynthesized by the leaf at node 10, more ^{14}C was translocated to the upper pods of treated racemes than to the upper pods of control racemes. Depodding increased the specific activity and the percent of the total ^{14}C measured in upper pods of node 10. When $^{14}CO_2$ photosynthesis was carried out at node 8, treated plants gained a significantly greater percentage of ^{14}C in the secondary and tertiary racemes at node 8 and in the pods at surrounding nodes (6,7,9, and 10). Little treatment effect on abscisic acid content of upper pods was found. Data suggest a controlling influence of lower pods over the development of upper pods on the same raceme.

087

ABA AND PREMATURE ABSCISSION OF SOYBEAN REPRODUCTIVE STRUCTURES.

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Extensisve premature abscission of soybean reproductive structures has been reported for both determinate and indeterminate varieties, with reports as high as 80% of all flowers produced. It has been suggested that ABA plays a significant role in the induction of abscission of these organs. Therefore, we have extracted purified and quantified endogenous ABA by HPLC and GLC-EC in abscissing and non-abscissing flowers/pods during the growing season of the relatively long axis raceme genotype IX93-100. In this genotype, normally the floral positions I,II,III and sometimes IV set pods, with more distal positions abscissing before maturity however removal of the basal three positions allow the more distal positions to increase set. Levels of ABA of positions II,IV and VI of control racemes were compared to flowers/pods of deflowered racemes. ABA levels were similar between treatment and control flowers except at early stages of growth, when non-abscissing flowers contained more ABA than did abscissing flowers. Partitioning studies of radio-labelled ABA and photoassimilates also showed few if any differences. From our studies, it does not appear that ABA induces abscission of soybean reproductive structures.

088

EFFECTS OF SADH ON GROWTH AND YIELD OF SOYBEAN

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Growth and yield of crop plants are commonly altered by the use of growth regulators. The effects of SADH (succinic acid-2,2-dimethylhydrazide), a growth retardant, on soybean cv.S.J.5 were determined by spraying this chemical at concentration 1000-6000ppm. to soybean plant. The results showed that plant height was inhibited by SADH application, and degree of inhibition increased with concentration. When applied at the bloom stage, the height of 1,000 ppm treated plants was reduced by 12 % whereas that of 6000 ppm treated was reduced by 30 %. Soybean yield (seed dry weight) was also affected by SADH. The yield increased when concentration of SADH was increased from 1000 - 3000 ppm, after this, yield declined. Highest yield of 42.57 gm/plant was recorded for plants which received 3000 ppm of SADH at the bloom stage. The control plants contained seed dry weight of only 35.54 gm/plant. The increment of soybean yield was presumed to contribute by the number of non-abortive pod/plant since the number of pod/plant and seed size (100 seed weight) remained the same. The number of abortive pod was reduced when plants were treated at the pre-bloom or at the bloom stages, but the result was reversed when treated at the late-bloom stage. The 3000 ppm treated plants which contained highest seed yield has only 5.33 abortive pod/plant as compared to 36.33 of the control.

089

INFLUENCE OF MALE-STERILE SOYBEAN GENE (ms_1) ON FEMALE GAMETOPHYTE:MICROSCOPY

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Four mutants of male-sterile Glycine max obtained from homozygous recessive ms_1 plants have reduced female fertility and increased frequencies of abnormalities such as polyembryos, haploids, and polyploids. Microscopic observations of these lines show a common abnormality; an increased number of nuclei within gametophytes. An ovule clearing technique was used to quantitate the frequencies of abnormalities within the four lines. Investigations of megasporogenesis and megagametogenesis using light and transmission electron microscopy indicate that partial or complete failure of cytokinesis at meiosis results in up to a four-nucleate functional megaspore. Development of two to four nuclei of the functional megaspore may lead to mature embryo sacs with up to four times (32) the normal number (8) of nuclei. Degeneration and/or nuclear fusion of developing nuclei result(s) in mature sacs that vary in nuclear number (<8 to 32).. The increased number of nuclei in the sac leads to overcrowding and often abortion. This may explain reduced fertility. Appearance of up to four egg cells (in mature embryo sac) can explain the increased frequencies of polyembryony and the fusion of nuclei can explain the higher than normal ploidy level observed in some embryos. Further work is needed to clarify these results, to understand the mechanisms involved in the production of these abnormalities, and to exploit the system for new improved lines for crop production.

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GYNOECIAL DEVELOPMENT AND THE ms_1 MALE-STERILE GENE IN SOYBEAN, GLYCINE MAX (L.) MERR.

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This presentation highlights salient aspects of the reproductive process in soybean. Greatest attention is directed to five features: 1) differentiation, development, and function of transmitting tissue (including stigma, style, and obturator); 2) relationship between pollen tube and female tissues; 3) synergid life cycle and function; 4) sperm delivery and double fertilization; and 5) nucellar, hypostase, and integumentary function in megagametophyte function. These features from fertile gynoecia, illustrated here, serve as a basis for comparison with ms_1 ms_1 gynoecia which exhibit reduced seed set and increased polyembryony accompanied by increased aneuploidy. In fertile gynoecia, the stigma secretes a lipoidal exudate overtoppd by a proteinaceous pellicle. Exudate in the stylar canal is lipoidal also. Pollen tubes grow through this exudate and between cells of the stylar transmitting tissue. Ovarian transmitting tissue forms an obturator that secretes an exudate, the surface of which pollen tubes grow on. At ovule maturity, antipodals are no longer present, the central cell is engorged with starch, and a filiform apparatus is present in the synergids. Pollen tubes enter the megagametophyte through the filiform apparatus of the degenerate synergid and discharge their contents into that cell.

091

FREQUENCY OF POLYEMBRYONIC SEEDLINGS AND POLYPLOIDS FROM MALE-STERILE (ms_1) SOYBEAN: CYTOLOGY

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Genetic male-sterile soybean (Glycine max [L.] Merr.) obtained from homozygous recessive ms_1 plants were studied for frequencies of polyembryonic seedlings and different levels of polyploidy among abnormal seedlings from six different source populations: Ames ms_1 (Ams), North Carolina ms_1 (NCms), Tonica ms_1 (Tms), Urbana ms_1 (Ums), and F_4 seed obtained from the cross of ms_1 to two chromosome interchange lines (Ams X Clark T/T and Ums X KS-172-11-3). Frequencies of polyembryony observed in Ams, NCms, Tms, Ums, F_4 seed from Ams X Clark T/T, and F_4 seed from Ums X KS-172-11-3 were 3.1%, 2.5%, 3.6%, 2.4%, 2.2% and 0.1%, respectively. Frequencies of abnormal seedlings from these six sources varied from 1.7% (Ums X KS-172-11-3) to 16.8% (Ams X Clark T/T). Frequencies of polyploids among the abnormal seedlings ranged from 6.8% in Ums X KS-172-11-3 to 66.7% in Tms. On average, the frequency of obtaining polyploid individuals from monoembryonic seedlings was 1.22%. Chromosome number of these seedlings varied from 20 to 200. Variation of the frequencies of polyembryonic seedlings and polyploid progeny among abnormal seedling suggested that the mechanism(s) controlling the characters of polyembryony and formation of polyploids was associated with the ms_1 gene and may be affected by some other gene(s) or environmental factors.

092

SOYBEAN OIL PRICE FUNDAMENTALS

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Price changes in the soybean complex can be explained in terms of supply and demand for soybean products and their substitutes. The focus here is on soybean oil, which has many substitutes among the animal and vegetable fats and oils. Thus, the price of soybean oil may be considered to be a function of the tightness of the market for all fats and oils, and not just the tightness of the soybean oil market. This paper examines the relationship between the price of soybean oil and the degree of supply/demand balance in the fats and oils market.

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POLICY IMPACT ON PRODUCTION, PRICE AND TRADE

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The countries in the Asian and Pacific Region such as ROC, Japan and Korea have all adopted strong price supporting policies for a long time in order to encourage the domestic soybean production Although there are some differences in patterns or names, i.e. government guarantee price scheme, a grant in aid program or government purchasing program, etc., these policies attempt mainly to encourage the domestic production by providing price incentives to the farmers. Therefore, these policies have resulted in a higher soybean price rise in the term of absolute level than that of the whole farm price index. However, these policies have failed to bring about the sufficient increase of domestic production due to the relatively low income from soybean production compared to that of other competitive crops. That is mainly caused by its low yields. The rapidly increased soybean consumption has, therefore, resulted in the same increase of soybean import. Of course, these policies seemed to provide a certain restriction on the increase of soybean import through the consumer price rise. In fact, about 12% consumer price rise was caused by the policy in 1981 in Japan and the price elasticity of soybean consumption was estimated as high as (−)0.6042. On the other hand, the highly increasing soybean price has resulted in the increase of palm oil import by the substitution of the soybean import, which seems to be bad for other farm sectors such as livestock farming. In conclusion, it seems to be better that more effort be made for the increase of yield for domestic production rather than that for continuous and strong price supporting policies.

094

FEED UTILIZATION IN THE EUROPEAN COMMUNITY

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Feed utilization in the European Community (EC) has undergone substantial changes since the early 1970's as a result of technological progress in the feed-livestock sector, the price impacts of the EC's Common Agricultural Policy (CAP), and the increased availability of various non-grain feeds. Oilseed meals as a share of total feed use increased from around 14 percent in 1970/71 to 25 percent in 1982/83 while grain's share declined from 63 percent to 58 percent. The use of other feeds also declined as a sharp reduction in feed potatoes offset recent increases in cassava and corn gluten feed and meal. Soybean meal use more than doubled during this period with its share of total feed use increasing to 13 percent and its share of total oilmeal use increasing to 56 percent. An econometric model of feed demand in the EC is used to analyze the relationship among

grains, soybean meal, and various non-grain feeds and to estimate the impact of proposed reforms in the EC's CAP. Proposals to reform the CAP by bringing EC prices for grains and livestock down to world levels would reduce the use of soybean meal and other non-grain feeds and increase the use of grains. Restrictions on imports of corn gluten feed and meal would increase the demand for soybean meal.

095

THE USE OF POD-BORNE INOCULUM TO PREDICT PHOMOPSIS SEED DECAY

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Epidemiological studies have demonstrated the feasibility of using the amount of inoculum of *Phomopsis* and *Diaporthe* species on soybean pods at the R6 growth stage to predict the severity of Phomopsis seed decay and the need for foliar fungicide control. Pod-borne inoculum is measured by detaching pods in the field, treating them with sodium hypochlorite, then with a herbicide and incubating at 95% relative humidity at room temperature for 7 days. Infected pods are detected by the presence of *Phomopsis* fruiting bodies. Cooperative experiments with 20 Iowa seed companies from 1981 - 83, have validated the predictability of the method in commercial soybean fields and demonstrated that, with minimal training, the test can be carried out by personel at the seed farm.

096

ENVIRONMENTAL FACTORS AFFECTING THE MOVEMENT OF *PHOMOPSIS* SPECIES FROM SOYBEAN PODS TO SEEDS

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Laboratory and field studies were performed to determine the influence of temperature, relative humidity (RH), and rainfall on the movement of *Phomopsis* spp. from pods to seeds after the soybean growth stage R6. Infection levels were determined by plating pods and seeds on acidified PDA. High RH for continuous periods of time was determined to be essential for the movement to occur. During these periods, temperature also was found to affect the rate of this movement. In laboratory studies, the movement occurred in 3, 4, and 6 days at 25, 20, and 15 C respectively. Pod inoculum levels, in either naturally or artificially inoculated treatments, showed a direct relationship to the resulting seed infection. In 1982 and 83, soybeans in the field were subject to overhead irrigation for 5-day periods. Increased seed infection at harvest maturity was associated with higher temperatures during irrigation periods.

097

OIL THERMOTHERAPY FOR CONTROL OF SEEDBORNE SOYBEAN PATHOGENS

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Hot maize, palm, soybean and sunflower seed oils were tested for their effect on germination, emergence, and recovery of Phomopsis spp. from Amsoy 71 and Swift soybean seeds. Seed samples were placed in each oil for 2, 4, 6, or 10 minutes at 80±2°C, or for 2.5 or 5 minutes at 90±2°C. No treatment affected germination in the laboratory at 25°C, only a few reduced emergence in the field, but at 2.5 and 5 minutes at 90±2°C, emergence was significantly reduced in the greenhouse. There was no significant effect on yield in the field. The treatment at 90±2°C significantly (P=0.05) reduced the recovery of seedborne Phomopsis spp.

098

SOYBEAN SEED QUALITY IN NEPAL INFLUENCED BY MATURITY GROUP, PLANTING DATE AND HARVEST TIME

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Maturity groups from 00 to VIII physiologically responded to planting dates at Khumaltar, 1000-seed weights decreased and seed infection by Cercospora spp., Colletotrichum truncatum and Phomopsis spp. increased with delayed harvest. Seed quality generally was poor in the maturity groups 00 to III; good in groups V to VIII; and best at later planting dates. Early planting dates enhance maturity by producing more and longer internodes per plant than the plants of later planting dates.

099

LOSS FROM BACTERIAL BLIGHT ON SOYBEAN

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Disease free seeds obtained by growing soybean crops four consecutive generations under furrow irrigation in the arid western United States were used to establish isolated, bacterial blight free field plots 30 m square, each year during a three year study. Inoculated and non-inoculated plots were compared relative to a number of parameters, including seed yield. Rows were 76 cm apart and two row sections of 76 cm each were inoculated in the plot center during the unifoliolate leaf stage. Readings on disease spread and severity with seasonal development were made weekly. At harvest plant height, pods/plant, seed weight and final yield figures were obtained on plants infected at different stages of development as disease spread from a central locus to adjacent plants following rain during the growing season. There were significant differences in disease severity in different locations within the plots and also

significant differences in amount of stunting of originally inoculated plants. No other differences were noted due to infection by Pseudomonas syringae pv. glycinea.

100

EFFECTS OF CROP ROTATION AND TILLAGE ON SOYBEAN SEED QUALITY

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Green and immature-shriveled seed was prevalent in 1983. These factors plus yield, seed weight and purple seed stain (PS) were evaluated in Cercospora-inoculated and non-inoculated Wells II soybeans in the 4th year of testing of the USDA-Purdue Integrated--Pest-Management project at Lafayette, IN, 1983. Late season disease development was negligible with regard to fungal seed infection except in the inoculated tests. Cercospora infected 32% of the seed in inoculated plants compared to 4% in the non-inoculated. Both seed infection and foliar blight phases of Cercospora kikuchii developed during 1983's hot, dry weather and significantly reduced yield, seed weight and quality. Percent PS in inoculated plots under No-Till was not as high in the Wheat-Corn-Soybean rotation (16%) as in the C-S (20%) or S-S (26%) rotations. In 1983, for the 1st time in the four year study, PS in the non-inoculated S-S rotation was significantly higher in the No-Till plots than with conventional or chisel tillage. However, in inoculated plots, less PS developed with No-Till than in the other tillage systems. Cercospora inoculations consistently increased the frequency of immature-dead seed and seed with green cotyledons. No-Till plots yielded more green seed (37%) than conventional (26%) or chisel (24%) tillage systems. Tillage and crop rotation influenced frequency of immature-shriveled seed somewhat, but was consistenly higher for inoculated (11-25%) than for non-inoculated plots (0-10%).

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GENOTYPE X ENVIRONMENT INTERACTIONS FOR SEED DISEASE DEVELOPMENT IN SOYBEANS

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A series of isogenic lines for maturity, developed by backcrossing into cvs. Clark, Harosoy, Williams, Wayne, and Chippewa backgrounds, were grown for 3 yrs. at 1 location, and compared to Amsoy 71, Gnome, and PI80837, within an evaluation of maturity-genotype x year, background x year, and maturity-genotype x background interactions for Cercospora and Diaporthe & Phomopsis pod and seed infection. Cercospora-inoculated and non-inoculated pods and seeds were bioassayed at physiological maturity to detect fungal colonization. The isogenic lines were tested in a wide range of maturity dates and environments within each year. Regression analyses were used to determine potential interactions. Results indicated that significant effects of year, maturitygenotype, and year x maturity-genotype interaction accounted for most variation in Cercospora seed infection in inoculated plants. Significant effects of background within a specific maturity-genotype were not detected among the isogenic lines, but were detected for the cv. Gnome and PI80837, which represent two distinct maturity classes. There was little variation in Cercospora pod infection among years and all lines were equally susceptible. Therefore, lack of inoculum was not a factor influencing seed infection. Background effects and year x background interactions, within specific maturity-genotypes were not significant for Diaporthe & Phomopsis seed infection.

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INFLUENCE OF GROWTH REGULATORS ON SOYBEAN POD MATURITY AND FUNGAL SEED INFECTION.

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Growth regulators were applied as foliar sprays in field tests to soybeans at growth stages V6, R5 or R6. Twelve different growth regulators were tested from 1981-83. Only 2-chloroethyl phosphonic acid (ethrel), an ethylene releaser, and chlorflurenol methyl ester (CF125), a morphactin that inhibits IAA oxidases, were effective in modifying the rate of pod senescence and fungal seed infection. Inoculum potentials (pod colonization by Cercospora and Diaporthe) were not significantly influenced by the growth regulators. Ethrel applied at the rate of 1000 ppm accelerated senescence of pod and seed tissues when applied at the R6 growth stage. Physiological maturity (R7) was advanced 1-5 days and averaged 2.5 days earlier for several soybean entries. Cercospora seed infection from Cercospora-inoculated plants was reduced 40%. Diaporthe seed infection from non-inoculated plants was reduced 70%. The morphactin CF125 applied at the rate of 20 ppm delayed senescence of pod and seed tissues when applied at the R5 growth stage. Physiological maturity was delayed up to five days when CF125 was applied to non-inoculated plants. This delay in maturity increased Diaporthe seed infection 50% in 1982. Each year Diaporthe seed infection increased as the rate of senescence was reduced but much less in 1981 and 1983. Trends for the response to the morphactin were not consistent among the soybean entries. CF125 applied to Cercospora-inoculated plants did not delay senescence.

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VIRUSES INFECT SOYBEANS IN EGYPT.

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Soybean mosaic virus and Tobacco Ring Spot virus were isolated from naturally infected soybean plants. Different cvs. of soybean showed different response to infection with the two viruses.

Soybean mosaic virus infection caused a significant reduction in ; number of pods / plant, size and number of bold smooth seeds. An increase of small shrivelled and mottled seeds was recorded.

Virus seed transmission varied from 32.7-52.9/ accordin to the stage of plants in time of infection. Mottled seeds and shrivelled ones showed a 40.5, 20.3/ of seed transmission

respectively.

Oil and protein content of infected seeds was significantly reduced.

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VECTOR RELATIONSHIPS AND HOST RANGE STUDIES WITH SOYBEAN DWARF VIRUS.

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Soybean dwarf virus (SDV) is a serious problem for soybean production in northern Japan causing as much as 50% crop loss in susceptible varieties. Research in our containment facility has shown that two endemic populations of Acyrthosiphon solani, the foxglove aphid, transmit the dwarfing and yellowing strains of SDV, though less efficiently than an A. solani population from Japan. The dwarfing strain is transmitted more efficiently than the yellowing strain by all aphids. The American aphids are smaller and more pigmented than the Japanese aphids and exhibit vastly different food preferences. Japanese aphids prefer soybeans while American aphids tolerate soybeans but actively prefer leaf lettuce, curly dock, and wild geranium. All aphids readily colonize Trifolium spp. Nymphs transmitted both strains of SDV equally or more efficiently than adults, while apterae and alatae transmit equally well. Of 120 leguminous accessions tested belonging to 56 species of Cassia, Lespedeza, Lupinus, Medicago, Trifolium, Vicia, and others, 23 were new hosts of the dwarfing strain and 20 were new hosts of the yellowing strain; more than 50% as symptomless hosts.

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ISOLATION OF A BETACAROTENE-PRODUCING CORYNEFORM BACTERIUM FROM SOYBEAN SEEDS AND LEAVES

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A bacterium that produced a yellow pigment was isolated during an assay of soybean seed for the soybean tan spot bacterium, Corynebacterium flaccumfaciens. Seeds (5 g) of each of 10 soybean cultivars (Coles, Steele, Beeson, Marion, Corsoy, Calland, Williams, Woodworth, Clark 63, and Cutler 71) were immersed first in 75% ethyl alcohol for 1 min, then in 0.5% sodium hypochlorite for 15 min, and rinsed in sterile water. Seeds were crushed aseptically in grinding medium in a sterile blender. Bacteria were separated from cellular debris by differential centrifugation, and plated on trypticase soy agar. Field-grown leaves (5 g) of each of the same cultivars were washed, crushed aseptically in grinding medium, and similarly centrifuged, and the bacteria plated. The yellow bacterium was consistently isolated from seeds and leaves of all cultivars in each of 3 years and was determined to be an undescribed species of Corynebacterium. The yellow pigment produced by this bacterium was soluble in methanol, ethanol, and hexane, and was identified spectroscopically as betacarotene. Thirty isolates of the bacterium were non-pathogenic on soybean plants of the cultivars Pella, Fayette, and Cutler 71 which are known to be susceptible to tan spot.

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REACTION OF Vigna mungo and V.radiata TO CYST NEMATODE

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Several species, other than soybean (Glycine max) have been reported to be the hosts of soybean cyst nematode (SCN), Heterodera glycines. The SCN race determination is done on the bases of its reaction on four soybean differentials. The object of the present study was to test selected PI lines of Vigna mungo and V. radiata against races 3, 4 & 5 of SCN. The reaction of the host was based on the number of white females/plant root, counted 30 days after inoculation. Of the 10 lines of V. radiata tested, PI 164.392, PI 179.399, PI 179.707, PI 207.504 and PI 217.953 were resistant; PI 164.301, PI 201.872 and PI 217.955 were susceptible; whereas, PI 140.043 and PI 163.110 were segregating. Among V. mungo lines, PI 211.068, PI 212.615 and PI 219.700 were resistant, while PI 164.423, PI 164.441, PI 214.338 and PI 218.105 were susceptible. Two lines gave differential reaction to the three races and are described below.

	SCN Race		
PI Line	#3	#4	#5
PI 180.466	Resistant	Susceptible	Resistant
PI 212.910	Susceptible	Susceptible	Resistant

PI 212.910 was resistant to race 5 but was susceptible to race 3. Such a combination of reaction has not been reported in soybeans. The genes for SCN resistance in V. mungo would have evolved in a different pattern than those in soybeans.

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PREDICTING THE IMPACT OF SOYBEAN MOSAIC VIRUS IN SOYBEAN

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Soybean mosaic virus (SMV) occurs wherever soybeans are grown. It is transmitted through soybean seed and, under field conditions, by aphids. SMV, a serious production problem in some parts of the world, could become serious in others if and when factors favor its early-season spread. These factors are primarily the density of aphid vectors early in the season and high levels of infection in the seed sown. We sought a method of forecasting the impact of SMV on yield and on seed transmission that would work in most of the soybean producing regions of the world. A dynamic simulation model of SMV was written in Fortran. It uses observed daily aphid landings, soybean planting data, and soybean varietal characteristics as inputs. Harvest time outputs are percentage yield reduction and percentage infected seed; daily outputs include percentage infected plants and percentage source plants. If aphid landing rate information is obtained for several years from a region, and if immigrants are virus free and do not colonize soybeans, this model can be used to compute the safe level of infection in planted seed.

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CHARACTERIZATION OF RESISTANCE IN TWO INCOMPATIBLE SOYBEAN CYST NEMATODE - SOYBEAN COMBINATIONS

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Two soybean cyst nematode (SCN) populations showed differences in development on incompatible hosts. SCN 209 selected and inbred on PI 209332 and SCN 89 selected and inbred on PI 89772 were inoculated in all four nematode-soybean combinations. Synchronous SCN development was attained by growing roots of three day old plants in infested soil for 24 hrs.; they were then washed and transferred to test tubes of deionized water. In various experiments, the plants were either severed below the cotyledons or cotyledons were trimmed to ½ their volume. Aeration was provided to each tube via a pasteur pipette. Plants were maintained at 27 C under 14 hr./day of fluorescent light for 15 or 20 days. Compatible combinations were similar in that ca. 60% of the nematodes that entered the roots matured to adults, both populations showing a 1:1 male-female ratio. SCN 209 on PI 89772 produced only ca. 15% mature nematodes, these were virtually all male. SCN 89 on PI 209332 resulted in ca. 45% mature SCN, the ratio was 2:1 male-female. The females of this combination were smaller and produced fewer eggs than the same population on its selecting host. Stained and cleared roots of all combinations suggests that PI 209332 and PI 89772 arrest SCN development at different stages. PI 290332 resistance apparently does not affect males, many females are arrested as third stage juveniles. PI 89772 arrests male and female development primarily as second stage juveniles.

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FAST-GROWING RHIZOBIUM JAPONICUM SHOW UNUSUAL NODULATION PROPERTIES IN HYDROPONICS

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Several years ago, fast-growing strains of Rhizobium japonicum were isolated in the People's Republic of China. We developed a model system for determining the symbiotic properties of these strains and mutants of these strains to compare them with the traditional slow-growing strains of R. japonicum. Greenhouse studies gave the following results: most North American cultivars show effective nodulation with the fast-growing R. japonicum strain USDA191 and ineffective nodulation with all other fast-growing strains tested, including USDA193, USDA201, and USDA205. An unexpected observation was made when these cultivars and Rhizobium strains were tested in a hydroponic growth system; no nodulation was observed in hydroponics for soybean-Rhizobium combinations that produced ineffective nodulation in the greenhouse. There are many explanations for this phenomenon. To distinguish among the alternatives, we have begun screening combinations of wild-type, fast-growing R. japonicum strains and soybean cultivars possessing mutant host genetic factors controlling symbiosis. We are also testing combinations of cultivars and symbiotically defective R. japonicum strains. Preliminary results indicate that a component in the nitrogen fixation response of the Rhizobium is involved in the nodulation process in hydroponics.

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ECOLOGICAL FIELD STUDIES WITH FAST GROWING R. JAPONICUM STRAINS

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Recently discovered fast-growing R. japonicum strains are effective on cv. Peking[1]. We have recently shown that one of those strains, USDA 191, is partially effective on seven commercial cultivars and forms an effective symbiosis on cv. Williams[2], while others[3] have shown that this strain forms effective nodules on U.S. soybean cultivars. We also have reported results of competition studies with these strains in laboratory studies[4]. We report here ecological field studies with six fast-growing R. japonicum strains applied at two inoculum levels on cultivars Peking and Jacques 130 in two mid-Western soils, containing high indigenous Rhizobium populations. Strain establishment was measured by selecting nodules, 40 and 80 days after planting; nodule occupancy was ascertained using antibiotic labelled strains. On cultivar Peking, two of the fast-growing strain formed greater than 60% of the nodules in both soils. None of those strains were competitive on cv. J130.

(1) Keyser H. H. et al. (1982) Science 215:1631-1632.
(2) McLoughlin, T. J. et al. (manuscript in preparation).
(3) Yelton, M. M. et al. (1983) J. Gen. Micro. 129:1537-1541.
(4) McLoughlin, T. J. et al. In: Advances in Nitrogen Fixation Research. C. Veeger and W.E. Newton (eds.) Nijhoff/Junk Pudoc., p. 422.

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SOYBEAN CULTIVAR-RHIZOBIUM STRAIN SPECIFICITY AND INTER-STRAIN COMPETITION IN EARLY-MATURING (00 and 000) SOYBEANS.

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Early-maturing soybean cultivars (groups 00 and 000) adapted to western Canada are now available but since the soils contain no indigenous R. japonicum, it is important to determine if strains selected for efficient N_2 fixation are adapted to Canadian cultivars and if single strain are superior to multistrain inoculants. R. japonicum strains 61A148 and 61A118 were consistently superior while 61A101 was an inefficient N_2 fixer. This efficiency was not related to the ability to take up H_2 evolved by nitrogenase. ^{15}N isotope dilution showed several strains to result in $\%N_2$ fixed exceeding 50% with N_2 fixed as high as 151 kg N ha^{-1} for strain 61A148 on King Grain Line X005. Soybean cultivars varied in their ability to support N_2 fixation by a wide range of rhizobial strains. Maple Amber was superior to X005 and Maple Presto. Cultivar-strain combinations resulting in lower N_2 fixation assimilated more soil N such that final N yields varied only slightly. Inter-strain competition occurred in multistrain inoculants to the detriment of plant yield. In spite of a shorter, cooler growing season, N_2 fixed was high in these Canadian soybeans, equal to N_2 fixation in US soybeans.

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FERTILIZER N LEVELS, RHIZOBIUM STRAINS EFFECT ON SOYBEAN N_2 FIXATION.

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It is well known that the efficiency of legume/Rhizobium symbiosis depends on compatability, but also on the environment conditions. The depression of N_2 fixation by the symbiotic systems as a result of addition of combined N has been investigated (Clayton et al., 1958; Giöbel, 1926; Harper, 1971; Webber, 1966). The present experiment was designed, using N labelled fertilizer to study the influence of Rhizobium strains, levels of N fertilizer (mineral N) and high level of fertilizer N immobilized by addition of carbon source (molasses) on growth, N_2 fixation, dry matter accumulation and yield of two promiscuous and one conventional soybean cv Glycine max (L) Merr. grown in Zambia. The results indicate that: (1) promiscuous nodulation under the conditions of this study did not provide enough N to the soybean crop and that N_2 fixation and yield can be increased by inoculation; (2) the application of 20 kg N/ha does not affect the amount of N fixed (which remain high) while it decreases substantially at 100 kg N/ha. In contrast, when 100 kg N/ha is immobilized by addition of molasses, as carbon source, the amount of N fixed remain high (80%). The problem of non nodule control is also discussed.

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INTERACTION OF SOYBEAN, RHIZOBIUM JAPONICUM STRAIN, AND SOIL AND WATER MANAGEMENT

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Improved soybean dinitrogen fixation and yield by the introduction of "superior" strains of Rhizobium japonicum have been investigated. Field and laboratory investigations with determinate soybean grown on sandy soils in the Southeastern Coastal Plain of the United States have shown the importance of interactions among soybean cultivars x Rhizobium japonicum strain x soil and water management practices. As a result of these interactions, inoculations with "superior" strains have produced both positive and negative results for both N accumulation and yield. Irrigation, conservation tillage, row orientation, and row width have been investigated. Depending upon the season, cultivar, and strain, all these management conditions have produced statistically significant differences. Soil water, soil temperature, soil pH, and canopy light quality are believed to be among the most influencial environmental factors. R. japonicum strain 3I1b110 seems to be one of the environmentally-sensitive strains; while strain 587 seems to be one of the least environmentally-sensitive strains.

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NODULATION AND N-FIXATION OF GROUP 000 SOYBEAN AS INFLUENCED BY STRAINS OF R. JAPONICUM

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The development of Group 000 cultivars of soybeans adapted to cool and short growing seasons have accelerated soybean production on the eastern Canadian prairies. There are however several production problems that need to be solved, chief of which is the low seed protein content. Previous investigations have determined that the problem is not genetic but may be due to a low level of N-fixation activity. In this study 7 pure strains and a commercial mixture of R. japonicum were evaluated in association with two cultivars of Group 000 soybeans (cv. Maple Presto and Maple Amber) for nodulation and N-fixation efficiency. Inoculated and uninoculated plants were grown in large pails outdoors. Soil temperature was monitored throughout the experimental period. At the 1st trifoliate, 2nd trifoliate, flowering and podding stages of growth whole plants were removed from the pails. Nodules were counted and weighed; roots and tops were separated weighed and analyzed for total-N. Four strains of R. japonicum were identified as being superior to the commercial mixture and the other strains in earliness of nodule formation, nodule numbers and weight, and are credited in promoting greater root and top growth and nitrogen accumulation in the plants. Maple Amber had the greater potential for symbiotic nitrogen fixation. This cultivar was capable of supporting a greater number and weight of nodules than Maple Presto, partly because of more rapid root and top growth. The result was that Maple Amber accumulated more nitrogen than Maple Presto.

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EFFECT OF PHOSPHORUS ON NODULATION OF SOYBEAN IN THE RHODUSTALFS

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Effect of phosphorus fertilization on nodulation of soybean (Glycine max (L.) Merill) was investigated in field experiments conducted during two seasons in Rhodustalfs (well drained - Reddish Brown Earths) in the dry zone of Sri Lanka. Five levels of phosphorus (0, 27, 54, 81 and 108 kg/ha P_2O_5) in the form of concentrated super phosphate were tested with inoculated and uninoculated soybean variety Pb-1. The ten treatments in factorial combination were arranged in a randomized complete block design with four replicates. Number of nodules per plant and nodule dry weight were determined to estimate the nodulation of soybean. Effective nodulation was observed in all the treatments and the effect of phosphorus on above two parameters of nodulation was highly significant. Increasing rates of P application raised nodule number and nodule weight during both seasons.

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SIMPLE TECHNIQUE FOR PRODUCTION OF RHIZOBIUM INOCULANTS FOR DEVELOPING COUNTRIES

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Simple media containing raw cane sugar and molasses are developed for culturing Rhizobium japonicum and Rhizobium of other legumes. Rhizobia are cultured in one liter serum bottles containing 500 ml of liquid

medium each. These bottles are mounted on dishes on a simple shaker which has an axis bearing 4 dishes. The assembly is mounted on an iron frame in such a way that the axis forms an angle of 40 degrees. The shaker is rotated by an electric motor equipped with a speed reducing gear. Four dishes hold 120 one liter serum bottles to produce 60 L of Rhizobium per batch within 3 to 6 days, the population of Rhizobium reaches 10^8 to 10^9 cells/ml in raw cane sugar media. Rhizobium culture is then mixed with fine peat powder. The shaker is easily made by any auto repair shop using regular iron bars and iron sheets. This technique is adapted well for village-level production of Rhizobium inoculants with low cost and minimum technical training.

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A HIGH ACTIVE RHIZOBIUM JAPONICUM STRAIN PRC 113-2

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Since 1972 for soybean cultivars a wide-ranging R. japonicum strain PRC 113-2 with high efficiency of energy utilization (Rel.Eff.=95-100%) and N_2-fixation (Increase in total N over that of uninoculated control was twice) has been selected through laboratory identifications and water culture tests for 1,313 strain-times in all, and multilocation trials of different cultivars inoculated with soybean strains in field. The PRC 113-2, isolated from nodule collected from cv. Hou-Zi-Mao is not homologous with other 12 serogroups tested, and more competitive, higher N_2-fixed and yield than another. Summarizing results at 24 sites, soybean cultivars sowing in spring, summer and/or autumn inoculated with the PRC 113-2 produced significantly (p 0.01) higher yield than the uninoculated control. The increase in yield ranged from 10.8 to 18.5%, or 25.3 to 28.3% jin/mu. The PRC 113-2 has been spreaded and used in some parts of China.

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EFFECT OF INOCULATION AND FERTILIZER APPLICATION ON SOYBEAN IN BANGLADESH

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Effect of applied N,PK or NPK and Rhizobium inoculation on soybean (Glycine max (L.) Merrill) was studied by several field trials during 1981-83 in a Eutric Fluvaquent soil (pH 6.8) of Bangladesh. Application of 100 kg N/ha produced significant increase in 100 grain weight and grain yield of Bragg soybean as well as dry matter weight, N uptake by plant tops and 100 grain weight of Davis soybean. The effect of PK applied at the rate of 100 kg P/ha and 100 kg K/ha was not significant while application of NPK resulted in considerable increase in N content and grain yield of Davis variety. In another field trial, the effects of 0, 10, 20 and 40 kg N/ha application on different crop characters were found statistically identical except that 40 kg N/ha gave higher N content in plant tops over 0 nitrogen treatment in Davis soybean. Rhizobium inoculation was found highly beneficial to produce number and weight of nodules, dry matter weight, N content and N uptake by plant tops, number of pods, 100 grain weight and grain yield of the crops. Rhizobium inoculation in absence of applied fertilizer produced 2037 kg/ha of grain yield compared to 1078 kg/ha and 1207 kg/ha recorded in 100 kg N/ha and 100 kg each of N, P and K/ha applications, respectively in 1981 field trial. In all cases Rhizobium inoculation produced better results than N, PK or NPK applications.

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INFLUENCE OF LIMING AN ULTISOL ON GROWTH AND YIELD OF SOYBEAN

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High acidity in some soils of the humid tropics is one of the factors which tend to reduce soybean yields. Field studies were carried out to determine the extent to which liming influences growth, nodulation and yield in inoculated and uninoculated soybean (variety Pb-1) grown in an ultisol of p^H 4.2. Lime was applied at the rate of 3 tons/ha and growth and nodulation were monitored over the whole growing period. Liming of inoculated plants caused better growth, increased nodulation and produced significantly higher yield (3528 kg/ha) than the unlimed inoculated plants (yield - 2658 kg/ha). Inoculation alone did not promote growth or nodulation nor produced higher yield (2522 kg/ha) compared to the uninoculated control (yield - 2420 kg/ha).

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FUNGICIDE TREATMENT AND RHIZOBIUM INOCULATION OF SOYBEANS UNDER SUB-TROPICAL CONDITIONS

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Seed treatment with a suitable fungicide is a must to ensure a good field emergence of soybeans in the warm and humid parts of the world. Soybean seeds treated with six commonly used seed treatment fungicides and inoculated with R. japonicum were planted at 0, 4, 24, 48 and 72 hrs after treatment to study their effect on emergence, nodulation, 1000-grain weight, and yield under Indian conditions. The field trial was conducted for 3 years. On planting immediately after treatment no adverse effect on emergence, nodulation, 1000-grain weight, and yield was noticed with any of the fungicides. However, significantly higher field emergence, and nodulation was obtained by seed treatment with Difolatan, Dithane M-45, thiram, and captan. All fungicides, except PCNB, increased the plot yield significantly. In general, as the sowing of the treated and inoculated seed was delayed a corresponding reduction, depending on the fungicide, in emergence nodulation and yield was noticed. Comparatively greater reductions were observed in case of the delayed plantings of the untreated but Rhizobium inoculated seed. No significant adverse effects were seen by planting within 48 hrs of treatment and inoculation of seeds. However, in order to ensure the maximum field emergence, nodulation, and yield, the thiram, Difolatan, and Dithane M-45 treated and Rhizobium inoculated seed must be planted within 4 hrs after the treatment.

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RESPONSE OF SOYBEANS TO NITROGEN FERTILIZER AND INOCULATION. H.A.Al-Dulaimi,T.A. ESSA, B.A.Al-Ithawi,Field Crop Dept.,College of Agric., Univ. of Baghdad,Abu-Ghraib, Iraq.

This study was conducted over a 2-years period (1980-1981) at sites never been planted soybeans to investigate the effects of nitrogen fertilizer and inoculation on yield and other characters of soybean. Five levels of nitrogen (0,40,80,120,and 160 kg/ha) were used with or without inoculum. Rhizobium inoculation significantly increased seed yield,number of pods/plant, seed weight,and plant height in both years. Increasing nitrogen rate from zero to 160 kg/ha gave significantly linear incrase in seed yield,number of pods,seed weight, and plant height in 1980,however nitrogen had no effect on these characters in 1981. The lowest shriveled seeds was obtained from inoculation and higher nitrogen levels. Nodules formed only on soybean plants received inoculum. Low N rate increased coexistance activity and N fixation by bacteria. Inoculation resulted in lower oil content and higher protein content.

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ASSAY OF INTRINSIC COMPETITION IN SOYBEAN GROWING SOILS BY ASYMBIOTIC RHIZOBIUM

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Fourteen sites of soils in which soybean had been grown with inoculation from various sources for over a decade were sampled. A 10 g sample was inoculated with the broth of the asymbiotic strain R. japonicum CB 1809 at the rate of 1000 million cells, and incubated. A one-hundred thousandth dilution of the original and the inoculated soil were tested for nodulation with the nodulating genotype of Clark 63. Nodules were serotyped with the antiserum of the asymbiotic rhizobium, to reveal the results of success of the inoculant strain. Although the competition was the least in inceptisols but it was of varying degree in vertisols of varying history of R. japonicum population. The use of an asymbiotic rhizobium strain lent itself as a tester of competitiveness.

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WORLD SOIL EROSION: PROBLEMS AND SOLUTIONS

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Sufficient evidence exists to warrant a high priority be given to soil erosion control worldwide. Erosion reduces soil productivity and deteriorates the quality of our environment. World soil erosion must be viewed in the context of the growing world population and a finite soil resource that is subject to forces of degradation. It is our thesis that the determination of the adequacy of the world's soil resources requires three things: 1) estimates of the inherent productivity of the world's soils, their distribution, and areal extent; 2) knowledge of the rate of change in productivity due to the many processes that threaten to degrade it; and 3) the rate of occurrence of the degradation process, i.e., erosion. Because soil erosion is dynamic, the effects of erosion on soil productivity are best viewed in terms of its rate of change. However, the sensitivity of soil to changes in its properties to erosion and the rate at which these changes occur are documented for only a few soils. Too few measurements have been made to obtain a statistical picture at the global level. Probing each of the three areas revealed that great strides are needed in each one. In spite of lack of necessary data and the time needed to obtain that data, critical decisions need to be made now and hopefully the best information will be used to make those decisions. In addition, non-technical constraints to soil conservation must be overcome to meet the challenge presented by erosion.

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INTEGRATED PEST MANAGEMENT IN SOYBEAN PRODUCTION SYSTEMS. A HOLISTIC VIEWPOINT.

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Most disciplines have developed management philosophies (integrated pest management, farm management, fertility management, etc.) that optimize single aspects of soybean production but fail to take a comprehensive approach. Consequently, adoption of new innovations is slow because farmers must empirically assess appropriateness to their production system. Clearly a integrated commodity-based approach is needed. The process begins by describing production site attributes, and the decisions required to produce the crop at that site. Models, if such exist or can be developed, are useful here to further describe system components and simulate various management strategies. Production system descriptions provide an interface between research and extension and facilitate joint research and implementation planning. Using the descriptions, researchers may evaluate the current production system for weaknesses and identify and prioritize research needs and minimum required data sets. Extension specialists use the descriptions to determine delivery requirements based on the type of decision aids proposed, the quantity and complexity of information, and clientele characteristics. Experiences in both developed and less developed countries are discussed.

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BREEDING SOYBEANS FOR PROTEIN QUANTITY AND QUALITY

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Protein is the seed constituent which gives the soybean crop its greatest value. The protein produced, though of a high quality, contains less of the sulfur containing amino acid, methionine, than that needed for proper animal nutrition. Plant breeding has been used to increase the protein quantity in soybean seeds and also to improve the protein quality. In 12 separate studies involving 32 populations of random lines from 2-, 3-, and 8-way crosses, heritability estimates for percent protein ranged from 0.39 to 0.96. The average heritability estimate was 0.80. Depending on methods and the genetic populations used, progress expected from selection for increased percent protein has ranged from 1.5% to 7.7% of the population mean. A difficulty of selection for increased protein has

been the existence of negative genetic correlations between protein and two other economically important traits, oil and yield. Reported occurrences of positive correlations between yield and percent protein, suggest that both traits can be increased simultaneously. Backcross, pedigree, index, recurrent and indirect selection methods have all been used to increase percent protein. Soybean germplasm with higher than average concentrations of methionine in the protein has been identified. N/S ratio, S content and direct measurement of methionine have been investigated as selection criteria for increasing methionine in seed protein. Increasing the protein content of seeds has not caused changes in methionine concentration. Thus, it should be possible to develop cultivars with both higher seed protein percentage and increased methionine concentration.

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ANTI-NUTRITIONAL FACTORS IN SOYBEANS:GENETICS AND BREEDING

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Raw mature soybean seeds contain anti-nutritional factors such as protease inhibitors, lectins, goitrogens, cyanogens, anti-vitamin factors, phytic acid, saponins and estrogens. Breeding to reduce anti-nutritional factors in soybeans is an extremely complex problem. Nevertheless investigations on the elimination of certain anti-nutritional components of soybean seed have been successful specifically, the Kunitz trypsin inhibitor and lectin. Much of the trypsin inhibitor activity in seed is thought to be due to the Kunitz trypsin inhibitor. Four electrophoretic forms of the inhibitor were discovered in the U.S. soybean germplasm collection. Three of the forms $\underline{Ti}^a$, $\underline{Ti}^b$, and $\underline{Ti}^c$ are controlled by a codominant multiple allelic system at a single locus. The fourth form does not have the inhibitor and is inherited as a recessive allele (ti). Yield trials of cv Williams near isolines without the Kunitz trypsin inhibitor suggest that the removal of the inhibitor does not affect yield, protein, or oil content in seed. Seed of the U.S. soybean germplasm collection were screened for the presence or absence of lectin. The presence of lectin is controlled by a simple dominant gene designated Le: the homozygous recessive allele le le results in the lack of lectin.

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BREEDING SOYBEANS FOR SPECIAL END USES

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The most important limiting factor to use of soybeans as a human food is the presence of 4-12% linolenic acid in the oil. Studies of soybeans and related species have shown no genotypes with linolenic acid levels low enough to eliminate this problem. Recent Australian work with linseed has identified mutants with only 0.5% linolenic acid compared to the 45-60% linolenic acid present in commercial linseed genotypes. Elimination of linolenic acid from soybean seed would also produce an oil ideally suited for use as a liquid fuel in diesel engines. Improvement of soybean seed composition for production of tofu, tempeh and soy milk is hampered by lack of rapid, reproduceable methods for identifying desirable seed composition. The ratio of 7S to 11S proteins influences tofu quality but can be largely overcome by varying calcium sulfate concentration used in manufacture. Flatulence is a serious problem in human food use of soybeans and is related to stachyose and raffinose content. Genotype variation in content of these oligosaccharides has been identified. Variation in cookability has also been identified. Long cooking time to produce a soft edible product greatly increases energy costs either in the factory or the home. Much greater emphasis must be placed on developing soybean genotypes which overcome deficiencies in relation to their use as human food. Elimination of expensive technology associated with hydrogenation of oil, inactivation of trypsin inhibitor and lipoxygenase has great potential to increase use of soybeans as a human food in developing countries and reduce processing costs in developed countries. Top priority should be given to elimination of linolenic acid.

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BREEDING SOYBEANS FOR IMPROVED OIL QUANTITY AND QUALITY

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Soybeans account for 50% of all oil seeds produced and 30% of the total supply of all vegetable oils in the world. Commercially grown soybean cultivars contain about 20% oil in the seed, a quantity that has been unchanged for 50 years. Oil content of the seed is controlled by the maternal parent rather than by the embryo. Oil content is controlled primarily by additive genetic effects and is more highly heritable than many other quantitative characteristics of soybeans. Recurrent selection has been effective in increasing oil content 0.35% per cycle for three cycles of selection. Soybean oil contains palmitic, stearic, oleic, linoleic, and linolenic acids. Breeding for improved oil quality has been concentrated on lowering the linolenic acid content of the oil. Recurrent selection and mutation breeding have successfully altered fatty acid composition of the oil. High stearic acid (28.1%) and low linolenic acid (3.4%) mutant lines have been identified. Oil quality may be further improved by removing lipoxygenase isoenzymes from the seed. Strains of soybeans lacking L-1, L-2, and L-3 have been identified, and the presence of L-1 and L-3 are controlled by single dominant genes. Economic incentives to insure profitable production of cultivars with unique oil properties are needed to stimulate the development of these cultivars.

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CARBON AND NITROGEN PARTITIONING IN SOYBEAN LEAVES DURING SEED FILLING

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Cellular aspects of carbon and nitrogen assimilate production, partitioning, and compartmentation in soybean leaves during seed filling will be addressed. The unique roll of the specialized paraveinal mesophyll in the synthesis, transport, compartmentation, and remobilization of nitrogen reserves in leaves in relation to reproductive growth will be examined. In addition, differential storage of carbohydrates among various leaf cell types will be characterized. It is concluded that a unique spatial and temporal compartmentation of both carbon and nitrogen assimilates exists in soybean leaves during seed fill. These events will be discussed in terms of the factors which influence assimilate export from source leaves.

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ASSIMILATE TRANSPORT AND SOYBEAN SEED DEVELOPMENT

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The controls of assimilate import and utilization by developing soybean seeds represent an important aspect of seed yield. These processes involve the transfer of assimilates between maternal (seed coat) and embryonic (cotyledon) tissues that are not cellularly linked. At least two of the transport steps involve carrier-mediated, energy-dependent processes: the unloading of assimilates from the phloem within the seed coat, and the subsequent active accumulation by the cells of the cotyledons. Both the import of assimilates and their utilization for seed growth and storage product formation are controlled by genetic and environmental constraints.

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AMINO ACID AND SUCROSE EFFLUX FROM SOYBEAN LEAVES

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Soybean seeds are highly dependent upon nutrients that are translocated from leaves. However, there is a dearth of information regarding nutrient efflux from leaves. We studied the nature of amino acid and/or sucrose efflux using discs and cells isolated from leaves of glasshouse-grown, reproductive soybean [Glycine max (L.) Merr.] plants. Total net amino acid efflux from isolated cells was not affected by pH, $[K^+]$, or current photosynthesis, thus, indicating that efflux occurs via diffusion. Analysis of individual amino acids showed that alanine, lysine, leucine, and glycine were exported fastest. Because the rate at which an amino acid was exported was not directly related to its intracellular concentration, efflux from isolated cells likely occurs via a selective, controlled diffusional process.
Total net amino acid efflux from leaf discs was 50 to 90% slower than sucrose efflux and data indicated that the two processes occur via two different mechanisms. Whereas net sucrose efflux was promoted by light and showed a positive hyperbolic response to pH and $[K^+]$, total net amino acid efflux was not affected by pH or light, and responded only slightly to $[K^+]$. The sulfhydral group inhibitor p-chloromecuribenzene sulfonic acid inhibited net sucrose efflux but accelerated total net amino acid efflux. These results suggest that transmembrane flux of sucrose is controlled by its efflux mechanism whereas amino acid flux is controlled by its influx mechanism.

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EXPORT OF NITROGENOUS COMPOUNDS FROM SOYBEAN ROOTS

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Soybean stem exudate contains a very wide range of organic compounds. The principal components are asparagine, allantoate, and allantoin. Nitrate is also a major component when plants are supplied with nitrate, especially during vegetative stages. The ureides in stem exudate originate in nodules but the source of other reduced N in exudate is less certain. It may represent nitrate reduced in roots or amino N which arose from nitrate assimilation in shoots.

A method to replace acetylene reduction assays is needed to estimate N_2 fixation in field studies involving large numbers of comparisons. The analysis of ureides in stem exudate or shoot tissues may provide a useful alternative to acetylene reduction and ^{15}N-based procedures. While an accurate and reliable system for exploiting ureide content to estimate N_2 fixation has not been perfected, recent studies suggest that such a system should be possible.

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SOYBEAN SEED PROGRAM OBJECTIVES AND CHALLENGES

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Lack of seed and poor seed quality are major constraints to the expansion and stabilization of soybean production in the humid tropics. Overcoming these constraints is more difficult for soybeans than other crops because soybean seed are more delicate and shorter lived than other seed kinds. The problems, however, can be resolved and have been in some countries. Seed production and supply programs for soybean seed must take into account the scale and orientation of the production. Relatively sophisticated seed production, conditioning and storage systems are needed and have been established to support concentrated commercial production. Much simpler, less costly and more innovative seed supply systems, however, are needed to support the widespread introduction or extension of soybean production among essentially subsistence farmers to improve the nutritive balance of the food they produce for home consumption. Major challenges related to soybean seed supply are the development of acceptable seed types with increased tolerance to field and storage deterioration, and the improvement of seed saving and "diffusion" procedures and practices at the farmer and village levels. The challenges need to be seriously addressed because achievement of the goals is possible, and the benefits would be extraordinary.

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SOYBEAN SEED PROGRAMS IN LATIN AMERICA

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Brazil, Argentina, Mexico and Paraguay are the major soybean producing countries in Latin America, followed by Colombia, Bolivia, Ecuador, Uruguay and Peru. Improved soybean seed use rate in these countries vary from nearly 100% in Colombia and Brazil, down to almost zero in Peru, where the program is just starting. Seed Certification is the most widely adopted quality-guarantee production system. " Seed Inspection" an alternative system, closely related to Seed Certification is responsible for controlling the quality of the majority of the seed produced in Brazil and Paraguay;it differs from Certification by lacking generation control and also giving to seed producers the responsibility over seed quality control, under the supervision of a public office.Both systems are operated by governmental agencies.Although plant variety protection legislation has already been sanctioned in Argentina, Bolivia, Mexico and Uruguay, almost all soybean cultivars currently in use in Latin America were introduced or developed by public institutions. Great efforts have been developed by governments in Latin-American countries to establish a minimum infra structure for cultivar development and testing, seed production and marketing control. There is, however, need for clear governmental seed policies, training of personnel, research in seed technology to solve

production and storage problems under a wide range of environmental conditions, intensifying seed marketing control, and specially to make provisions and establishing incentives to get the private sector further involved in the program.

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SOYBEAN SEED PROGRAMS IN SOUTHERN AFRICA

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Soybean (Glycine max (L.) Merr.) is increasingly becoming an important crop in several African countries. The success of the crop will be contingent upon an adequate supply of reliable seed. Utilization of soybean in foods, stockfeeds and extraction of cooking oil will engender a demand for increased production. The environment of both large and small growers in soybean production will necessitate development of appropriate varieties. Fungal and bacterial leaf diseases, proneness to shattering and lodging, poor seed longevity as well as the need for promiscuously nodulating varieties constitute currently recognized biological constraints. There is a great diversity in the completeness of seed programs in Africa. Whereas some countries have comprehensive seed programs, others have none. Zambia, Zimbabwe, Malawi and Tanzania have seed regulations and standards which include field and seed quality requirements. Seed quality standards generally require a purity of 98 percent and germination of 75 percent. Seed growers are required to register and their crops are subject to inspection and certification. Where unavailable, minimum facilities for an adequate supply of good seed will need to be established in order to ensure the success of soybean production.

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SOYBEAN SEED PRODUCTION IN ASIA

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In Asia, a major factor limiting increased soybean production and yields is lack of good-quality seed of high-yielding cultivars. As seed production in hot humid climates is risky, losses are high and returns are low, this constraint will exist until suitable organizational structures are developed to emphasize supply of quality seed of improved cultivars, and the technology necessary to provide good seed quality under existing climates can be applied. The organization must have the facilities, funds and highly-trained staff required to carry out essential seed operations without delay and at the necessary level of technology. Research, seed production, promotion, and seed supply must be closely coordinated. Special incentives should be offered to seed producers and farmer seed-users. Crop rotations should permit seed harvest during dry periods; seed should mature properly and then be harvested and dried immediately, conditioned, packaged and placed in protective storage without delay. Storage must provide the conditions (temperature and moisture) required to protect seed until needed for planting. Recommendations for soybean seed programs and operations in tropical and subtropical Asian regions are offered.

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SOYBEAN ANTHRACNOSE. Paul R. Hepperly, College of Agricultural Sciences, University of Puerto Rico, Mayaguez 00709.

Soybean anthracnose is a disease of increasing importance. This is partly due to increased soybean production in tropical and subtropical areas. Prolonged high humidity, rainfall and temperature appear to favor severe anthracnose. Calcium deficiency and weeds predispose soybean plants to increased anthracnose. In the short term, fungicides can be used in control of soybean anthracnose and will reduced seed quality and yield losses. Increased monitoring and prediction of soybean anthracnose epidemics will help reduce unnecessary applications of foliar fungicides on soybeans. Research efforts should focus on increasing soybean resistance to anthracnose. In breeding programs sources of resistance must be identified, inheritance determined, and its durability established. Controlled inoculations under environments modified to favor anthracnose will favor the establishment of consistent epidemics necessary for breeding work. Basic studies of the biology of anthracnose fungi will be helpful in discovering new control methods.

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EPIDEMIOLOGY OF SOYBEAN DOWNY MILDEW

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Downy mildew, caused by Peronospora manshurica, is a prevalent soybean (Glycine max) foliar disease. The fungus infects leaves, grows within the plant by producing mycelium with haustoria, invades pods, and covers seeds with a crust of oospores. Secondary inoculum, consisting of sporangia, is produced on the underside of infected leaves. Sporangia are disseminated readily throughout the growing season. Downy mildew often reduces seed quality but does not significantly reduce soybean yield in Illinois. In 1981, a new race of P. manshurica occurred in the Illinois soybean disease monitoring plots. The new race was designated as race 33 and was virulent on the soybean cultivar Union, which carries the gene Rpm for resistance to the 32 previously described races of P. manshurica. Five cultivars (Pridesoy, Palmetto, Kabott, Ogden, Acadian) from a set of differential cultivars and three additional cultivars (Fayette, Tracy, PI88788) were resistant to race 33.

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SOYBEAN RUST RESEARCH: AN INTERNATIONAL REVIEW

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Soybean rust is a major disease that limits soybean production in the tropics and subtropics of Asia. The disease is also a potential threat to soybean production in other tropical areas and in the soybean growing regions of the southern USA. Rust causes small lesions (<2 mm^2) that are tan to dark or reddish brown. Lesions contain variable numbers of uredia that exude spores through a central pore. Rust lesions can be confused with bacterial pustule. Telia and teliospores are produced at day temperatures of 20 to 25°C with night temperatures of 5 to 15°C. Germination of teliospores and their role in epidemiology are unknown. The optimum temperature for rust development is between 18 and 26°C with 6 or more

hours of leaf wetness, depending on temperature. Mean night temperatures below 14°C and mean daily temperatures above 27°C retard or prevent rust development, regardless of leaf wetness. Both race specific and rate-reducing resistance have been identified. Three genes for specific resistance have been characterized and several more have been implicated. However, rust races compatible with all except one source of resistance have been identified. Wide variations in tolerance to rust has been reported. Exploiting tolerance appears to be the most promising approach for reducing yield losses due to rust. An International Working Group on Soybean Rust (IWGSR) was organized in 1976. The IWGSR publishes the Soybean Rust Newsletter.

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POWDERY MILDEW, A SPORADIC BUT POTENTIALLY DAMAGING DISEASE OF SOYBEAN

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Powdery mildew of soybean occurs in most regions of the world where soybeans are grown. However, this disease has a history of occurring in a sporadic manner. Although the disease was reported in the United States in 1931, it was not reported to be epiphytotic until the 1970's. Powdery mildew of soybean is caused by the fungus Microsphaera diffusa, although some confusion persists that Erysiphe polygoni may also cause a separate powdery mildew of soybean. The disease cycle of powdery mildew in soybean is poorly understood; e.g., it is not known where and in what form M. diffusa survives in the absence of a host. Powdery mildew develops earlier and more rapidly when maximum air temperatures are below 30°C. Conidia are abundantly produced on susceptible cultivars and the disease can develop rapidly when environmental conditions are favorable. Two forms of resistance have been reported; virtual immunity and a form referred to as adult plant resistance. The latter form of resistance is inherited as a single dominant gene. In the field, both forms of resistance are very effective for control to prevent potential yield losses of 10-26%. Yield losses of this magnitude have been estimated from the difference between fungicide treated and untreated susceptible soybean cultivars. Fungicides are available and offer control, but prediction of their need and timing of their application is not well understood. Host resistance is a very effective control, but physiologic races of M. diffusa may exist in nature.

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SOYBEAN PRODUCTION AND UTILIZATION IN SUB-SAHARAN AFRICA

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Within the past 25 years the interest in soybeans in Africa has increased to the point where virtually all African countries are producing soybeans or have soybean research programs. Goals of soybean production are to improve human diets, develop a local source of cooking oil and animal feed, and export. Constraints to increased production include unfamiliarity of the crop to local farmers and housewives, lack of processing facilities, shortage of adapted high-yielding varieties, unavailability of inoculant, and poor seed viability in storage especially in humid areas. The potential growing area is vast and includes the savanna zones and mid-altitude highlands. Currently Nigeria has the largest area in soybean production followed by Zimbabwe, Zambia, Zaire, Rwanda and Uganda. Aggressive programs are underway in Cameroon and Benin to promote production and local utilization. Senegal, Ethiopia, Ivory Coast, and Togo have active research programs. With the recent development of tropically adapted high yielding varieties in Senegal, Zimbabwe, Nigeria, and Zambia and with improved seed longevity and promiscuity, most biological constraints to soybean production have been eliminated. Insect pests and diseases though widespread are so far only localized constraints. Soybeans are becoming increasingly popular in local diets, and plans are underway to develop traditional dishes using soybeans and commercial processing methods appropriate to Africa.

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SOYBEAN PRODUCTION IN ASIA

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Soybean production in Asia is concentrated in East and Southeast Asia, with China as the major producing country. New production areas are developing in South Asia. From 1977 to 1981, Asia devoted to soybean production an annual hectarage of 12.24 million which gave a total production of 12 million mt with an average yield of 986 kg/ha. In spite of this production, Asia had to import 2.67 million mt of raw beans, 1.26 million mt of oil and 0.94 million mt of cake and meal to meet requirements.

In Asia, soybean farming is largely intensive and subsistent. It is grown as a sole crop or intercropped with other upland crops. Its cultivation after rice is based on stubble planting relying on residual moisture or flush irrigations.

Soybean is beset by several problems, among which are rapid loss of seed viability causing poor stands of the crop, pests such as the beanfly and pod borer, and diseases such as yellow mosaic virus in South Asia, and rust in most of Asia. Work on varietal resistance to pests and diseases needs to be intensified and sustained. Varietal adaptation to different latitudes, growing seasons and cropping systems needs to be systematically worked out. Inoculation with Rhizobia is not widely practiced. Much work is needed to understand nodulation and rhizobial action in the tropics. Manpower supply in Asia is short and there is a need to organize collaborative undertakings that will address common problems.

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PRODUCTION, CULTURAL PRACTICES AND UTILIZATION OF SOYBEAN IN EUROPE.

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Temperatures convenient to soybean yields competing with other intensive plant productions (cereals, industrial crops) are only found in the Southern part of Europe. Water shortage is frequent in such areas, where irrigation is not applied in a very large extent ; ecological characters mainly explain the small European production. Acreage is however significantly expanding in several countries : Romania, Yugoslavia, Bulgaria, Italy, Hungary, France... Many other countries have research and even breeding programs on soybean. Undetermined types of groups 00-II are mainly used, partly with varieties developed in North-America. There are no native Rhizobia in soils, and inoculation is practiced where no soybean was previous-

ly cropped. Weed control is generally made by chemicals, and arises some problems. But the main research subjects are adaptation to low - and variable - temperatures (primary condition of expansion in Europe), drought tolerance and water use efficiency with or without irrigation, and nitrogen nutrition, interacting with water status. More basic works on physiology are also pursued. Till now plant protection is not a too great problem. Meal utilization greatly increased in the last decades, especially in E.E.C., with increasing animal proteins in food ; oil is less determinant. Some other species could also contribute to animal feeding.

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SOYBEAN PRODUCTION IN SOUTH AMERICA

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Soybean is a very recent crop in South America. In the last twenty years its production has reached values that allowed South American countries to compete with traditional producers in the international market. In 1976, South America ranked second among the soybean producers in the World, being overcome by North America. In the beginning of the 70's, China was surpassed by Brazil, whose production has been the second largest in the World. Besides Brazil, Argentina and Paraguay has reached an oustanding position among the ten most important producers. Other countries, such as Bolivia, Chile, Ecuador and Peru, have shown a much less accelerated production growth, but they may change this figure in a near future, since there are available land that can be easily cultivated with the crop. The majority of the South American countries produces soybean with the purpose of exporting, but the situation has changed after the construction of a great number of industries. Soybean oil consumption has increased as well as the use of soybean meal for feedstuff. Chile presents the special circumstance of having most of the produced soybean utilized for human consumption; the production areas in this country are mainly concentrated on irrigated lands. The majority of the cultivars was developed in South America, and exchanged among the countries, trying to fullill the agronomic needs of a particular zone. Certain cultural practices were developed, and have contributed to higher yields. The possibility of the utilization of new areas may increase soybean production in the near future, if an effective governmental policy is adopted.

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USE OF TISSUE CULTURE AS A TOOL IN SOYBEAN IMPROVEMENT

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At present, the regeneration of soybean plants from cell culture is not a practical method for producing new cultivars of transformed or engineered plants. However, new advances in soybean tissue culture have created genetic and cellular tools for use by plant breeders, biochemists and physiologists. Among these tools, one of the most powerful is the production of partial haploid cells. Such cells provide a rapid tool for mapping qualitative markers to particular chromosomes. Hybrid plants are prepared by standard sexual crosses. Subsequently cell lines are prepared from these plants as well as from the parent germplasm. Biochemical, physiological and molecular markers are then established for these parent and "hybrid" cell lines. Loss of chromosomes from the hybrid cell line may reveal a particular parental phenotype due to the loss of genes derived from the other parent. Sometimes, however, new phenotypes are produced which reflect unexpected interactions between gene products possibly due to the loss of second site suppressors. Occasionally, such phenotypes are deleterious leading to reduced cell growth or death. A prediction from these results is that some combinations of genes may be lethal in segregants or backcrosses, from healthy hybrid plants. In support of this, we have now observed aberrant segregation ratios for certain markers in crosses between Minsoy and PI-290136. The implications of these findings for breeding will be discussed together with the use of somatic cell genetics to help predict cases in which this may be a problem.

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MOLECULAR FEATURES OF STORAGE PROTEINS IN SOYBEANS

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The nutritional and functional properties of the seed proteins in soybeans are to a great extent determined by glycinin and β-conglycinin. At physiological maturity they together account for about 70 percent of the seed protein. These two proteins are found together within protein bodies and glycinin often predominates. Both are isolated as large multisubunit complexes. Since genetic polymorphisms with regard to subunit composition can be demonstrated, opportunities exist to manipulate genetically their nutritional and functional properties to facilitate such efforts we have studied glycinin and the genes which direct its synthesis. The complex consists of six subunits and each subunit is composed of an acidic polypeptide component linked to a basic component by a single disulfide bond. The subunits are produced by a small family of at least 5 homologous genes, several of which have been cloned and sequenced. The glycinin genes contain three small introns and have regions homologous with consensus regulatory sequences found in other eukaryotic genes. The initial translation product is a 60,000 molecular weight precursor that consists of a signal sequence, the acidic polypeptide component, a short linker, the basic component and then a short trailer sequence. The signal sequence is removed cotranslationally whereas the linker and trailer regions appear to be removed post-translationally in a manner analogous to the conversion of proinsulin to insulin.

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THE ORGANIZATION OF GENES INVOLVED IN SYMBIOTIC NITROGEN FIXATION ON INDIGENOUS PLASMIDS OF RHIZOBIUM JAPONICUM

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All of the slow and fast-growing strains of Rhizobium japonicum examined have large plasmids ranging in molecular weight from 54 to >500 megadaltons. Only in the fast-growing strains, however, were Nif and Nod genes found; in most cases on the same Sym plasmid. The conservation of DNA sequences surrounding Nif and Nod was high, yielding identical restriction cut patterns in either slow or fast-growing strains. An estimation of the number of copies of Nif and Nod in two strains (USDA193 and USDA205) showed that Nif DH is present twice and NifK once. At least two copies of some Nod genes are also present in each strain. Transfer of the Sym plasmid from USDA191 or USDA193 to Agrobacterium tumefaciens yielded exconjugants that formed ineffective nodules on soybean plants. Both USDA191 and USDA193 Sym plasmids were unstable in other R. japonicum strains as well as R. phaseoli, and R. trifolii. USDA193 Sym plasmid was stable in R. leguminosarium and R. meliloti, but did not extend its host range to soybeans.

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PRODUCTION CONSTRAINTS AND SOIL EROSION IN THE HUMID TROPICS OF DENSELY POPULATED JAVA

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Java with approximately the area of the state of Louisiana has a population of 91.3 million and the country's % population growth rate is 2.32/year. Soybean is one of the major sources of protein but production has been maintained constant for the last. 10 years while consumption has increased by approximately 60%. Population increase without a similar production increase has caused imports to rise from 150 to 330,000 t during the last 10 years. The production constraints are many, including soil acidity, germ plasm, and pest control, but the major one that appears to go unnoticed is the rapid degradation of the soil due to water erosion. This problem is aggravated by population densities in the rainfed uplands of over 700 people/km2 and thus marginal steep lands are under production with little or no soil conservation management practices. Substantial capital investments are needed from the government to provide farmers with adequate inputs to fully utilize their land resources. In the Citanduy watershed, Java, those inputs are provided only to farmers willling to follow conservation practices that will stabilize their land. the farmers' labor is their contribution to this partnership with the government to attain a stable and productive agricultu re system for the nation.

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SOYBEAN PRODUCTION AND SOIL EROSION PROBLEMS AND SOLUTIONS - AFRICA

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Suitable regions for soybean cultivation in tropical Africa extend from approximately 7° to 12° north and south of the equator and have a mean annual rainfall of 800 to 1300 mm. Most soils in this ecology are prone to severe soil erosion. The potential soil erosion hazard ranges from about 160 to 400 t/ha/year, which corresponds to an annual erosivity index of 800 to 200 m-ton/ha and to mean soil erodibility of 0.20 t/m-ton. Erosion measured on field plots growing soybeans is recorded to range from 40 to 68 t/ha/year, a value that grossly exceeds the measured soil loss tolerance of less than 2 t/ha/annum. Soil erosion from fields growing soybeans is, however, less than from those growing maize. Although tied-ridges made on contour can control erosion on soils of gentle slopes and stable structure, ridges have the disadvantages of supra-optimal soil temperatures and high soil-water evaporation. Terraces, if properly constructed and regularly maintained, reduce soil erosion but are prohibitively expensive. The no-till system with residue mulch has been shown to reduce mean annual soil loss from 68 t/ha for the soybeans grown with the conventional tillage to practically zero soil loss. Biological and soil-management erosion preventive measures are superior to mechanical curative techniques.

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SOYBEAN PRODUCTION AND THE SOIL EROSION PROBLEMS AND SOLUTIONS - SOUTH AMERICA

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Soil erosion problems have been serious and are greatly increasing in major soybean producer countries of South America, especially Brazil. These problems are mainly represented by soil loss rates above tolerable limits, large runoff amounts, and high nutrient losses. Main factors causing these erosion problems are the highly erosive rains, long or steep slopes, indiscriminated land use with annual row crops, excessive soil pulverization under conventional tillage methods, critical soil compaction levels, and limited use of sound erosion control practices. The large and disordered increase in the soybean hectareage, which occurred without an accompanying policy on soil conservation requirements, has also contributed to the present status of soil erosion. Prompt solutions to these erosion problems are required. The immediate action is to increase the utilization of the already proved erosion control practices, notedly conservation tillage systems and crop rotation. Parallel to this, local erosion research should be strengthened to obtain on site parameter values. Finally, it is necessary to change from the present deleterious agriculture type into a stable and conservationist one. These erosion solutions can be better implemented through the development of effective, nationwide crop diversification and soil conservation programs.

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WORLD SOIL EROSION--PROBLEMS AND SOLUTIONS: NORTH AMERICA

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The soil erosion problems in North America have increased greatly since 1950. The primary cause has been the replacement of sod-based crop rotations by continuous row cropping, mainly in the U.S. Corn Belt. This has resulted in a quadrupling of soil erosion on such lands. Additionally, row cropping is practiced on lands previously uncropped, resulting in soil erosion on the order of 30 to 100 times that occurring for the prior land use--pasture or forest--on such lands. Soil erosion can be controlled on many lands by some combination of a crop production and tillage system. On more erodible areas, additional protection by terraces, stripcropping and grassed waterways may be needed. Soil erosion after soybean production can be reduced substantially by the use of no-till. Other alternatives can also be used, if conditions permit.

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DAMAGE SIMULATIONS AS AN APPROACH TO UNDERSTANDING ECONOMIC LOSSES TO INSECTS

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The influence of 4 levels of hand depodding (0, 1/3, 2/3, and 3/3) at 4 levels of hand defoliation (0, 1/3, 2/3, and 3/3) on yield of soybeans was evaluated at each of 5 stages of growth (R3, R4, R5, R6, and R7). Defoliation at R3 had no significant effect on yield at 1/3 but did at 2/3. Depodding at R3 did not significantly reduce yields at all levels of pod removal. As at R3, defoliation of 1/3 at R4 did not significantly reduce yields, but depodding of 1/3 did. At both R5

and R6, both defoliation and depodding of 1/3 significantly reduced yields. Defoliation at R7 did not cause significant reductions at any level, but depodding of 1/3 significantly reduced yields. Multiple regression techniques were used to develop equations for yield reduction at each growth stage as functions of defoliation and depodding. Based on average leaf area for each growth stage and average leaf area consumed in their development, economic injury levels were calculated for 4 insect pests of soybeans. A single hand defoliation of soybean plants at threshold levels for 5 growth stages (R3-40%, R4-19%, R5-6%, R6-6%, R7-20%) did not significantly affect yield. Sequential defoliations at the same threshold values initiated at each of the same 5 growth stages significantly affected yield only at those defoliations initiated at growth stage R3. Then, only the 2 heaviest defoliations caused significant yield reductions. The effects of hand and insect defoliation by the cabbage looper, Trichoplusia ni (Hübner), on yield was compared. At 6% defoliation, both hand and insect defoliation did not significantly affect yield.

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EFFECTS OF INSECT-PESTS COMPLEXES ON SOYBEANS

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Complexes of pests commonly occur on soybean [Glycine max (L.) Merrill]. Single or multiple insect species, infectious diseases including nematodes, and numerous weed species exert biological stress on crop plants by direct damage or competition for available moisture and nutrients. Effects of damage by the various species on crop yield may be discrete and simply additive, or synergistic among species as well as with other yield limiting factors. Relative yield losses in soybean resulting from plant damage by single and multiple pest species was determined in a series of field experiments utilizing artificial infestations of selected insect species in 1974-1979. Subsequently, research involving insect/nematode, insect/weed and insect/foliar disease interactions have been initiated. Generally, yield reductions resulting from damage by caged populations of velvetbean caterpillar Anticarsia gemmatalis Hubner and southern green stink bug, Nezara viridula (L.) have been discrete and additive. Yield reductions ranging from 0 to 93.4% have been noted from artificial infestations of these two species confined for ca. 14 day periods from R3 through R7. Environmental conditions, especially rainfall, influenced the compensatory ability of the plants in some years. Significant interactions were detected when velvetbean caterpillar and brown spot Septoria glycines Hemmi were the major damaging insect and fungal disease, respectively. Yield reductions resulting from brown spot infection alone were minimal. No significant interaction was noted in tests where insect/nematode populations were managed to result in various damage levels of these pest groups.

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IMPACT AND ECONOMICS OF THREECORNERED ALFALFA HOPPER FEEDING ON SOYBEAN

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The threecornered alfalfa hopper, Spissistilus festinus (Say) is a small triangular shaped insect in the family Membracidae. Its distributional range is from Missouri, USA south to Costa Rica. As a pest of soybean, its most obvious feeding injury is a girdle at the base of the soybean plant. The insect girdles the stem by repeatedly inserting its piercing-sucking mouthparts, circumscribing the stem. Girdles low on the main stem are associated with lodging, breakage, and plant mortality. This type of feeding occurs before plants are 20-25 cm tall. Girdles disrupt the vascular system of the plant and frequently a swelling of the stem appears above the girdle. Plants respond in five major ways due to girdling: death, break and become unharvestable, an incomplete break but continue to grow, become spindly with greatly reduced yield, and recover and produce full or nearly full complement of pods. Based on research conducted in Arkansas, action thresholds were revised in 1981. Recommendations are to take control action when fewer than 12-18 ungirdled plants per row m remain, plants are less than 25 cm tall, and hoppers are present. This recommendation refers only to conventional row spacing; no thresholds are presently recommended for narrow row or solid planted soybeans. There is some evidence that indicate that feeding on leaf petioles and racemes during the reproductive stages also may reduce yields. However, more research is necessary before the impact of late season feeding injury can be fully determined.

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APPROACHES TO STUDYING INTERACTIVE STRESSES CAUSED BY INSECTS AND WEEDS. R. A. Higgins, Dep. of Entomology, Kansas State Univ., Manhattan, Kansas, U.S.A. 66506.

Very few studies of soybean [Glycine max (L.) Merrill] have been conducted where competition from weeds and damage from insects were combined experimentally. However, if the concepts of economic thresholds, economic injury levels, critical durations of competition, and critical weed-free requirements are to be expanded from limited discipline-specific tools to comprehensive management guidelines then the resilience of plant processes to multiple biotic stresses must be understood. Density, duration, phenology, and spacial distribution of treatments should be considered in most preliminary interdisciplinary investigations of damage/loss. Experiments which quantify rates of change over critical intervals are much more valuable than studies which assess change infrequently, irregularly, or not at all. Combining yield component analyses with intensive monitoring of seasonal weed and crop development facilitates a greater understanding of treatment interaction than a superficial analysis of economic yield. Knowledge of crop and relative growth rates, phenological, morphological, and physiological changes in both the crop and weed are often prerequisites to the design and validation of mathematical models of plant growth and development. As treatment combinations become more elaborate, traditional analytical approaches may have to be modified or replaced for the experiment to remain practical. Acquiring an understanding of stress-induced interactions between competition and defoliation will require substantial improvement in communication and cooperation between agronomists, weed scientists, and entomologists.

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PHYTOPHTHORA ROOT ROT OF SOYBEAN

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Phytophthora root rot is one of the most destructive diseases of soybean. It was first observed in Indiana and Ohio in the late 1940's. Since then it has been reported in most of the soybean producing areas in

the United States, and in Canada, Argentina, Australia, Hungary, Japan, and New Zealand. The disease may cause seed rot, pre- or post-emergence damping-off, or a more gradual killing or reduction of vigor of plants throughout the season. The disease is caused by the soil fungus Phytophthora megasperma f. sp. glycinea Kuan & Erwin. The disease is most severe on wet, poorly drained, fine textured clay soils because the fungus zoospores, the main source of root infection, move in the soil water. The zoospores swim in the soil water that fills the pore spaces between the soil particles, are attracted to soybean roots where they attach themselves, encyst, germinate, and infect the roots directly through the epidermis. The fungus survives in the soil for long periods in the absence of soybeans as oospores which have a thick, protective wall. Twenty-three physiologic races of the fungus have been described. Cultural practices which improve drainage, genetic resistance, and seed and soil treatment with the systemic fungicide metalaxyl provide the best control for Phytophthora root rot.

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SCLEROTINIA ROT OF SOYBEANS, ITS IMPORTANCE AND RESEARCH IN BRAZIL.

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Sclerotinia rot [S. sclerotiorum (Lib.) de Bary] is one of the most destructive soybean diseases in Brazil. It is most severe in Central and Southern Brazil where climate is best suited for production of high quality seed. In 1983, yield loss of individual farms in the states of Minas Gerais and Paraná was estimated to be as high as 60%. An estimated overall loss of 12% in 51,000ha of soybean fields amounted to 3.9 million dollars (16,317 t x US$ 238.1/t) in 1983. Research has shown that disease incidence can be reduced by (i) reducing plant population; (ii) winter cropping with wheat and barley; (iii) rotating with corn; (iv) winter cover cropping with black oat (Avena strigosa Schreb.); (v) winter fallowing; (vi) spraying with fungicides iprodione (0.2 - 1.0 kg a.i.) and vinclozolin (0.5 kg a.i.) in 400 l water/ha; and (vii) plowing and discing. Seed treatment with thiram (0.21 kg a.i./100 kg seed), benomyl (0.1 kg), captan (0.15 kg) and thiabendazol (0.02 kg) completely erradicated S. sclerotiorum from the seed. No tillage increased disease incidence. Sclerotia exposed on soil surface remained viable for 12 months but were completely dead after 18 months, whereas, viability was unchanged when buried to depths from 5 to 50 cm for the same period. Eight common weeds were identified as natural hosts: Euphorbia heterophylla, Amaranthus spp., Ipomoea spp., Borreria alata, Galinsoga spp., Sida rombifolia, Brassica campestris, Bidens pilosa and Emilia sonchifolia.

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ETIOLOGY, EPIDEMIOLOGY, AND CONTROL OF STEM CANKER

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Stem canker caused by the fungus Diaporthe phaseolorum var. caulivora (Dpc) has been recognized as a disease of soybeans for 40 years, but recently the disease has become significantly more important in the southern U.S. Reports indicate at least six physiologic races of Dpc, three common in the South and three from the North. Further, there are morphological differences between Dpc races. All races infect through leaves early in the crop season with inoculum originating from debris or infested seed as ascospores. Late planting appears to avoid much of the spore flight, while no-till systems have commonly potentiated the problem. Commercial cultivars range in susceptibility from virtually immune to extremely susceptible. Fungicide applications made to cultivars of intermediate susceptibility during the early vegetative period (V_2-V_8) have been effective in controlling the disease. Because data indicate northern cultivars are susceptible to southern races of Dpc, there is a possibility that the aggressive southern races may continue their spread into other production areas.

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BROWN STEM ROT OF SOYBEANS

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Variation in pathogenicity of Phialophora gregata isolates has been established. Defoliating and non-defoliating isolates of the fungus have been recovered from soybean fields in Illinois. Both isolate types cause vascular browning but only defoliating isolates kill the plant. Defoliating isolates of the pathogen have been recovered from infected soybeans from Illinois, Wisconsin, Indiana, and Minnesota. The importance of selecting pathogenic isolates of the fungus for greenhouse and laboratory studies will be discussed. Spore germination and subsequent sporulation of Phialophora are sensitive to air temperature. Phialophora readily colonizes leaves of plants and air temperature affects the rate of leaf colonization. Certain isolates of Philalophora are reported to produce toxins that cause vascular browning in soybeans. The role of toxins in disease symptom development is still uncertain. Current research in my laboratory dealing with toxin production by Phialophora will be discussed. There are several sources of resistance to Phialophora and their use in development of resistant varieties will be covered. A rapid greenhouse screening procedure has been developed for screening soybean breeding lines for resistance. The correct choice of fungus isolate, air temperature, lighting, and soil moisture conditions are necessary for the screening technique to work.

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AGRONOMIC PERFORMANCE OF LINES SELECTED FOR ENHANCED NITROGEN-FIXING ABILITY

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Enhanced nitrogen-fixing ability has been suggested as a characteristic which would result in increased seed yield of soybeans [Glycine max (L.) Merr.]. A selection program was initiated in 1980 in a F-2 population derived from the cross 'Ware' x D66-5566. The selection criterion of total fixed nitrogen (N) was determined on seed of individual N-fixing plants by multiplying seed N percent by total seed weight and subtracting the total N accumulated in non-fixing control plants. The 10 highest and 3 lowest F-2 plants were identified using this criterion and were advanced to the F-3. Reselection for this criterion was continued among the advanced progenies during each of the F-3 and F-4 generations. Ten F-4 derived lines for high total N, 3 lines with low total N,

both parents, and a bulk sample of the original unselected population were evaluated in 1983 at two locations for several agronomic traits. Seed yield of lines selected for high total N exceeded the yield of those selected for low total N and exceeded the yield of the unselected population at both locations, but these differences were statistically significant at only one location.

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SELECTION FOR HIGH NITROGEN FIXATION AMONG SOUTHERN SOYBEAN LINES.

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Selection for improved nitrogen fixation based on several nodulation characteristics has been incorporated into a current soybean [Glycine max (L.) Merrill] breeding program. One hundred southern soybean breeding lines and commercial cultivars were evaluated for nodulation characteristics under field conditions at two sites in Florida. Locations varied with respect to soil type, moisture regime and Rhizobium field populations. Cored root systems were examined for root branching and mass, nodule distribution, number, and dry weight, and Rhizobium serogroup affinity. Differences in nodule distribution along the tap and lateral roots were found among the tested breeding lines and commercial cultivars. Nodule mass and number varied among the soybean lines and there were significant location differences. It is expected that the use of these nodulation characteristics will aid in the early selection of breeding lines for improved nitrogen fixation.

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METHODS USED TO IDENTIFY PROMISCUOUS SOYBEAN LINES

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The procedure that has been used to identify soybeans that nodulate with a relatively wide range of rhizobial strains has been quite successful. This involves evaluating nodulation of soybean lines in performance trials that are planted on land that has not been inoculated with Rhizobium japonicum and selecting those lines that consistently have good nodulation. Other procedures are now being investigated to determine if they could be used to identify promiscuous soybeans. The method described here, called the indicator strain technique, relies on the existance of rhizobial strains that were found to be specific to promiscuous soybeans. When these strains are used as inoculants under asepitic conditions, promiscuous soybeans can be identified by the presence of nodules, non promiscuous soybeans by the absence of nodules.

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BREEDING SUPER-EARLY SOYBEAN CULTIVARS FOR EXPANDING PRODUCTION TO HIGH LATITUDE REGIONS

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Breeding super-early soybean cultivars for expanding soybean production to the high latitude and high altitude regions is of great significance for increasing world soybean production. By crossing two extremely early soybean varieties Logbeau and Dono 47-10 several super-early soybean strains had been developed by North East Agricultural College. Among them Dono 36 had been registered and released in the most northern part of Heilongjiang province where the latitude is around 50° N. and formerly only spring wheat was grown. Dono 36 is 7 days earlier than Maple Presto (000 maturity group), 11 days earlier than Portage (00 maturity group), its average yield was 1623 kg/ha. On 1979 10 early varieties of different geographical origination were used as parents for 21 crosses. Performance of F_1, mode of genetic segregation of growth period of F_2 and F_3 lines were studied. The results pointed out that crosses in which Heihe Early and Fiskevy of 000 maturity group were used in combination with other early parents gave the highest percentage of super-early segregates in F_2 and F_3. However, it seems that effect of gene interaction on this respect is evident since percentage of extremely early segregates of some crosses were not in close accordance with the earliness of their respective parents. On 1983 1000 F_4 plants which were earlier than their extremely early parents were selected and would be planted as F_5 progeny rows in the most northern part of Heilongjiang province for further selection on 1984.

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THE YIELD SEED-FILLING PERIOD RELATIONSHIP OF F_5 LINES

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The use of seed-filling period (SFP) has been suggested as a selection criterion in soybean [Glycine max (L.) Merrill] yield improvement programs. The purpose of this study was to evaluate the relationship between SFP and yield among F_5 soybean lines from the cross 'Williams' X 'Kanrich'. Divergent selection for SFP within each of 3 maturity groups (I, II, and III) was conducted in the F_5. Each SFP category (long and short) was represented by 11 lines. All lines were grown in replicated yield plots in 1982 and 1983 at Urbana, Ill. Days from R4 to R7 were used to estimate SFP. In 1982, for all groups, the mean of lines classified as having a long SFP in the F_5, had a longer SFP and a higher yield than did the mean of lines classified as having a short SFP in the F_5. The genotypic correlations between SFP and yield for this year were 0.70 ± 0.21, 0.83 ± 0.12, and 0.47 ± 0.23 for groups I, II, and III respectively. The 1982 growing season was favorable for soybean growth, whereas that of 1983 was less favorable. When the same comparisons were conducted on 1983 data, as for 1982 data, differences were found in all groups between SFP means, but were only found in group I between yield means. Group III yield means continued the same trend, whereas those in group II did not. 1983 genotypic correlations between yield and SFP for group I and III lines were 0.72 ± 0.15 and 0.71 ± 0.17 respectively, whereas that of the group II lines was 0.03 ± 0.25. In conclusion, these F_5 lines indicate a positive relationship between SFP and yield, but stress altered this relationship in some lines.

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MODE OF INHERITANCE OF THE VEGETATIVE PERIOD OF SOYBEAN

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In this study, we made diallel crosses using the varieties Fiskeby, Schafer, Evans, Hodgson, NS-11,

and Corsoy as parents. Schafer had the shortest vegetative period and NS-11 the longest - 93 and 146 days, respectively. Considering F_1 and F_2 together, the shortest vegetative period was found in the progenies of Fiskeby x Schafer, the longest in the progenies of NS-11 x Corsoy. The inheritance of the vegetative period was mostly intermediate and partially dominant. Highly significant values were found for both GCA and SCA. The ratio GCA vs. SCA was larger than units. NS-11 and Corsoy had largest GCA values. The crosses Fiskeby x Hodgson, Hodgson x Schafer, and NS-11 x Schafer had highly significant values of SCA. The additive component of genetic variance (D) exceeded the dominant component (H_1 and H_2). The value of F was larger than unity whereas the calculated value of V H_1/D was lower than unity. The ratio total number of dominant vs. recessive alleles (K_D/K_R) was larger than unity indicating the prevalence of dominant genes in the parents. The wide-sense heritability ranged between 54.3 and 91.6% and the narrow-sense heritability was 92.0%. The regression analysis VrWr confirmed the dominant role of additive genic effects in the inheritance of the vegetative period. Our results show that the breeding for the vegetative period may successfully be started in early generations since the expression of that character is governed by additive genic effects.

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INHERITANCE OF FLOWER ABORTION AND POD TYPE IN SOYBEAN GENOTYPES DIFFERING IN RACEME LENGTH.

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Ten soybean genotypes and a cross of 'Amsoy' and 'IX93-100' were studied for flower abortion, raceme length, flowers and seeds/raceme, pod type (percent one, two, or three- seeded pods), seed weight, plant height, and nodes/plant for 2 years. Effects, on percent abortion and pod type, of flower position on the raceme and node position on the main stem were also determined. Genotypes differed significantly for all characters. Flower abortion ranged from 22% for 'Fiskeby' to 77% for 'Chusei'. Flower position x genotype interaction was significant for flower abortion and pod type, but node position within genotype showed no effect. In the Amsoy x IX93-100 cross, percent flower abortion and seeds/raceme were positively associated with raceme length, flowers/raceme, nodes/plant, and plant height, but they were negatively associated with percent pod type and seed weight. The correlation of seeds/raceme with percent abortion was negative in F2 and positive in F3. Raceme length, nodes/plant, and plant height were negatively correlated with seed weight, whereas the correlation with flowers/raceme and pod type was positive. Frequency distributions of F2 and F3 suggest polygenic inheritance with dominance effects for high percent abortion, high flower number/raceme, long racemes, low seed weight, low percent pod type, and few seeds per raceme.

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SEED YIELD EFFICIENCY IN SOYBEAN GERMPLASM.

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There is evidence that improvement in yield of crops has resulted partly from unconscious selection for high yield efficiency (or harvest index). The yield plateau in commercial soybean cultivars may be exceeded if germplasm with high seed yield efficiency can be identified from the several thousands of plant introductions held in germplasm banks. Soybean plant introductions and cultivars in each of MG III, IV and V were, therefore, evaluated during the 1982 and 1983 planting seasons for seed yield efficiency. Each entry was grown in a three row plot and replicated three times. In 1982 plots measured 6 m x 0.5 m, but in 1983 a plot measured 1.60 m x 60 cm. A seeding rate of 30 seeds/m of row was used. Plots were treated with lurox and lasso as pre-emergence herbicides, followed later in the season by inter row cultivation and hand removal of weeds within the plant rows. At physiological maturity 4 plants were harvested from each plot, oven dried and seeds and straw (stem and pod walls) weighed separately. Seed yield efficiency was calculated as seed dry weight/straw weight. SYE varied in all the maturity groups. Several PI's had SYE higher than commercial cultivars used in the test. Some of these PI's are considered good parents in breeding programs to improve the yield of local cultivars.

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REPRODUCTIVE PERIOD, PHOTOPERIOD SENSITIVITY, AND PHYSIOLOGICAL MATURITY IN 3 WIDE SOYBEAN CROSSES

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Crosses of two photoperiod insensitive, determinate plant introductions with 'Harosoy 63' produced populations of F_2 - derived lines with genetic variability for lengths of the seed filling period (SFP) and reproductive period (RP). This genetic variability was not as closely associated with date of physiological maturity (R7) (r= -0.22 t0 0.48) as the association between RP and R7 reported in most USA-adapted germplasm. Early dates of onset of flowering (R1), rapid seed filling (R5), and R7 of F_2 - derived lines were closely associated with photoperiod insensitivity of F_2 plants. However, lengths of SFP and RP were not SFP and RP could be lengthened by six days due to selection without affecting date of R7.

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SOYBEAN CULTIVARS IN THE TROPICS, SUBTROPICS AND TEMPERATE ZONE

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Sixty-six cultivars were tested in the 1980-82 International Soybean Variety Experiment (ISVEX). Three sets of cultivars were tested: Group A in the tropics; Group B, subtropics; and Group C, temperate regions. The characteristics: yield, days to flowering and maturity, plant height, height to first pod, seed size and several other characteristics were measured. Twenty-one year-cultivar combinations were included in both the tropics and sub-tropics. The mean adjusted yield in the tropics was the same as that in the subtropics, 1818 kg/ha. The difference in days to flower was pronounced, 36.4 in the tropics and 52.2 in the subtropics. The difference in days to maturity was still greater, 99.2 in the tropics and 121.2 in the subtropics. Differences in plant height were pronounced, 48.7 cm in the tropics and 67.3 in the subtropics. Average seed weight was greater in the trop-

ics, 16.6 g/100 and 15.6 g/100 in the subtropics. Another set of 11 year-cultivar combinations was in both the subtropics and temperate regions. The mean yield in the subtropics was substantially lower, 1782 kg/ha than in the temperate region, 2449 kg/ha. In the subtropics, days to flower was 39.4 and in the temperate region, it was 56.5. Time to maturity was 107.8 days in the subtropics and 129.9 days in the temperate region. The plants were much shorter, 51.7 cm in the subtropics than in the temperate region, 76.2 cm. Seed weight was greater in the subtropics, 17.4 g/100, than in the temperate region, 16.9 g/100.

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SOYBEAN IMPROVEMENT WORK IN MADHYA PRADESH, INDIA

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Soybean (Glycine max (L.) Merrill) at JNKVV Jabalpur started since 1965 with a large number of germplasm introduction, evaluation and selection made under local conditions. Exotics 'Clark63' (early) and 'Bragg' (medium) gave earlier high yields but suffered from poor seed viability and germinability resulting in low yields. Breeding objectives therefore aims to evolve high yielding varieties with better seed viability, wider adaptability, desirable maturity and resistance for diseases and pests. Pure line selection in local material evolved an early and high yielding 'JS2' which replaced 'Clark63' from cultivation. Evolution and release of two medium maturing and high yielding viz., 'Gaurav' (D60-9647 x EC7034) and 'Durga' (EC14437 x Bragg) when given for cultivation in the State, has overcome seed germination problems of exotics to greater extent. Maximum yields of 30 q/ha over the highest yielder 'Gaurav' achieved by evolution of 'JS75-46' (Improved Pelican x Seemes) and 'JS75-19' (Pb1 x Bragg). Intercrossing 'Kalitur' (Indegenous) with selected parents led to evolve agronomically superior 'Kalitur derivatives' (JS76 series) and 'New Plant Types' (JS78 series), the superiority of these have been discussed.

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SOYBEAN BREEDING FOR RAINFED TROPICS

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Soybean (June/July to September/October) suffers from water stresses (erratic rainfall distribution and quantum/season; 75 to 80% in July and August) followed by high aridity. Therefore, alongwith selection of genetically diverse and stable yielding genotypes, plant ideotypes should be estimated because their specifications can differ with rainfed regions. Diallel crossing between these parents will quantify gene action and combining ability trends thereby suggesting breeding procedures. Besides this, likely advantages from cytoplasm x genotype interactions influencing the frequency of transgressive segregates and genetic diversity can be exploited. Another approach lies in selective diallel mating with cyclical selections for high and stable yields. These populations hold promise for selections and also as gene reserviors for future use. Our recent approach indicated that environments at any location can be created by manipulating agronomical inputs, and also by considering middle (intense competition) and border (space effects) plot yields. These steps economise identification of high and stable yielding selections in initial stages for elaborate multilocation (depending on nature of problems) testing to evolve desirable soybean cultivars for rainfed regions.

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SOYBEAN COMBINING ABILITY UNDER CLIMATIC CONDITIONS IN POLAND

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Fifty entries carring valuable genes /growing period up to 150 days/ were recognized. Unfortunately, earliness was associated with poor morphotype and low yielding potential. The first step of our extensive crossing program was to determine effective crossing methods; the second to find cross formula for selection of optimal combinations of agronomic traits. Combining ability of several forms, inheritance, heritability, segregation of agronomic traits were analyzed in 1978-83. Variation in traits of F_2 populations from crosses determinate or semideterminate with indeterminate strains revealed that no good prospects can be expected from selection for genotypes tolerant to varying termic and fotoperiodic conditions. The highest frequency of valuable gene combinations was observed in F_2 populations from crosses early determinate with semideterminate strains. Variety Fiskeby V, PI 194643, PI 250002 manifested very advantageous genotypes for crosses under our climatic conditions.

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GERMPLASM IMPROVEMENT THROUGH EARLY-GENERATION TESTING

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In 1982, over 500 F_2 families in the F_3 generation were evaluated for seed yield in single row plots. These populations involved 22 crosses between 31 soybean introductions in the USDA Soybean Germplasm Collection. Using those results, 5 crosses with 10 families each, 5 crosses with 9 families each, and 4 crosses with 7 families each were selected in maturity groups I, II, and III, respectively. Crosses were selected to provide a range in seed yield. In 1983, each family was tested in 4-row plots with 2 replications. Three methods of selection with 2 levels of intensity were used with the 1982 data to determine the most effective way of identifying in the F_3 the highest yielding families as defined in the F_4. Selection was based on cross means with all families within selected crosses kept, on individual family means with the highest yielding families kept regardless of parentage, or on individual family means within crosses with an equal number of families kept from each cross. Selection on cross means in the F_3 was the most effective procedure. Because of a complete reversal in rank of one cross in

group I, no procedure identified any of the top five families in that group, but 6 of the 12 highest yielding families would have been selected with either the top 2 (40%) or top 3 (60%) of the crosses. In groups II and III, selecting 3 (60%) or 2 (50%) of the crosses, respectively, identified four of the five highest yielding families in 1983 including those ranked 1 and 2 in each group. This data suggests that testing F_2 families could be effective in screening large numbers of crosses in a germplasm improvement program.

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RESEARCH ON THE WILD SOYBEAN

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This paper gave an investigation on the resources of wild soybean in Heilongjiang province China, and through observation, the different forms of wild soybean had different resistance to diseases and pests. Wild soybean has high protein content, low fat content and oleic acid and high linoleic acid content. According the shape of leaves, one variety and five forms of Glycine soja were described: G. soja Var. gracillia (SKV.) L. Z. Wang, G. soja gracilis F. maximowiczi (ENK.) L. Z. Wang G. soja F. lanceolata (SKV.) P. Y. Fu et Y. A. Chen, G. soja F. brevifolia (Kom. et Alis.) L. Z. Wang, G. soja F. ovata (SKV.) L. Z. Wang and G. soja F. ovata (SKV.) L. Z. Wang and G. soja F. limearifolia L. Z. Wang.

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SOYBEAN GERMPLASM IN BRAZIL

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The National Genetic Resources Center (CENARGEN) and the National Soybean Research Center (CNPS) of the Brazilian Enterprise for Agriculture Research (EMBRAPA) are actively engaged in the task of introduction, preservation, evaluation, characterization and documentation of soybean germplasm in Brazil. This paper discusses the situation of world soybean collections; indicates the collecting priorities for soybean germplasm set out by the Internacional Board for Plant Genetic Resources-IBPGR; reports about germplasm introduction and exchange; defines terminology such as 'world collections', 'active collection' and 'basic collection'; explains how the Brazilian soybean basic collection is conserved; provides information about the accessions in the basic collection, as well as on the characterization and evaluation handbook and on the Soybean Germplasm Catalog. Finally it indicates how the data available is used in the EMBRAPA computer facilities.

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EFFECTS OF SELECTION FOR YIELD UPON YIELD COMPONENTS AND OTHER CHARACTERISTICS IN SOYBEAN

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Number of pods per plant, number of seeds per pod and 100 seed weight were analyzed in segregants from cross combinations involving the japanese variety Mikawashima, with high unitary seed weight, and some euroamerican varieties, with high number of pods per plant. Pedigree selection, for seed yield only, was made at Padova (Northern Italy) on plants grown at a density lower than normal (20 pp/m^2). From F_2 to F_5 an increase in seed size, sometimes negatively correlated with number of seeds per pod, was observed. In F_5 most of the lines overyielded the parents. In some combinations (Mikawashima x Beeson) such an increase was due to seed size, and in others (Mikawashima x Caloria, Mikawashima x SRF150) both to seed size and number of pods per plant. Side effects on plant hight and earlyness were observed: independently of parental performance, selected lines within each cross combination tended to give rather similar mean values as far as plant hight and earlyness were concerned.

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OFFSEASON SOYBEAN CULTIVATION POSSIBILITIES UNDER SEMI-TROPICAL CONDITIONS

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Increasing acreage of soybean (Glycine max (L.) Merrill) to 8 lakh hectare which is 70% of the country acreage and the targeted 18 lakh hectare by end of 1985 has explored the possibility of growing soybean in offseason in view of increasing irrigation resources in the State. G x E interaction indicates that 15th December planting, 'Hood' and 'Umerkote' (19°N latitude) were found to be most potential planting time, environment and genotypes. In varietal screening, 'JS71-5' found to be the most suitable for rabi conditions under irrigation at Jabalpur (23°N). Based on mean yield performances 'JS71-5' in varietal trial (1975 to 1978) and in adaptive trials (1979 to 1981) yielded 2071 and 1731 kg/ha which are significantly superior over yields of JS2 (1489 and 999 kg/ha) and Bragg (1303 and 965 kg/ha) respectively. Mean flowering and maturity durations were 64 and 115 days. It is free from 'bud blight' like disease. These findings indicate possibilities of undertaking breeder seed programme and advancing generation in offseason successfully.

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THE ORIGIN OF CULTIVATED SOYBEAN

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A famous historian of the Han Dynasty (145 B.C.-93 B.C.), Shima Qian, wrote a book of history. He mentioned, Huangdi (one of the oldest kings) grew five crops (millet, glutinous millet, soybeans, wheat and rice). According to the "Crhonological talle of Chinese history, the time of Huangdi was 2,550 B.C." Zhu Shao Hou recorded that in the Shang dynasty, oracle inscriptions on tortoise shells and animals bones included rice, soybean, millet, barley, wheat, glutinous millet and others. In China the word "Shu" (soybean) was mentioned several times in the "Shijing" (Book of poetry). This book has a collection of more than three hundred songs. In Xiao Ya from "shijing, it was mentioned that" in central China there was the soybean and farmers collected it."

Another song, "Gaofen" stated that, "October rice and soybeans are collected." This song belonged to an early stage, about 1,000 B.C. of western "zhou". The place of origin of this song was Bin County, Shanxi Province. The history of soybean culture in China dates back several thousand years. According to shijing. This is at least 3,000 years and perhaps 4,500 years or more according to "Shigi". During 1959 in Houma County, Shanxi Province, archaeologists unearthed grains. These soybeans are not in the Natural Museum in Beijing. According to C determination, they are 2300 years old. The weight of a hundred grains is about 20 grams. These are the earliest and oldest of archaeological soybean seed relics in the world. It was cultured over 2300 years.

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ABSCISIC ACID CONTENT IN DIFFERENT SEED-SIZE SOYBEANS

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Abscisic acid is one of the plant growth substances believed to influence sink strength in reproductive organs. In soybeans it has been suggested that ABA may regulate sucrose unloading in the seed coat. In this study the ABA concentration in seeds of 3 soybean PI lines, differing in seed size and seed growth rate, was determined to investigate its relationship with seed growth rate. Seeds sampled biweekly from field-grown plants were subdivided into seed coats, cotyledons and embryonic axes and ABA content was determined for each tissue. Across genotypes, whole seed ABA concentration was 8.5 ug/g fwt early in filling and declined to 1.2 ug/g fwt at physiological maturity. This decrease coincided with a decrease in seed growth rate during filling. Seeds of the large-seeded line maintained an ABA concentration at least 50% greater than seeds of the small-seeded line throughout the latter half of the filling period. Much higher concentrations of ABA (up to 12 ug/g fwt) were found in seed coats and cotyledons than in embryonic axes (up to 4 ug/g fwt). Seed coats of the large-seeded line had a higher concentration of ABA than seed coats of the small-seeded line. It is suggested that this higher concentration of ABA in the seed coats of the large-seeded line may enhance the rapid sucrose unloading necessary to support the high seed growth rate of that genotype.

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LONG DISTANCE TRANSPORT OF ABSCISIC ACID IN SOYBEANS

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Abscisic acid has been implicated as a mediator of correlative relationships between sources and sinks in several plants. The objectives of this investigation were to compare the translocation of ABA and sucrose from their sites of synthesis in soybean leaves to vegetative sinks throughout the plant. ^{3}H-ABA and ^{14}C-sucrose were introduced together into the third trifoliolate leaf of growth chamber grown soybean plants [Glycine max (L.) Merrill, cv. Clay]. The plants were harvested 1/4, 1/2, 1, 2, and 4 hours later and divided into various parts which were counted on a scintillation counter. Translocation of ^{14}C appeared to be completed after 1 hour while that of ^{3}H-ABA continued for at least 4 hours. Both ^{3}H and ^{14}C activities were detected in all plant parts at all sampling times. At the node of the treated leaf, ^{3}H more than ^{14}C initially tended to partition downward toward the root. Sink intensities [% dpm/ mg dry wt.] of the various plant parts for ^{14}C were fairly constant over sampling times, except for young leaves in which they increased markedly during the first two hours, but then leveled at 4 hours. Sink intensities [% dpm/ mg dry wt.] of plant parts for ^{3}H were also fairly constant with time, except for young leaves in which they increased continuously during the experiment. The results are interpreted to show that ABA is quickly translocated from leaves to other parts of the plant. The initial translocation of both ABA and sucrose was primarily toward the root, but per gram of tissue, the young leaves eventually became very strong sinks for both ^{3}H-ABA and ^{14}C-sucrose.

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RELATIONSHIP OF COTYLEDON CELL NUMBER TO SEED GROWTH IN SOYBEAN

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The objectives of this study were to investigate the relationship of cotyledonary cell number to seed growth rate and final seed size for three soybean [Glycine max (L.) Merrill] Plant Introduction (PI) lines with genetic differences in seed size. They were PI 361.058 (small seeded), PI 317.336 (medium seeded), and PI 416.845 (large seeded). Final seed dry weight ranged from 92 to 316 mg/seed among the lines. Seed growth rate varied from 2.6 to 10.0 mg/seed/day, and the number of cells in the cotyledons varied from 4.6×10^{6} to 10.3×10^{6}. The three PI lines examined differed in both rates and duration of cell division in the developing seeds. Seed growth rate and final seed size were related to number of cells in the cotyledons. However, the relationship was not linear. Growth rate per cell for the large seeded line was approximately 67% greater than that for the small seeded line.

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POD SET ON TERMINAL RACEMES OF SOYBEAN

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Reduction in yield potential of soybean [Glycine max (L.) Merr.] is due partly to the abscission of flowers and pods from distal nodes of racemes. Studies were performed on field-grown soybean plants in an attempt to increase pod set on more distal nodes of terminal racemes (TR). In one experiment, over 90% of the potential pods on TR abscised, mostly as open flowers or young pods. More than 60% of these abscissions occurred in mid-August during a 14-day period when flowering reached its peak. Most of the abscissions occurred at distal nodes, although in 25% of the TR all potential pods abscised. At harvest, 83% of the mature pods were located at the first 7 proximal nodes. Removal of open flowers from the first 6 proximal nodes increased pod set at other nodes, but did not compensate entirely for the loss of previously-excised proximal flowers. Excising either the distal one-third of the TR or flowers at alternate nodes had little effect on total pod set. TR were sprayed with 10^{-7}, 10^{-5}, or 10^{-3} M 6-benzylaminopurine (BAP) to determine the influence of a cytokinin on pod set. A significant decrease in abscissions with 10^{-3} M

BAP was observed within 10 days after spraying. The increased number of mature pods following a 10^{-3} M BAP treatment was due to a significantly higher number of mature pods at nodes distal to node 7. These studies demonstrate that both the numbers of flowers or pods at proximal nodes and exogenously applied growth regulators affect pod set and pod distribution on more distal nodes of TR.

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VARIETAL AND SHADE EFFECTS ON SOYBEAN LEAF STARCH LEVELS

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Soybeans (Glycine max L. Merrill) are able to store a considerable amount of photosynthate as starch granules within chloroplasts. Leaf starch levels rise during the day and decline at night, suggesting that starch accumulation represents a temporary sink. When sampled at stage R3, upper leaves of Corsoy soybeans showed a daily accumulation of 0.32 mg starch/cm^2, and Williams accumulated 0.08 mg/cm^2. Average morning levels were about 0.5 mg/cm^2 for both varieties. Wells soybeans were shaded for 8 days during stage R6, and sampled on 3 of these days. Average daily leaf starch accumulation was 0.51, 0.52, 0.23, and -0.08 mg/cm^2 under 0, 39, 78, and 98% shade, respectively. On unshaded plots, morning starch levels appeared to be inversely related to minimum night temperature. Daily starch accumulation was higher when morning levels were low and when solar radiation was high. Yields were reduced by 8, 18, and 30% under 39, 78, and 98% shade, respectively. After removal of the shades, morning starch returned to pre-shading levels. From previous growth chamber studies, it appears that starch levels in the field may not be high enough to inhibit photosynthesis.

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SOYBEAN SEED GROWTH AND MATURATION IN VITRO

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Immature soybean seeds were grown and matured in vitro with and without pods. Surface sterilized pods or excised seeds without pods were floated in a liquid medium containing 5 percent sucrose, minerals, and glutamine in 125 ml Erlenmeyer flasks and incubated at 25°C under 300 to 350 µmol m^{-2} s^{-1} fluorescent light. Seeds matured in vitro are similar to naturally matured seeds in composition, are tolerant to desiccation and are capable of germination upon hydration. In pod culture seeds initially at 50 to 70 mg fresh weight grew at 3 mg day^{-1} to a mature dry weight of 90 to 100 mg $seed^{-1}$, retained an intact seed coat, and germinated 90 to 100 percent with good seedling vigor. During 16 to 21 days in culture, excised seeds initially between 50 and 450 mg fresh weight grew to a mature dry weight of 100 to 600 mg $seed^{-1}$ at an average rate of 5 to 25 mg dry weight $seed^{-1}$ day^{-1} depending on initial size. Growth rates were maximal during the first 8 to 10 days in vitro. Seed coats ruptured with rapid cotyledon expansion during the first 2 days in culture. Embryos were tolerant to desiccation and 80 to 90 percent germinated if removed from culture before complete loss of green color. The growth of excised seeds exceeded seed growth in detached pods, but when windows were cut in pods to permit direct exposure of seeds to the medium, seed growth was comparable. Precocious germination in initially large seeds was prevented by high osmolality of the medium or by ABA in low osmolality medium. Seed dry weight was not affected by a wide range of osmolality or ABA concentrations. The pod and seed culture technique can be used to study seed maturation events independent of the mother plant.

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SEED COAT DEVELOPMENT IN SOYBEAN

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The formation of pores in the seed coat surface and the development of the water impermeable seed coat were followed during seed formation in soybean [Glycine max (L.) Merrill]. Pods were sampled at random from the four uppermost nodes of field grown plants. The sampling period began when beans were first felt in the pod and ended when plants reached maturity. After desiccation in the pod, soybean seeds were observed to progress through three distinct developmental shapes: "transversely narrowly elliptic", "depressed ovate", and "mature". Light and scanning electron microscopy revealed that pores were formed in seed coats when the seed reached the "depressed ovate" stage. Examining imbibition of water by the seeds demonstrated that the water impermeable seed coat also formed in the "depressed ovate" stage. These results suggested (1) that desiccation signals the expression of pore development and the hard seed coat character in soybean and (2) that the potential to express these characters upon desiccation is formed early in seed development.

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USING A MECHANISTIC MODEL, GLYCIM, TO SCREEN HYPOTHESES ABOUT SOYBEAN PHYSIOLOGY

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GLYCIM is a dynamic soybean crop growth model which mechanistically simulates environmental and physiological processes. It is being used to examine various hypotheses about the way plants control their photosynthetic rate, nitrogen fixation rate and carbon partitioning. The demands for both carbon (C) and nitrogen (N) after podset are much higher than before podset. The plant anticipates these demands and increases C and N fixation rates during flowering. Much of the excess C is stored, even while pods are aborting, during podset. The mechanisms controlling these processes cannot be observed experimentally. Therefore, various hypotheses have been tested in the model to determine which of them give simulated results similar to observed results. The model and some of these results will be described and the utility of models for testing hypotheses in this way will be discussed.

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THE ANATOMY OF SOYBEAN LEAVES AT DIFFERENT NODES

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The main stems of eight cultivars (four old cultivars and four new ones) of soybean (Glycine max [L.] Merrill) develop 17-21 nodes (beginning with cotyledon node). The primary leaves and those at 3-6th nodes and 12-14 nodes have greater thickness and more cells per unit area. The leaves at 7-11

nodes and above 15th node are thinner and have less cells. The primary leaves of most cultivars formed two or three layers of palisade cells, a few new cultivars that formed four layers was discovered. The leaves at 3-5th nodes and 13-14th nodes of new cultivars all formed three layers of palisade cells, which also was true of few old cultivars. In general, new cultivars have thicker leaves and more cells than old ones.

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SOYBEAN SEED MULTIPLICATION IN BANGLADESH

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A project introducing soybean [Glycine max (L.) Merrill] cultivation and utilization in southern Bangladesh is run by the Mennonite Central Committee. Seed supply and quality has been a major constraint. Winter season seed production suffers from preharvest field deterioration, adverse storage conditions, and poor seed longevity of approved cultivars. Rainy season seed production is not feasible because of widespread flooding. However, rainy season seed production shows potential in the drier regions of western Bangladesh. A seed multiplication project was initiated there in 1981. Seed is multiplied by contracted farmers for winter season extension in the south. Yields were low (500-600 kg/ha) in 1981 and 1982 because of poor plant stands, incorrect planting time, late season drought, and farmers' unfamiliarity with the crop. Research has shown mid-July to August planting best for yield and seed quality. In 1983, 75,000 kg of seed was produced with acceptable yields of 1000 kg/ha. Farmers' field variety trials show maximum yields of 2800 kg/ha. High yields in both seasons, drought tolerance, and seed quality are important varietal characteristics. Ambient storage trials attempted to identify cultivars with superior seed storability. Because of its yield potential, and the way soybean fits into the rice and wheat based cropping patterns, response by farmers has been good. Besides supplying seeds for the current needs, the project may provide a model for future, larger scale seed production.

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EVALUATION OF SOYBEAN STORAGE CONDITIONS ON SEED PRODUCTION AND QUALITY

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Hundred seed weight of cultivar Williams exceeded that of Calland and Clark respectively. Seed moisture content was higher in Clark thaen Williams then Calland. The germination percentage of caltivar Williams was higher than that of Clark and Calland. The germination percentage was also great in seeds under cold conditions while the ahnormal, hard and dead seeds percentages were lower. The protetein percentage was high in Calland than Williams and Clark respectively while Williams exceeded Calland and Clark in oil percentage. The protein and oil percentages began to increase after two months of storage period. Hundred seed weight and moisture content were higher in cold storage. The germination percentage of seeds supplied from Lower Egypt was low than that from Upper Egypt .The germination percentage of seeds supplied from different governorates increased while the hard seed percentage decreased with increasing storage period.The highest protein percentoge was estimated in seeds supplied from El Monofia governorate (Calland Cultivar) while the highest oil percentage was in seeds from kafr El Sheikh (Williams Cultivar).Cultivating differant cultivars of stored soybean in different storage conditions revealed that Williams was the earlist in emergence while Clark in flowering.

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SOYBEAN SEED PRODUCTION IN ARGENTINA

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Following the successfull introduction of soy beans as a commercial crop during the late sixties, a well balanced seed industry has grown up in Argentina, reaching the production goal of 95.000 metric tons of certified seeds during the agricultural year of 1982/83, which is enough for about 50% the total cultivation area of 2.600.000 hectares. About 320 seeds producers are registrated under the provissions of the argentinian seeds law (Ley n° 20.247). Most of them are independent producers, producing mainly in small to medium acreages, and even if several big corporated concerns and cooperative organizations exist, none of them control the market due to the impossibility of supporting the extensive sales network which should cover the vast and scattered agricultural areas of the country. The argentinian legislation also provides a protection system for new cultivars, under which 25 certificates of protection had been issued to soybean varieties, 19 of theses to american owners who applied under the reciprocity agreement seltled between both countries. The 85 soybean varieties currently spread in Argentina are mostly of american origin, but the development of materials well adapted to local edaphic and climatic conditions has already been undertaken by several private and state owned concerns.

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SOYBEAN SEED QUALITY DURING CONDITIONING

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Soybean seed quality at various steps in conditioning as affected by equipment, seed moisture and temperature were determined. Three cultivars, two seed moistures, two temperatures and five conditioning operations were included in the experiments. Handling soybean seeds by a conventional steel-flighting auger significantly decreased germination, and increased splits and seedcoat damage. An air-screen cleaner was the most effective equipment for cleaning of soybean seed. Soybean seeds conditioned at 12-14% moistures retained germination whereas seedlots below 10% moisture declined in germination as a result of conditioning. Temperature during conditioning did not have a major influence on soybean seed germination or seedcoat damage but did influence the amount of splits produced. Low-moisture (below 10%) seedlots conditioned at near 0 degrees F temperatures declined in germination.

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SOYBEAN CROP SEQUENCE IN THE SUBHUMID TROPICS

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Soybean /Glycine max (L.) Merrill/ produced grains of 25-32 q/ha in well drained alluvial upland soils of West Bengal. A variety of crops are under cultivation in sequence or interplanted throughout the year in this region. A photoneutral early jute-late sown soybean-wheat crop sequence gave maximum monetary return and profit as compared to other sequences, the benefit cost ratio being also high(2.0). The cultivators received marketable produce only after 3 months and residual benefit of a leguminous crop in wheat production. Also soybean-wheat-greengram sequence gave maximum benefit by economizing chemical fertilizers, based on studies on the direct and residual effect of phosphate on the crops. The total grain, protein, calorie yield and monetary return were maximum when 75 kg P_2O_5/ha was applied to soybean and again to wheat; greengram being grown without fertilizer. The benefit cost ratio (3.0) being highest, indicated the efficiency of the sequence in utilizing split phosphate application. Soybean-maize, soybean-rice and soybean-pegionpea inter-cropping gave more total yields of grains and calories, monetary returns/ unit area, produced high L E R values at low nitrogen supply. The paper illustrates scope of integrating soybean into diversified cropping patterns, during wet (June-October) and dry (January-May) seasons and soybean was found to be remunerative component crop both under sequential and intercropping system, where supply of fertilizer is limiting.

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ANTHRACNOSE REDUCTION AND YIELD ENHANCEMENT WITH POTASSIUM FERTILIZER AND BENOMYL

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On many soils addition of potassium (K) fertilizer can increase soybean [Glycine max (L.) Merr.] yield 100% or more. Potassium has also been beneficial in suppressing certain major diseases that limit production. Anthracnose (Colletotrichum dematium var. truncatum) is considered one of the major diseases affecting soybeans in the Southern U.S. The effects of K fertilizer with and without benomyl fungicide on yield and anthracnose development in soybeans grown on a Typic Agriaquoll soil (low in available K but high in phosphorous) were determined over a three-year period. Treatments consisted of six levels of K and two levels of benomyl on "Davis" soybeans harvested at maturity and four weeks later. Anthracnose disease ratings were reduced significantly by K, reaching a minimum rating at the highest level (538 kg K_2O/ha). Benomyl and K + benomyl resulted in further disease reduction over K alone. Yields increased with increasing K. Addition of benomyl increased yields over K alone except at the highest K level. Delayed harvest losses were reduced by K, benomyl, and K + benomyl, peaking around 268 kg K_2O/ha. The effects of K, benomyl, and K + benomyl on anthracnose and yield were evident the following year in a K residual study designed to determine carryover effects of K. It was concluded from the data that the beneficial effects of benomyl on anthracnose suppression were additive to that afforded by K alone.

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THE OCCURRENCE AND CONTROL OF PYRENOCHAETA GLYCINES ON SOYBEANS IN ZAMBIA

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A red leaf blotch disease of soybean (Glycine max (L.) Merr.) caused by Pyrenochaeta glycines R.D. Stewart was considered to be of minor importance in Zambia. However, as the hectarage planted to soybeans has been increasing, the disease is regarded as potentially serious. As only limited information on the disease is available, trials were initiated in 1979 to evaluate varietal reaction and to estimate loss in yield. During a season lasting from November to April, either late maturing varieties or later plantings in December were less severely affected. In 1982, 515 varieties were assessed for disease reaction in single row plots on a scale of 1 to 9 at R5-R6. Three varieties had a score of 1 while 32 rated 3 compared to the susceptible Oribi which rated 7.6. Two applications each of benomyl and fentin acetate at 0.5 kg/ha increased the yield by 13 and 23 percent respectively over the control. In order to obtain more information on the disease, current investigations are being conducted to relate disease incidence to loss in yield and to further evaluate varietal reaction.

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THE STATUS OF SOYBEAN RUST IN BRAZIL.

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The rust fungus, Phakopsora pachyrhizi H. & P. Sydow, was first found infecting soybeans [Glycine max (L.) Merrill] in Brazil in field plots at Lavras, Minas Gerais (Feb., 1979). It has since been found in commercial fields in the most important soybean producing states of Central (Goias and Minas Gerais) and Southern (Paraná) Brazil. In 1983, it was found in several counties in the state of Paraná and was most severe in fields of cultivars Bragg and UFV-1, with disease intensity of 4 (scale of 0 = no symptom to 4 = severe infection with yellowing and defoliation). Yield was apparently less than normal, but actual loss was not assessed. Rust lesions have been predominantly of the RB (reddish brown or "resistant") type but TAN (susceptible) type is occasionally mixed with RB lesions. Disease survey carried out until early April, 1984, at all places where rust had been found on commercial fields in 1983, failed to detect the disease except at Ponta Grossa (South of Paraná state) where it appeared at trace level. The widespread distribution of rust in 1983 could be due to the favorable weather condition throughout the crop season, and the limited occurrence in 1984 due to the abnormally dry and hot weather during most of the growing season. P. pachyrhizi has been found on other legume species (especially on Neonotonia wightii) in the states of Minas Gerais, Espirito Santo, Sao Paulo and Paraná. Up to this moment, 22 legume species have been found infected by P. pachyrhizi either naturally or by artificial inoculation at Lavras, Minas Gerais. Currently, research on rust resistance and assessment of yield losses is emphasized.

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RHIZOCTONIA WEB BLIGHT OF SOYBEAN IN PAKISTAN

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Rhizoctonia aerial or web blight of soybean (Glycine max (L.) Merril), caused by Rhizoctonia solani Kuehn, is reported for the first time at National Agricultural Research Centre, Islamabad in Pakistan. Pathogenicity tests and reisolation from inoculated plants confirmed that Rhizoctonia solani, Kuehn was the incitant.

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FACTORS AFFECTING SOYBEAN ANTHRACNOSE

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Anthracnose caused by Colletotrichum dematium f.sp. truncata attacks all the above ground parts of plants like stem, leaf, flowers, pods and seeds in soybean. Several factors have been observed to influence the disease severity like cultivars, row to row and plant to plant distance i.e. plant population, planting date, fertilizer dose, irrigation level, planting site, plant protection measures and climatic conditions including rains. Great variability in disease severity has been observed in cultivars. Increased row to row and plant to plant distance i.e. lesser population had lesser disease severity. Late plantings resulted in lesser disease incidence, more nitrogen had more disease, increased irrigation level had higher incidence of the disease, areas with lesser rainfall and less water stagnation had lesser disease severity. Rain splashes were mainly responsible for the initial infection of plant parts. As the disease is both seed- and soil-borne, the inoculum at both the sources is responsible for the disease initiation. Several chemicals like Dithane M-45 checked the outbreak of the disease and delayed the outbreak point and the exponential phase. Funcicidal spray also improved the seed quality.

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BLACK LEAF BLIGHT, A NEW DISEASE OF SOYBEAN

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In March 1982, a new aerial blight disease was identified in an isolated crop of soybeans at Wauchope on the North Coast of New South Wales. Large circular to oval (2-6 mm) dark grey leaf spots were abundant and spotting and blighting of the stems and pods was also evident. Dark brown fungal hyphae were present on the spots and ran across the surface of leaves, branches and pods forming complex branched appressoria from which penetration of the tissues occurred. No spores or other fruiting structures were present on infected plants and in culture on PDA the fungus only formed black hyphal colonies. In subsequent studies ascocarps were found on leaf litter from diseased crops collected during September 1983 and were also formed on water agar cultures amended with sterile soybean leaves. Single ascospore cultures have produced the same fungus in culture as originally isolated from diseased plants. A full description of the fungus will be published separately. In artificial inoculation tests all commercial soybean cultivars were susceptible and a range of other legumes native to Australia has also been infected. Following the initial outbreak in 1982, this disease has spread in the subsequent season so that an area 120 km long by 45 km wide is now known to be infected. Estimates of losses in seriously affected areas range from 30 to 50 per cent.

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A DIFFERENTIAL SET FOR IDENTIFYING RACES OF SOYBEAN LEAF RUST (Phakopsora pachyrhizi Syd.)

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Few genes for resistance to soybean leaf rust have been identified in either G.max or G.soja and, consequently, little is known about variation in the pathogen. Screening tests involving four Australian native species of Glycine (G.canescens, G.clandestina, G.tabacina and G.tomentella) have uncovered an extensive range of qualitative and quantitative resistance to P.pachyrhizi. Glycine accessions possessing qualitative (hypersensitive) resistance have been used to construct a set of differential hosts with which to identify virulence races of the pathogen. In an initial sample of nine rust isolates, collected from soybean fields in widely dispersed areas along the eastern Australian coast, six different virulence races have been identified. These different races display a very considerable range of virulence. Assuming a gene-for-gene relationship between the various hosts and this pathogen, these virulence races have been used to detect a minimum of 5,3,4 and 4 genes in the four Glycine hosts respectively. In at least three cases the resistance gene(s) involved have been shown to be dominant and inherited in a simple Mendelian manner.

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SOYBEAN INSECT PEST COMPLEX EVALUATIONS.

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Several insect and mite pests attack Virginia's soybean crop annually, often causing substantial crop losses. Treatment decision guidelines are established for each insect/mite pest. The effects of certain pest complexes on soybean quality and yield were evaluated in a series of 7 experiments in 3 geographic areas of the state. Pest complexes were maintained in controlled field plots by selectively using insecticidal applications. Soybean yields were increased at one test site when all pests or only corn earworms were removed. At a second site yields were lower in the no insect plots (5 appl. of pyrethroid insecticide) due to a heavy outbreak of two-spotted spider mites. The naturally occurring pest complex densities at the remaining 5 sites did not reduce soybean yields below the untreated controls.

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INTERACTIONS BETWEEN SEEDCORN MAGGOT DAMAGE AND SUBSEQUENT STRESSORS ON SOYBEAN

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Seedcorn maggots (SCM) damage soybean by reducing plant stand and by producing "Y-plants" (which develop after the destruction of the growing tip and growth of the axilary buds). As part of a characterization of soybean response to SCM damage (using different plant densities and normal to Y-plant ratios), we examined how this damage influences additional biological stressors. Increasing susceptibility to potato leafhopper damage with increasing Y-plant ratio was indicated. Seedcorn maggot-damaged plants produced significant interactions with weeds. Plots with more Y-plants were less susceptible to leaf brown spot disease. Data from 1982 and 1983 indicated that interactions between weeds, diseases, and insects with SCM-damaged plant stands are influenced by environmental factors, especially temperature and rainfall.

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ECONOMIC IMPLICATIONS OF SEEDCORN MAGGOT DAMAGE TO SOYBEAN

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The effect of seedcorn maggot (SCM), Delia platura (Meigen), damage to soybean, Glycine max (L.) Merrill, growth and development represents a complex set of pest interactions which must be considered collectively. The economic consideration of SCM damage is reflected by direct stand decline and the production of lower yielding "Y-plants". In addition to this primary damage syndrome, the effects of other pests (weeds and diseases) become more prolific as a consequence of SCM damage and act to stress the crop further. These additional pests magnify crop stress and should be considered as unfavorable externalities resulting from poor SCM management. Linear programming techniques were employed to evaluate the potential cost and benefits of SCM control versus non-control. In the case of non-control, the possibility of subsequent damage from additional weed and insect populations was considered and an optimum integrated pest control strategy for each situation was calculated.

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INTERACTIONS OF SOYBEAN DEFOLIATION BY INSECTS AND WEED COMPETITION

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The quantitative analysis of the interactions of pest complexes is essential to the establishment of improved economic injury levels and management guidelines. An adult release technique, using soybean looper (Pseudoplusia includens) moths has been utilized to establish controlled levels of defoliation at sensitive soybean developmental stages, R2 and R5. Season-long weed competition was provided by pre-established infestations of velvetleaf (1 weed/0.9m and 1 weed/0.45m) in 1982 and cocklebur (1 weed/3.6m and 1 weed/2.7m) in 1983. In addition to these single factors, all possible combinations of defoliation levels and weed densities were included in the design. In 1982, the single effects of defoliation (30% and 60%) and weed competition reduced yields significantly; however, no weed x defoliation level interactions were statistically significant. The single effect of defoliation (20% and 40%) also reduced yields significantly in 1983, but neither weed competition alone nor any of the interactions were statistically significant. Lowest yields were found in the combination treatments with highest levels of defoliation and weed density. In both years, the combined effects were in many cases additive, and in all cases were at least greater than the single effect of either individual pest. Soybean defoliation often appeared to result in increased weed growth as evidenced by end-of-season biomass.

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SOYBEAN GERMPLASM EVALUATION FOR RESISTANCE TO MEXICAN BEAN BEETLES

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In 1982 and 1983, a total of 2,788 soybean accessions, 39 commercial varieties and 8 breeding lines mostly belong to maturity groups V-VI were evaluated for resistance to Mexican been beetle (MBB) under field conditions. Two rows of soybeans planting followed a row of contender snap beans mixed with Henderson bush lima beans to attract emerging MBB from hibernation. An average of one thousand laboratory reared MBB per day were released uniformaly in sequence all over the field in addition to the natural field population. At each of three weeks interval, individual lines were evaluated visually on a scale of 1-10, with 1 being the least damage and 10 the most damaged. A total of 32 accessions, 6 varieties and 2 breeding lines have been selected as comparatively resistant to MBB. These selections will be re-tested and further evaluated in both greenhouse and in field to work out mechanisms of resistance.

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DEVELOPMENT OF ECONOMIC INJURY LEVELS FOR INDIVIDUAL AND COMPLEXES OF PEST ARTHROPOD SPECIES ON SOYBEAN GROWN ON VARIOUS ROW SPACINGS

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In 1982 and 1983, selective soil and foliar pesticides were used to manipulate soybean insects on Centennial soybean grown on 51 and 76 cm row spacings. Weekly treatments included: methyl parathion/permethrin, in combination, to eliminate all pest species; methyl parathion, to maintain soybean loopers(SBL); chlorpyrifos, to maintain threecornered alfalfa hoppers(TCAH); Bacillus thuringiensis, to maintain TCAH, bean leaf bettles(BLB), southern green stinkbugs(SGSB), soybean nodule flies(SNF), and Colaspis louisianae Blake(CL); and a control to maintain all pest species. Plots devoid of all insects had the highest yield for both years. In 1982, no differences in yield were found between plots maintained for TCAH,BLB,SGSB SNF, and CL, for SBL, and for plots where all pests were controlled. Plots maintained for TCAH alone produced lowest yields(ca. 37% lower than plots devoid of insects). Yield data for 1983 showed a similar pattern except overall yields were ca. 390 Kg/ha less. No differences in insect populations occurred due to row spacing. Yields for 51 cm row plots were higher than those on

76 cm rows(3208 & 2849,respectively) in 1982. In 1983, the 76 cm row plots outyielded plots on 51 cm rows(2778 & 2498 Kg/ha, respectively). Although individual pest populations never reached economic threshold (except TCAH in 1983), the data suggests that sub-threshold levels for individual species in the pest complexes can have significant impact on soybean yield potential.

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ECONOMIC THRESHOLDS AND THE ROLE OF PEST MORTALITY

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Economic thresholds for the green cloverworm and other soybean pests currently assume 100% survivorship of the damaging stages. Consequently, these thresholds are fully conservative and ignore the importance of natural mortality agents to pest management. Savings can be generated for crop producers if reliable estimates of this natural mortality can be incorporated into action thresholds. An innovative method is proposed which incorporates pest survivorship into economic thresholds. This method converts sample counts into "damage equivalents" based on damage expectations for each life stage. Normal decision-making criteria then can be applied to damage equivalents instead of population estimates. Damage expectations are derived from stage-specific survivorship and damage distribution by life stage. Examples of damage equivalency calculations and the field use of this method in green cloverworm pest management are presented.

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BEAN POD MOTTLE VIRUS AND SOYBEAN YIELD: EFFECTS OF INOCULATION DATE AND INFECTION RATE

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Bean pod mottle virus (BPMV) has been shown to reduce yield of soybean when infection is 100% or when young plants were inoculated. Inoculation date and infection rate were factors in a field experiment arranged as a 4 x 5 factorial design with 3 replications. Field plots of 4 rows by 3 meters with a 0.76cm row spacing of cultivar Hodgson 78 were established. Soybeans were mechanically inoculated with BPMV during developmental stages V-1, V-5, R-2 and R-4 at an infection rate of 0, 5, 10, 20 or 40%. Seasonal abundance of the bean leaf beetle, Cerotoma trifurcata, the primary vector of BPMV, was monitored with weekly sweep net samples. Yield was significantly reduced ($P<0.01$) when BPMV infection was initiated during the vegetative growth stages. The specific comparison of V1 + V5 versus R2 + R4, with all infection rates combined, resulted in a loss of 8.9%. Analysis of the effect of infection rate on yield, for the V-1 and V-5 stages only, showed that only when the infection rate reached 40%, were yields significantly reduced ($P<0.05$). Correlation of the seasonal history of the bean leaf beetle with plant developmental stage showed that in Minnesota the F1 beetles did not emerge until after the onset of flowering (R1). Consequently, only the adult beetles which successfully overwintered were present during the vegetative stages and were capable of transmitting BPMV which could result in a loss of yield.

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INFECTION OF SOYBEAN ROOTS BY PHYTOPHTHORA MEGASPERMA F.SP. GLYCINEA.AN ELECTRON MICROSCOPIC STUDY.

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Phytophthora rot is caused in susceptible soybeans by an infection with Phytophthora megasperma f.sp.glycinea (PMG).To determine the resistance to incompatible races of PMG a comparative study using light and electron microscopy (semi- and ultrathin sectioning, freeze-fracture and scanning microscopy) was made.The sequence of pre- and post-penetration events was studied in roots of 2-day-old seedlings of susceptible and resistant soybeans (Glycine max(L.)Merill,cv.Harosoy and Harosoy 63) after inoculation with zoospores of races 3 and 1 of PMG,respectively. Both zoospore suspensions were adjusted to the same density($5x10^5$/ml).The zoospores of both races preferentially infect the growth zone of the root with a density of 2000-2500 spores per mm^2 surface area.After penetration of the epidermis compatible and incompatible races already show clear differences in developement a few hours after infection (12hpi).In the compatible interaction the infection progresses more intensively in both a perpendicular and in a longitudinal direction.Most of the PMG3-hyphae grow intracellularly.This may be the reason for the growth stop in susceptible roots beginning from 12-14hpi.In PMG1-infected roots the hyphae grow intercellularly without hindrance of root growth.Some ultrastructural cell wall alterations were detected.

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DETECTION OF MACROPHOMINA PHASEOLINA IN SOYBEAN STEMS

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Basal stem portions of field-grown soybean plants were visually rated for the occurrence of charcoal rot, caused by Macrophomina phaseolina, using the presence or absence of microsclerotia. In addition, basal stem pieces without microsclerotia were dipped for 1 minute in 11.64% commercial paraquat after washing for 2 hours in tap water. Stems were incubated for 3 to 4 days on moist cellulose pads at 25±2°C. The percentage of infected stems was significantly ($P=0.05$) higher after the paraquat treatment than the visual field rating. Paraquat induced the expression of latent infection by M. phaseolina and inhibited the growth of Alternaria spp. to provide a more accurate determination of colonization of soybean stems by M. phaseolina.

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PATHOGENIC SPECIALIZATION OF DIAPORTHE PHASEOLORUM VAR. CAULIVORA OF SOYBEAN.

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Pathogenic specialization of Diaporthe phaseolorum var. caulivora (Dpc) was found when one Iowa and two

Mississippi (A and B) isolates were tested for pathogenicity in 10 soybean cultivars. The Iowa and Mississippi isolates reacted as two distinct pathogenic races. There was no significant difference between the two Mississippi isolates. Soybeans D60-9647 and Tracy M, considered resistant to Dpc at Mississippi, were susceptible to the Iowa isolate. The line J77-339, reported susceptible in Mississippi, was resistant to the Iowa isolate. The soybeans Blackhawk; L-4404, and Harosoy, used as susceptible controls for the Iowa isolate, were resistant to both the Mississippi isolates. The Iowa isolate seemed to be more virulent. Relative virulence of the Iowa and Mississippi A and B isolates was 62.2, 25.5, and 21.4% plants affected, respectively, based upon overall averages for this study. The lines most resistant to the Iowa isolate averaged only 60.5% resistant. Resistance to the Mississippi A and B isolates averaged 87.1% and 84.6%, respectively.

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SIMULATED PLANT LOSS IN SOYBEANS DUE TO PATHOGENS

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Most data on the relationship between soybean planting density and crop yield have been obtained from stand comparisons fixed at planting while diseases cause density change at variable but measurable rates throughout the growing season. Diseases resulting from Phytophthora, Rhizoctonia, and iron deficiency can cause plant yield losses, by reducing soybean stand density over time. In 1980-83 we used soybean cultivars Hodgson 78 and McCall in randomized complete blocks to compare different rates of plant density change by removing plants by pulling or cutting; final plant densities within rows were 6/ft, 3/ft, 1/ft, and 1/3 ft. There were no significant differences between pulling or cutting plants at the base to simulate disease. Seed weight showed no significant effect when plant densities declined at fast or slow rates but pod number/plant increased while total yield/plot decreased with decreasing stand. Equations were developed to predict soybean yield loss/unit area and yield increase/plant from plant density and death rate at specific growth stages.

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SCREENING SOYBEANS FOR RESISTANCE TO CHARCOAL ROT IN PAKISTAN

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In a two years test during 1981-82 twenty-five soybean cultivars were evaluated for resistance to Macrophomina phaseolina (Tossi.) Goid., causal agent of charcoal rot under natural epiphytotic conditions at National Agricultural Research Centre, Islamabad. The results indicated great differences among the cultivars in their degree of resistance or susceptibility to the disease. Two cultivars Celest and Centennial of groups V and VI respectively, exhibited a high level of resistance with less than 10 percent mortality. The remainings were either moderately susceptible or highly susceptible. Differences in the disease response of Celest and Centennial were highly significant from Calland, Gasoy and Woodworth as shown by the Duncan's Multiple Range Test at 0.05 level.

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SOYBEAN PRODUCTION AS A SECOND CROP IN TURKEY

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The Aegean,mediterrenean and sout-Eastern regions have the most productive soils in Turkey. It has about 3.4 mil.ha lands for farming.The main Crops are wheat (%62) and Cotton (%20) in these regions.Because of the suitable ecological conditions it is possible to produce more than one crop in a year. In these regions there is an unused period of 6 months after wheat harvest in Cotton-Wheat Cropping system.According to the researches and three years of production experiences, it has found that soybean Could be grown successfuly as a second crop in these regions. The annualy soybean production was 2300 ton in 1980, but it has reached about 50.000 tons in 1983, after the initiation of the soybean project as a second crop by the ministry of Agriculture. About 5000-6000 farmers taken part in this project for Soybean production. Varieties Such as Amsoy 71, Calland, Mitchel and Williams were produced in these regions. The main problems in Soybean production as a second crop in these regions are obtaining adequate and good quality seeds, Storage and drying facilaties and minimizing harvesting losses.

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REPORT ON NATIONALLY COORDINATED RESEARCH PROJECTS ON SOYBEANS IN NIGERIA

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Soybeans were introduced to Nigeria as early as 1906 and were developed primarily as an export crop until the 1960s. At present about 30,000 ha of soybeans are grown in Nigeria and virtually all of that production is used for direct human consumption. In 1981 the four institutes in Nigeria responsible for soybean research and improvement initiated a coordinated research project to test promising varieties and cooperate on other research projects such as insecticide trials and on-farm testing. Since that time the trial network has expanded from seven to 16 locations ranging from tropical rain forest (>1500mm rainfall) to northern Guinea Savanna (1000mm rainfall). 1984 trial will comprise 12 medium (105-120 days) and 12 late (120 days) duration entries. The trials are uninoculated and new entries are duplicated for a with N and without N treatment. Results so far show no consistent advantage of supplemental N for promiscuous varieties. Two varieties SAMSOY '1' and SAMSOY '2' have shown broad adaptation and have been released as a result of this program and three other lines TGx 536-100C-Y, TGx 297-192C, and TGx 306-036C have had consistently high yield. TGx 304-034D has shown promise in the higher rainfall areas. Although bacterial pustule was the most widespread disease on soybean in the trials, it did not appear to depress yield much and a few varieties like TGx 306-036C showed some resistance.

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SOYBEAN PRODUCTION SYSTEM FOR GERMANY AND CENTRAL AFRICA

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With a total sum of temperature from 2100 to 2400 C° from May to October only a few locations in southern Germany are suitable for soybean cultivation. Because of delayed ripening only a limited amount of N fertilization is possible. To get a minimum grain yield of 25 dt/ha with 40 % crude protein contents it is therefore necessary that at least 200 kg N/ha must be accumulated biologically. Due to low temperature early sowing in April delayed germination for about two weeks with a 30 % germination reduction. Increasing the plant population from 60 to 120 plants/m^2 brought no increase in seed yield. At locations with sandy soils and 2400 C° sum of temperature six sprinkle irrigations of 20 mm each between R_3 and R_6 increased the grain yield from 15 to 34 dt/ha. The grains are severely attacted with fungus in areas with fog formation in the month of September. In southern Germany monoculturing of cultivars from maturity groups 0 and 00 in the month of May after tilling the soil with cultivator, using herbicides, like Basagran, Tantizon or Sencor, plus mechanical weeding can give a harvest between 25 to 35 dt/ha in areas without fog and high temperature. If soybean is sown as a second crop after early potatoes the yield is limited to 20 dt/ha. Soybean production under tropical conditions demands another set of parameters like disc harrowing or Chisel ploughing instead of discing or mouldboard ploughing alongwith mulching in order to preserve rhizobia against high temperature and moisture stress.

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SOYBEAN IN SPAIN

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The soybean has been grown commercially in Spain for many years. However, the planted area has been small despite incentives for expansion of the crop. Since 1969 a considerable effort has been made to coordinate the activities of public and private groups in a manner that would result in the proper development of the crop. Agronomic and economic conditions have emphasized the need to irrigate soybeans in most areas of Spain. Because of the competition with other crops, soybeans are grown as a second crop in 80% of the planted acreage. The maximum planted area in the past 15 years has been 25,000 ha, with an average of 8,000 ha per year. A prolonged drought significantly lowered the planted area during the past three years. Normal seed yield ranges between 3,000 and 4,000 kg/ha for the first crop and between 2,000 and 3,000 kg/ha for the second crop. The research effort has been principally carried out by a group of INIA scientists located in San Jose' de la Rinconada (Sevilla), supported by other regional centers of INIA. The principal centers of INIA. The principal areas of research have been evaluation of varieties, planting dates, breeding, irrigation, production systems, weed control, selection of efficient Rhizobium, inoculant production, and the development of an INIA inoculant factory to supply national needs. The animal production structure of Spain demands a larger amount of soybean production. However, it would be desirable to increase the planted area to between 50,000 and 100,000 ha in order to balance land utilization and the other agricultural needs of the country.

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INFLUENCE OF LOCATION ON GRAIN YIELD AND SEED COMPONENTS

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Field trials with seven soybean varieties were carried out in the Federal Republic of Germany (Gross-Gerau), Austria (Vienna), Turkey (Bornova), Tunesia (Medjerda Valey) and Morocco (Rabat, Maracesh and Agadir). The effect of the locations as well as the interactions locations/seasons are highly significant. The yield differences are influenced by the water supply. Early sowing in March/April could help reduce the water consumption. In relation to the seed ingredients the effects of the locations, seasons and their interactions are evident. The warmer locations obtained a lower protein-content than the cooler regions, where as the acid-fat-content increases with higher temperatures and reaches in Tunesia 24,5 % in the mean of the varieties. With later sowing, increasing temperatures and drought conditions, the linolenic-acid-content is reduced, where as the olein-acid-content increases.

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AGRO - CLIMATIC POTENTIAL OF NORTHERN UGANDA FOR EXTENSIVE CULTIVATION OF SOYABEAN

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Edaphological, rainfall and weather characteristics of northern Uganda were studied and potential areas for extensive cultivation of soyabean identified. Climatic water balance studies using 10 day rainfall at Gulu and Lira as inputs to the soil moisture storage and estimated evapotranspiration for different cropping sequence for soyabean as withdrawals, were carried out to evaluate soil moisture regime and crop available water. Agro - environmental conditions at both sites are judged conducive for growth of cultivars of about 100 days duration during late March to early July and of about 120 days duration during late July to early November. Though rainfall potential at Lira is lower, the rainfall utilization efficiency and crop production potential are expected to be higher than that of Gulu. This type of study has great potential for selection of suitable crops and varieties for a location and identification of ecological iso-climes to facilitate transfer of appropriate farming system technology.

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SOYABEAN PRODUCTION BY SMALL SCALE FARMERS IN ZAMBIA

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Soyabeans (Glycine max (L) Merr.) are a relatively new crop in Zambia and until recently it was primarily grown by large scale farmers in rotation with irri-

gated wheat and rainfed maize. Recently there has been an increased government emphasis to promote soyabean production among the small scale farmers. Major limiting factors in soyabean production by Small Scale farmers was the availability, storage and application of inoculum. This constraint has been overcome by the development of two naturally nodulating soyabean varieties namely Hernon 147 and Magoye that can produce yields of 2-3 tonnes per ha without the use of inoculum because these have the capability of effective nodulation with the indigenous Rhizobia. The possible donor of this trait is cultivar Gilbert. Drilling as a method of planting has not become popular with the small scale farmers. Experimental data indicate that similar yields can be obtained if soyabean is planted on Hills of 25cm apart, with 7 to 10 seeds per hill as compared to drilling. The use of an effective extension method which is based on simple measurements has contributed significantly towards promoting soyabean production among these farmers.

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SOYBEAN RESEARCH AND PRODUCTION IN ETHIOPIA

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Soybean, even though introduced as a new crop to Ethiopia in 1950s, does have high potential in nutritional value and yield. Starting the period soybean was introduced research is being done to identify; suitable varieties and areas, its agronomic aspect, limiting factors in production and its utilization. Varieties Davis, Clark 63K, Williams, Cocker 240, Mandarine, Kanrich V_1, Celeste etc. are high yielders with wide adaptation. Early maturity group cultivars such as Williams are highly adapted to areas with erratic rainfall. Sowing date varies depending on the climatic condition of a region and maturity group of the cultivars; Generally it is with in mid-June to mid-July. Bacterial blight (Xanthomonas phaseoli) is an important disease. Cut worm (Agrotis segtum) is an important insect pest. Broad leafed weeds are problematic if not weeded at the proper time in production areas. Traditional Recipes 'Injera', 'Kita', 'Dabo', 'Dabokolo' and Porridge are prepared by mixing roasted soybean flour with cereals flour except corn. Most of the varieties mentioned above are under production and the main constraints are lack of trained man power and strengthened extension work.

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IMPORTANT ADVANCES IN SOYBEAN BREEDING IN CHINA

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Limiting source materials to the same maturity group or neighboring groups is an important reason that soybean breeders cannot achieve a breakthrough in their breeding. Using geographically distant hybridization, polyway crosses and SSD, the author has developed successfully some new lines with specific characteristics. It is a first in soybean breeding history in China. The new soybean line, Shennong 25104, significantly surpassed the check under normal and abnormal conditions. Its adaptation extends to summer-soybean and double-crop areas. Author's success resulted in widening breeders' thoughts and ideas. It breaks the barrier of genetic research in soybean maturity, and will enrich Chinese breeders; from now on they can withdraw their "deposit" from the "genebank" for all purposes.

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NEW APPROACH TO SOYBEAN PROGRAM THROUGH GROWERS COOPERATIVES IN INDIA

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Soybean program is gaining momentum in soybean State (Madhya Pradesh) of India through Soybean Growers Cooperatives which are federated into Apex Institution. The specific objectives of new integrated approach are to step up production of soybean, to organise producers cooperatives, to ensure procurement of produce by cooperatives, to secure premium price to growers, to retrieve growers from trade exploitation, to build up adequate effective marketing, training, research and development. The system likely to succeed for a new introductory crop like soybean has to be one which links all the stages through which a commodity passes, production, processing, marketing and distribution. Attempts are made to solve production problems at Research and Development Centre and low cost production technology is transferred to soybean growers. Location specific research has been done at such centres. Results of such an approach on soybean production and prevailing market price have been amazing. It has brought good economic returns to farmers and resulted in increased productivity of soybean. This has been termed as "Anand pattern approach".

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THE POTENTIAL OF SOYBEANS IN THE CROPPING PATTERNS OF PAKISTAN

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Although testing on small scale is in progress since long development of soybeans as an edible oilseed crop has only been started recently with a view to arrest the expanding deficit of edible oils which stood at over 500 thousand tonnes during 1982-83. Local demand for soy meal is developing from fast expanding poultry industry. Northern hilly areas and southernmost part have shown good potential as summer crop where it covers 5000 ha. In the irrigated plains of central & southern Pakistan spring crop has given good performance. The soil improving property of soybeans has been demonstrated. Excellent response to Rhizobium inoculation in the plains has been obtained. It has appeared promising as intercrop especially with sugarcane & maize. Due to stable yields soybeans could prove a dependable rotation crop in much of the 14.3 m. ha. irrigated area and 5 million ha rainfed area which have a number of cropping patterns. Of the production problems limiting soybean expansion, poor seed germination and absence of regular supplies of effective Rhizobium inoculum are important. Varieties with tolerance to salinity would be necessary for expanding the scope of its cultivation.

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COUNTRY REPORT - RESEARCH AND DEVELOPMENT ACTIVITIES ON SOYBEAN IN PAKISTAN

Akhtar Beg, Mohammad Yousaf, A. Rahman Khan, NARC, PARC, Islamabad, Pakistan.

A primitive variety of soybean is grown in the foot hill areas of North West Frontier Province of Pakistan. The seed of this variety is dark mustard in colour and contains 15.3% oil. This prompted soybean research in Pakistan in late fifties and early sixties. Many cultivars from USA have been tried in different areas of the country. In 1968 variety Lee and Bragg were approved for commercial cultivation in North West Frontier Province. Later areas have been identified in Central and South Pakistan where after harvest of cotton and rice about 3 million acres remain fallow in winter months from November/December to May. Short duration varieties of soybean have been selected which are planted in February and harvested in May to allow rice and cotton planting in June. The present area and production of soybean in Pakistan are 3237 hectares and 2074 metric tonnes with an average yield of 641 kg/ha. Production technology like date of planting, row and plant spacing, sowing method, fertilizer and irrigation need have been worked out. There are three researchable areas of economic importance viz., short duration varieties, rhizobium inoculation and mosaic virus.

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EVALUATION OF SOYBEAN VARIETIES IN PAKISTAN

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A field experiment consisting of 16 varieties differing in maturity and growth characteristics from group II to VII were planted in 5-meter rows, 60 cm apart in 1976 in four ecological regions at Islamabad, Lahore, Swat and Mirwah. Data were taken on days to flowering and maturity, plant height, lodging and seed yield. Highest yield was obtained by Bragg(1129.37 kg/ha) at Islamabad. Ransom gave 211.10 kg/ha and Davis 215.35 kg/ha at Lahore. Davis gave 3161.03 kg/ha and Bragg 3024.60 kg/ha at Swat. Varieties Ransom and Bragg top the list by giving 2392.14 kg/ha and 1228.78 kg/ha at Mirwah. The yield level were highest at Swat compared to other locations due to suitable climatic condition prevailing at that place. Average of the four locations indicate that Bragg gave the maximum seed yield (1644.14 kg/ha) with plant height of 58.38 cm & flowered in 42.6 days, the average maturity of Bragg was 98.7 days. The variety which matured in the least number of days was Woodworth taking 88.1 days, Williams and Well took 89.1 days and Beeson 90 days. Short duration varieties are the most suitable for cotton growing areas of Pakistan due to availability of fallow land.

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PERFORMANCE OF EXOTIC SOYBEAN CULTIVARS IN BANGLADESH

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Soybean is a new crop in Bangladesh. It was effectively introduced in 1975-76. Bangladesh Agricultural Research Institute (BARI) has been conducting research on Soybean since then. By now two varieties namely Bragg and Davis have been released as cultivars. This is an ISVEX trial taken up as a part of INTSOY programme taken up in summer 1983 at BARI with a view to select high yielding varieties. It appears from the result that all the varieties under trial have out yielded the local check "Davis". SIASTA 194 was first with 2356 kg/ha and F-75-9207 was second with 1871 kg/ha in yield against Davis with 1348.88 kg/ha. As regards days to maturity SIASTA 194 took only 3 days more than the check.

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EVALUATION OF SOYBEAN VARIETIES IN SOUTHERN BANGLADESH

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A soybean production and utilization project is run by the Mennonite Central Committee in southern Bangladesh. Currently only Bragg and Davis varieties are approved by the government for extension. To fit the traditional rice-rice-winter crop pattern, a variety with short duration (growing season) is necessary. Other factors important in establishing soybean as a crop in Bangladesh are yield and planting seed longevity. Evaluation of soybean varieties centers on these three factors, using date-of-planting and seed storage trials. Bragg has proved superior to Davis, as it matures two to three weeks earlier. Soybeans must be harvested by mid April, when the first rice crop is planted. Soybeans are planted from early December to mid January. This requires a maximum duration of from 120 down to 90 days. Variation in duration has been noted for varieties, years, locations, and soil moisture conditions. Varieties which are of suitable duration and yield higher than Bragg include: Essex, Union, Elf, Williams, Pb-1 (from Sri Lanka), and Crawford. Yields for these varieties were significantly higher (30-55%) than Bragg (1110 kg/ha) in the 1982-83 evaluation at Raipur. In 1980-81 farmers' field trials, Williams averaged 1640 kg/ha and Bragg 1400 kg/ha. Williams seed stored up to eight months in polythene bags averaged 79% emergence, Bragg seed 69%. In other seed storage trials, Pb-1 has consistently germinated over 80%. Essex has stored better than Bragg, while Elf has stored poorly. New varieties for southern Bangladesh should mature by mid April and have better yield and seed longevity than Bragg.

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SOYBEAN EXTENSION WORK IN THAILAND

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The Soybean Extension Programme is part of the National Soybean Production Plan which aims for the development of the livelihood of the farmers and to increase the domestic production to 300,000 metric tonnes. The present soybean production is approximately 150,000 metric tonnes. It is difficult to carry out the extension programme because farmers are poor, low educated and a lack knowledge to develop themselves. Then, the goal of the programme is mainly concerned with the distribution of quality inputs, stands on the concept of "learning by doing", such as seeds, rhizobium and pesticides in the form of

seed exchange programme, rhizobium distribution, existing technology transfer and the marketing information. Thailand, in cooperation with the American Soybean Association has also "Soybean Weeks" conducted in Thailand to utilize soybeans in the local people's diet. The extension programme will try to encourage the farmers to work as a group, sharing initial investments and utilizing known practices. Farmers could be trained by group activities.

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MALAYSIAN EXPERIENCE IN SOYBEAN PRODUCTION

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The increase in population and living standard have triggered a substantial increase in the demand for high-protein diets in Malaysia. The soybean is potentially vital because of its versatility and high protein values as human food and animal feed. As Malaysia is the world's major palm oil producer,soybean is considered as an important source of protein and not oil.
Local scientists are looking into the possibilities of growing soybeans commercially. The research programmes now being undertaken indicate that soybean has a high yield potential. However, a number of production problems such as yield instability, pests and diseases, weeds, inefficient water management could negatively affect the exploitation of this yield potential. Though its potential use as an intercrop in young rubber and oil palm plantations has been highlighted, it is still unprofitable to grow soybean compared to other intercrops.
In order to commercialize soybean production in Malaysia, the first priority in research may have to do with yield improvement coupled with a production technology such as mechanization to reduce labour cost. Otherwise,it is uneconomical to produce soybean locally.

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AGRONOMIC PRACTICES FOR SOYBEAN PRODUCTION AFTER LOWLAND RICE IN INDONESIA

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The potential for increasing soybean production following crops of rice offers one of the best immediate opportunities for increased food production in Indonesia. Of 800,000 ha of soybean harvested annually,about 60 percent are planted after lowland rice.
The yields range from o.6 to 1.o t/ha,with average of o.9 t/ha. These average yields have not changed significantly during the past ten years. In spite of the value of soybean as a food,feed and oil source in Indonesia,production has not been sufficient to meet local requirements.
Dibbling the seed rather than broadcasting can increase yield by up to 50% in certain varieties.A further cultural practise which may improved establishment and yield is mulching with rice straw at sowing.In responsive variety there was a 25% increase in yield in both broadcast and dibblid crops. One potential method for increasing soybean yield without using expensive fertilizer is to inoculate the seed with suitable Rhizobium culture. The limited results obtained for East Java are not encouraging,perhape due to the presence of suitable Rhizobium strains in the soil,or to other more important limitation to yield.
Recommended practise must pay intention to position of the crop in the succession,the constraints labour availability and the limitation on yield escoted by the available water. Research so far indicated that dibbling rather than broadcasting the seed and mulching with rice straw are worthwhile improvements,which can be adopted by farmers without difficulty.

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IMPROVEMENT OF SOYBEANS IN THE CERRADOS OF CENTRAL BRAZIL

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The response of cultivated soybeans (Glycine max (L.) Merrill) to changes in photoperiod has limited its expansion to tropical regions. When soybean cultivars are introduced in regions of lower latitudes than those of their adaptation there will be a reduction in their biological cycle followed by reduction in plant height, a decisive factor in the fully-mechanized crop. The research work on soybean breeding in Brazil has made it possible to obtain new cultivars highly adapted to low latitudes. Variety trials conducted in many locations have shown the potential for the soybean crop in the low latitude Cerrados. The results of soybean varietal research conducted by the Centro de Pesquisa Agropecuária dos Cerrados (Cerrados National Research Center) at latitudes between 14 and 16° South are discussed. The adaptability of the new soybean genotypes created for low latitudes is evidenced by the good agronomic characteristics and high yield ability, which is comparable or superior to that obtained in the traditional soybean cropping areas of Brazil.

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NEW CULTURAL PRACTICES AND TECHNOLOGY FOR PRODUCING AND MAKING USE OF SOYBEAN AT DOMESTIC LEVEL IN MEXICO

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Protein defficiency is a major problem in marginal sectors of México. Animal protein supply is insufficient and its price is prohibite to low income group. High protein content. good nutritional quality and low cost make soybean an attractive sbstitute for meat or fish, provided that it's produced, transformed and incorporated into traditional dishes by the members of the family. From 1976, through the aid of the Government of Guerrero State, we began a series of "Educational Programs with Soybean" which are now expanded in more than 6 states of the Republic (Colima. México, etc.). The programs consisted of two facets: 1) Training and supplying to a family with designed rustic implements, seeds, pesticides, fertilizers, and the technological package, presented in "Cooking Recipe Style" on how to produce BM_2 soybean at domestic level. The methodological procedure and the results of these programs will be discussed in this paper.

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SOYBEAN DEVELOPMENT FOR THE IRRIGATED CANADIAN PRAIRIES

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The lack of early-maturing and high-yielding cultivars with acceptable protein levels restricted soybean production in the Canadian Prairies in the past, but now the maturity bottleneck has been broken by recent Ottawa-bred varieties and agronomic and microbiological studies at Lethbridge have defined practices and conditions suitable for soybean production. Irrigation is required in southern Alberta to optimize yields. Seasonal water use averages over 400 mm, peaking near R5 with 7 mm/day. Inoculation with rhizobia, which do not exist in western Canadian soils, increases soybean yields. Inoculated, unfertilized soybeans outyielded uninoculated soybeans receiving 160 kg/ha of fertilizer N. R. japonicum strains 61A148 and 61A118 were superior in fixing nitrogen, while the unimproved 61A101 was inefficient. NIR calibrations for plant nitrogen are in progress to aid early-generation screening for enhanced N_2-fixation support. Our breeding program emphasizes high-protein lines. Early-generation NIR- screening permits over 90% of entries with adequate protein levels in multi-site yield tests. The breeding program is aided by 1- or 2-generation increases in a winter nursery. We are incorporating diverse lines from China to broaden our germplasm base.

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SOYBEANS IN INDIA

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Soybean is a newly introduced crop in Indian Agriculture. As a rainy season crop soybean can be grown in different parts of the country. The increase in planted area of soybeans from 300 ha in 1968 to about 0.9 million ha during 1983-84, and with ambitious plans to achieve a target of around 2.5 million ha by 1985-86, speaks for itself. It shows that, despite of numerous detractions, the value of soybeans in the country has been recognized. The Indian Council of Agricultural Research has launched a multilocation, inter-disciplinary All-India Coordinated Research Project on Soybeans. There are 18 centers for the project in the country. The research efforts on various aspects of crop management have sequentially led to standardization of production technology for profitable yield. About 4,000 lines from different parts of the world have systematically been evaluated and sources identified for resistance to yellow mosaic, rust, bacterial pustule, and macro-phomina. Emphasis has been on the development of varieties suitable for different regions of the Indian subcontinent. Further work is necessary to gain a deeper insight into specific problems of practical importance, so that productivity of the soybean can be enhanced further. The goal is to achieve the level of the world productivity average, and to popularize its utilization in the villages.

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SOYBEANS IN CHILE

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Soybeans were introduced in Chile in the early fifties, as an oil crop. The species did not compete well with sunflower or rapeseed, the country's two main oil crops. In the early seventies it again arose interest as a protein-producing crop. Efforts to increase its area met with limited success, now because of non-attractive prices, and due to competition for soil with corn, a high-yielding crop, and common beans, an export and domestic-use crop. Soybean utilization, however, is important, as oil, animal feed and protein products. Soybeans are mainly imported from Brazil and Paraguay. Research data show that US cultivars belonging to Maturity Groups (MG) 00 and 0 planted immediately after a small grain, and I, II and III using the full season, yield well above 3 tons per hectare. Narrow rows (20 to 40 cm) are recommended, with populations of 400,000 plants per hectare. If an effective plant-Rhizobium japonicum symbiosis is attained, nitrogen fertilizer may be detrimental to yield. Cultivars of MG I, II and III yield better in early plantings (October). The crop which must be grown under irrigation since usually there is no precipitation during its growing cycle, is susceptible to moisture stress.

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A COMPARATIVE STUDY ON SOME EARLY MATURING SOYBEAN CULTIVARS GROWN UNDER EGYPTIAN CONDITIONS

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Soybean is a newly introduced crop in Egypt. It competes with other summer crops for limited land. For achieving a higher degree of crop intensification early maturing cultivars are required. Field experiments were conducted to compare the growth and yield of 14 cultivars of soybean for temperate zones imported from the USA-INTSOY (Exp. 3523-1983), with the local cultivars Columbus and Forrest. The two local soybean cultivars were relatively late maturing (D. to maturity = 129-133) and low yielding. Evans proved to be the earliest maturing soybean cultivar (D. to maturity = 78), and produced the lowest vegetative growth and yield. The most promising cultivars were BSR 201 and Lacota, they matured 40 days earer and produced higher yield than that of the two local cultivars. The highest yield was produced by Crawford and Sparks, which were medium maturity (D. to maturity = 115-117). Thus, it was concluded that BSR 201 and Lakota are early maturing soybean cultivars that can be used in crop intensification programs.

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PRODUCTION OF SOYBEAN IN EGYPT

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Soybean in Egypt succeeds all over the country. It gives high benefit to the farmers because of the short time it stays in the soil. It is good in light, sandy soils; bad in sandy and salt soils. Soybean

is planted in Egypt after early winter crops. It succeeds when planted in April.

The planted area

Year	Feddan (Acre)	Production Ton
1979	100421	106033
1980	84767	92377
1981	109420	130360
1982	146018	151689
1983	147155	161763

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PHYSIOLOGICAL ASPECTS OF SOYBEAN VERSUS MAIZE IN NORTH ITALY

L. Toniolo, G. Mosca, M. Sattin, Institute of Agronomy University od Padova, Italy

In the North Italy soybean has been introduced and studied only recently. It has been compared with maize which is more suitable and cultivated on large scale. Corn and soybean have been comparing on dry culture in field trials for two years (1981-82). Two soybean varieties and two corn's hybrids were considered in factorial combination with two plant densities (soybean: 20-50 plants/sqm; maize: 5-7 plants/sqm). This research was carried out by growth analysis method: many indeces were detected but only L,E,C, are resulted more interesting. In the two years experiments, the rainfall and the water table depth were quite different, while heat units and helio-thermal units were very similar. In the 1982 there was a drought period at corn flowering time that caused a water stress. In the corn L had the same course in two years of trials, while E decreased roughly in the filling period in latter year. It means that there was a less efficiency in the storing up of dry matter from flowering till the last part of the growing season. The low growth rate (C) during the water stress, shows further the less efficiency. In soybean, during the former year L was normal, while in the latter it was very low. In the whole period of trial E showed similar data: a constant decrease during the whole cycle. L was slightly lower in the latter year. In this case the lower number of leaves in one species which shows an over L and normal E, can bear, at last, water stress more than maize. The varieties used in the experiments changed there growth rate according to the variation of sqm plant number and of the year.

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PARTITIONING OF CARBON AND NITROGEN WITHIN N_2 — FIXING GRAIN LEGUMES

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This paper provides detailed assessments of the economy of functioning of different organs of selected grain legumes and presents an overview of the principles whereby these plant parts interact nutritionally during plant growth and development. Budgets for carbon, nitrogen and water are constructed for selected plant organs and an attempt made to show how the structural, physiological and metabolic characteristics of each organ shape the contributions and demands which it makes in whole plant functioning. The plant parts whose economies will be considered are, the root, root nodule, developing leaf, leaf, fruit, and stem. Emphasis is placed throughout on the role of xylem and phloem long distance transport and of short distance xylem to phloem or xylem to xylem exchange in partitioning of water and solutes throughout the plant. The ultimate aim of studies of this nature is to provide a physiological basis for evaluating how effectively different plant genotypes utilize their photosynthetic resource, water and fixed nitrogen for the production of plant and seed dry matter. It should then prove possible to provide physiological criteria for selecting more productive plants or plants specifically suited to specific environments.

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EXPANDING OPPORTUNITIES FOR UTILIZATION OF SOYBEAN OIL AND PROTEIN

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Many new and ever increasing uses of soybean oil and proteins fuel continued expansion in consumption of soybeans throughout the world. Although there are hundreds of uses for soy products, about 95% of the oil is used in food products and an even higher percentage of the extracted meal is used in poultry and livestock feeds. There continues to be opportunities to increase consumption in conventional items by innovations in product development and marketing and to expand into new areas with the help of additional research. Several such opportunities reviewed under these parameters will include such areas as a) use of soy flour in breads and breadlike products, b) new types of soy based protein beverages, c) increased consumption of protein meals in such places as the USSR and China in poultry and swine production; cooperative market and feeding studies seem indicated to achieve results, d) use of soybean oil as replacement for animal fats in meats and milks, e) use of soybean oil in pesticide applications, f) use of oil as a dust suppressant in grain handling, g) use of soybean oil as a caloric energy source in developing countries such as India; market research and product development indicated in order to develop acceptable foods and food delivery systems, h) further use of soybean oil as a replacement for cholesterol containing fats in meats and milks, i) nutritional uses of soybean lecithin, and j) use of soybean oil or methyl esters as additive to diesel and kerosene fuels.

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BREEDING PRODUCTIVE SOYBEAN VARIETIES WITH RESISTANCE TO THE SOYBEAN CYST NEMATODE

E. E. Hartwig, USDA, ARS, Stoneville, MS

Breeding programs to develop productive soybean varieties resistant to the soybean cyst nematode (SCN) have been in progress in the U.S. since 1957 when resistant germplasm was identified. Fifteen publicly developed SCN resistant varieties have been released for production. The first SCN resistant varieties to be released (Pickett and Dyer) averaged about 10% lower in yield than adapted varieties when grown in the absence of SCN. Forrest (Group V), having resistance to SCN race 3 and released in 1972, is highly productive and remains one of the highest yielding varieties available in its area of adaptation. All subsequent SCN resistant varieties released for production in the Southern U.S. have been high yielding in the absence of SCN. The initial source of resistance used in the breeding program was Peking. After variation in the nematode populations was recognized and races designated, PI 88788 was used as a source of resistance to

SCN race 4. Bedford was released in 1977 to provide a productive variety resistant to SCN race 4. Several other biotypes of the nematode have been recognized in fields after the major populations have been reduced in numbers following production of SCN resistant varieties. It appears that the four sources of resistance to SCN, Peking, PI 88788, PI 89772, and PI 90763 provide genes for controlling the nematode population within the U.S. An attempt is being made to accumulate genes from the several sources into a common background. Linkage appears to hamper combining resistance to races 4 and 5.

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RESISTANCE TO INSECT DEFOLIATORS

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Major foliage feeders of soybean are velvetbean caterpillar, Anticarsia gemmatalis Hubner and soybean looper, Pseudoplusia includens[Walker]. Others include Mexican bean beetle, Epilachna varivestis Mulsant, corn earworm, Heliothis zea[Boddie],cabbage looper, Trichoplusia ni Hubner, and green cloverworm, Platypena scabra[Fabricius]. Excellent sources of resistance to all of these pests, except velvetbean caterpillar, have been demonstrated in Plant Introductions 171451, 227687, 229358; moderate levels of resistance to velvetbean caterpillar have been shown. These PI's belong to maturity groups VII and VIII. Additional sources of resistance to Mexican bean beetle are available in maturity groups III-V in Plant Introductions 90481, 96089, and 157413. Advanced breeding lines have been developed in several programs that have resulted in nine germplasm line releases. These are D75-10169 (Group VIII) resistant to velvetbean caterpillar, soybean looper, corn earworm, and Mexican bean beetle; N80-50232 (Group VII), N79-2282 (Group VII), N80-53201 (Group V) all resistant to corn earworm and Mexican bean beetle; L76-0038 (Group IV), L76-0049 (Group V), L76-0132 (Group V), L76-0272 (Group IV), L76-0328 (Group IV) all resistant to Mexican bean beetle. Seed of these germplasm line releases are available upon request.

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PHYSIOLOGICAL ACTIVITY OF RUBP CARBOXYLASE FROM FIELD-GROWN SOYBEAN (CV. WILLIAMS 79)

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Studies were initiated to evaluate the extent to which RubPC physiological activity varies under field conditions, and to relate RubPC activity to net photosynthesis rates. Enzyme activity was measured immediately after extraction without prior activation (initial activity, IA), and following CO_2 and Mg^{2+} activation in vitro (total activity, TA). RubPC protein was measured by rocket immunoelectrophoresis. IA represents physiological RubPC activity. IA and TA were measured from upper canopy leaves from 5:45 AM until 10:00 PM. IA varied from about 0.15 units (μmol(mg RubPC)$^{-1}$ min^{-1}) before sunrise to 1.0-1.2 units at mid-day. TA varied from 0.4 units (morning) to 1.0-1.2 units (mid-day). When plots were shaded until noon, both IA and TA remained at pre-dawn levels, but when the shades were removed activity increased sharply to maximal values. When shades were replaced TA remained high but IA declined slowly. IA from untreated lower canopy leaves was about 38% of TA (1.2 units). When lower leaves were exposed to full sun, activity increased sharply but only to about 2/3 of TA. In vivo mechanisms to account for light-induced changes in IA based upon chloroplast stroma pH and [Mg^{2+}] are apparent, but the explanation for low TA from dark-adapted leaves is not clear. It is not due to slow activation kinetics or to a mechanism sensitive to DTT. In greenhouse studies it was found that leaf PHS and IA were highly correlated when both were varied by changes in light intensity.

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POTENTIAL FOR CONTROLLING PHOTORESPIRATION IN SOYBEANS.

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Photorespiration is a major limitation to soybean photosynthetic productivity, and eliminating photorespiration in the laboratory increases net photosynthesis by about 50%. Both photosynthesis and photorespiration are initiated by the bifunctional enzyme ribulose bisphosphate carboxylase/oxygenase (Rubisco). Three strategies have been employed in this laboratory in attempts to reduce the photorespiration. In the first procedure, using Arabidopsis thaliana as a model organism, several single recessive nuclear mutations have been recovered in enzymes of the photorespiratory pathway. These mutations render photorespiration a conditionally lethal characteristic. The mutant strains are then used to select for second-site revertants which survive the lethal conditions. Such revertants would be unable to initiate the photorespiratory pathway and therefore possess enhanced photosynthetic activity. A second approach, using the green alga Chlamydomonas reinhardii, was designed to determine the feasibility of altering the two activities of Rubisco. Mutants have been recovered which possess defective Rubisco and thus lack the ability to fix CO_2. Photoautotrophic revertants are then recovered and the Rubisco enzyme is examined. We are searching for revertants with an increased carboxylation/oxygenation ratio, indicating increased photosynthetic efficiency. In the third approach, Chlamydomonas mutants defective in the algal CO_2-concentrating system have been isolated and characterized to determine whether such a system might be incorporated into higher plant species with C_3 photosynthesis, such as soybeans.

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FACTORS INFLUENCING CANOPY ASSIMILATION OF SOYBEAN

K. J. Boote, J. W. Jones, and J. M. Bennett, Univ. of Florida, Gainesville, USA 32611

The literature reviewed in this paper illustrates that canopy assimilation of soybean is directly related to yield capacity, and can be selected for to improve yield. This contrasts to leaf photosynthesis rates which have often not shown good relationships to soybean seed yields inspite of the intuitive importance of assimilation to seed yield. There is a need to properly report canopy assimilation measurements as apparent canopy photosynthesis (ACP), net canopy photosynthesis (NCP), or total canopy photosynthesis (TCP) depending on whether the measurements include CO_2 efflux from soil-roots-nodules (SOILFLUX) and/or CO_2 efflux from non-photosynthesizing tissue (CROPRESP). Field measurement of ACP is the net result of three concurrent CO_2 fluxes: SOILFLUX, CROPRESP, and TCP. NCP is defined as ACP minus SOILFLUX and TCP is defined as ACP minus SOILFLUX and CROPRESP. Most researchers report fairly similar results if assimilation is compared

within ACP, NCP, or TCP categories. Responses of ACP, NCP, TCP, and efflux components are influenced by light, temperature, leaf area index, N-remobilization, root-and-nodule growth, canopy biomass, and soil water. Early season ACP can be negative when the absolute value of SOILFLUX is larger than photosynthetic uptake. Response of TCP to LAI appears to become asymptotic above an LAI of 5. Cultivar differences in assimilation are minimal during early growth, but become significant during mid-to-late seed growth. There appears to be only moderate potential to genetically improve canopy assimilation.

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PHYSIOLOGY OF GENOTYPIC DIFFERENCES

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Over the past 25-year period, numerous groups have studied the physiology of genotypic differences in leaf photosynthetic CO_2 exchange rates (CER) in soybean. Controlling stomatal conductance for measurements within a genotype is a major problem. Generalizations have emerged from the mass of data reported that are fairly consistent among reports; exceptions usually can be explained. During vegetative growth through early pod fill, CER frequently is positively correlated with chlorophyll, protein, percent N, leaf thickness and Specific Leaf Mass (SLM); such correlation is associated with an energy cost for the needed extra C and N. Area per foliolate at the higher mainstem nodes on the plant is negatively correlated with CER during flowering and early pod fill. Lower leaf CER and SLM values can result in greater area and CER per plant during canopy expansion. CER during pod fill is negatively correlated with redistribution of leaf N to the seed. Considerations of interactions between CER and other physiological and agronomical aspects of whole plant behavior should result soon in simple crop measurements that can be correlated with yield.

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TECHNOLOGICAL ISSUES IN THE PROCESSING INDUSTRY

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In recent years the soybean processing industry has been affected by a number of economic factors which is significantly changing its character and makeup. The effect these and other factors are having on the technology of the industry is dramatic. Plants are becoming larger in capacity, simpler in layout, increasingly controlled by computers, and operated by less personnel. As a result they are even more cost efficient then ever. Fluidized bed based preparation processes, more energy efficient disolventizers and dryers, and other improved equipment and processes are being used to accomplish these improvements.

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IMPORTER AND EXPORTER PROCESSING AND THE BEAN-PRODUCT TRADE MIX

G. W. Williams, Iowa State U., Ames, USA.

The annual level of soybean processing in an importing or exporting country is affected by the relative profitability of crushing soybeans, the level of installed crush capacity, and the availability of soybean supplies. Crush margins have remained high enough on average over time that annual variations in crush can be explained mainly by changes in capacity and availability. Over the long run, sustained profitability of crushing, given adequate supplies, leads to increased investment in crush capacity. The bean-product mix of trade is largely a by-product of the interrelated forces that determine the geographic location and levels of soybean crushing in the world. These include: (1) the cheaper cost of transporting soybeans in the raw than in the processed form, (2) the profitability of crushing and availability of supplies, (3) the relative efficiencies of the soybean processing industries among countries, (4) the strength of the demands for processed soybeans in producing compared to importing countries, (5) the level of product demand compared to crush capacity in producing and importing countries, (6) the sizes of the meal and oil markets in exporting compared to importing countries, and (7) government intervention in bean and product markets. The net effect of these forces is largely a shift of processing over time from producing to importing countries. Even so, the relative efficiency of the U.S. industry together with protectionistic government policies will likely continue to provide producing countries with a competitive edge.

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THE IMPACT OF TRANSPORTATION RATES ON WORLD SOYBEAN TRADE COMPETITION

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Although world soybean trade is still dominated by the United States, the challenges from Brazil and Argentina have increased the level of competition for soybean exports. Economically, competition of the world soybean market depends on the product costs, quality of the soybean, and marketing costs. A large share of marketing costs are transportation costs because of the long distances between production regions in exporting countries and importing ports. This paper examines the relative transportation costs from the United States and Brazil to major importing regions and the impact of changing barge and ocean rates on the relative transportation costs from the United States and Brazil to major importing countries.

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FOREIGN DEMAND FOR U.S. AND BRAZILIAN SOYBEANS AND SOYBEAN MEAL

K. D. Sisson, USDA, FAS/CMP, Washington, United States

The availability of competing meals and oilseeds and livestock inventories are the most important factors in explaining U.S. and Brazilian soybean and soybean meal exports to the European Community. Importers are sensitive to prices and readily substitute U.S. beans and meal for Brazilian beans and meal or vice versa. The U.S. soybean meal/European corn price ratio is a significant factor influencing the soybean meal/corn composition of European compound feeds and thus, imports of U.S. soybeans and meal. As long as the prices of soybeans(meal) and corn stay close to each other soybean meal is substituted for corn as an energy source. The price of soybean oil is not considered to be an important factor in explaining either U.S. or Brazilian soybean exports.

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OPTIMIZING SEED PLACEMENT TO MAXIMISE GERMINATION AND EARLY GROWTH

C.J. Baker, New Zealand; P.J. Desborough, Australia

Work at Massey University in temperate New Zealand over 15 years has shown that in no-tillage soils supporting appreciable surface residues, there exists an unusual potential for retention of soil moisture vapour in the surface profile. The single-pass operation of direct-drilling, encourages loss of this moisture vapour from the drilled groove where this is U or V shaped in cross section. An experimental inverted T shaped groove which retains residue over the seed zone has consistently promoted large and significant improvements in seedling emergence and sub-surface seedling survival in dry soils. Residue-retention decreases loss of in-groove humidity which results in reduced pre-emergence embryonic seedling dessication. In wet warm soils containing earthworms, retention of surface residues over inverted T shaped grooves significantly encourages earthworm activity and thence oxygen diffusion rate with a consequent beneficial effect on seed germination and seedling survival compared with the more common open and/or smeared grooves. Physical placement of seeds in predictable and narrow-tolerance zones in relation to compaction and fertilizer zones and the soil surface, is an important machine function which affects seed/seedling/crop performance in otherwise optimal soil moisture conditions. Direct drilling opener design criteria have been adjusted accordingly and successful machines produced.

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IRRIGATION MANAGEMENT FOR SOYBEAN YIELD ENHANCEMENT

L. G. Heatherly, USDA-ARS, Stoneville, MS

Variability in both the occurrence and amount of rainfall during the growing season is often a factor that limits yield potential of soybeans [Glycine max (L.) Merr.]. Irrigation is a management tool that can be utilized to overcome the potential yield-reducing effects of these periods of moisture deficit. Proper timing of application of irrigation to soybeans is critical for the efficient utilization of available water. Available research data indicate that irrigation should be initiated at or near beginning of flowering if needed, and be continued as needed until seed are fully developed to realize maximum yield potential. Irrigation should be utilized in any year when periods of drought stress occur in order to maintain the yield potential established by previous irrigation or prior periods of adequate rainfall. If a limited amount of irrigation water is available, then this water should be applied during the podfill stage in order to obtain maximum benefit, because this stage appears to be the most susceptible to drought stress. If irrigation water is not limited, soybeans should be irrigated as needed throughout the reproductive period in order to consistently produce yields of 3000 kg/ha or greater.

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THE IMPACT OF SOYBEANS ON SOIL PHYSICAL PROPERTIES AND SOIL ERODIBILITY

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W. C. Moldenhauer, USDA-ARS, Lafayette, IN, USA
D. V. McCracken, Purdue Univ., Lafayette, IN, USA

The effect of prior cropping on soil erosion is well recognized. When the prior crop is meadow, erosion is greatly reduced; but, if the prior crop is soybeans, erosion is greatly increased. In this paper, the available literature on the effect of soybeans on soil properties and soil erodibility are summarized. Additionally, alternatives for controlling soil erosion during the period after soybeans are harvested is discussed. These alternatives may include no-till, terracing, land use change, contouring, and double cropping.

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RESIDUAL EFFECTS OF CORN AND SOYBEANS ON SUBSEQUENT CORN CROP

R. M. Cruse and I. C. Anderson, Iowa State University, Ames, U.S.A.

Corn (Zea mays L.) crop following soybeans (Glycine max L.) yields about 10% more than corn following corn under conditions of adequate nitrogen fertilizer. This effect has been reported by researchers based on the long term crop rotations conducted in the Midwest. The response appears to be an allelochemical effect of the previous soybean or corn crop on yield of the subsequent corn crop. Research is being conducted to determine if the yield difference is due to a stimulatory allelochemical effect of the previous soybean crop or an inhibitory allelochemical effect of the previous corn crop. Evidence supporting both concepts have been reported. Chloroform extracts of soil-soybean residue taken after soybeans when fractionated by column chromatography contains two chemicals, in addition to triacontanol, which stimulate early growth of corn seedlings; but of course such a phenomena proves little about effects on corn yield. Water extracts of corn residue or soil-corn residue or the residue itself are inhibitory to early growth of corn seedlings. Residue of corn hybrids differ in toxicity. Also, during the summer corn plants excrete inhibitors into the soil which are extractible with water. These inhibitory chemicals appear to be rather stable in the soil. Experiments with removing or moving above ground soybean and corn residue indicate that the major portion of the allelochemical is associated with the soil instead with the above ground residue.

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NEW NON-FOOD UESE OF SOYBEAN OIL

L. Beauregard, Erickson, D., American Soybean Assn., St. Louis, U.S.A.

This presentation will deal primarily with recent programs of the American Soybean Association aimed towards the development of new, non-food uses for soybean oil. A brief review will be given of the market situation and forces which motivate ASA's development of programs to seek out new uses. Then, an overview will be given of the most promising, ongoing non-food programs. These involve the utilization of soybean oil in a variety of pesticide formulations, and as a dust suppressant in grain

elevators. Finally, a review will be made of the more traditional uses for soybean oil as a chemical feedstock or as an alternative chemical.

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SOYA OIL USES IN FOODS

S. Patel, Central Soya, Ft. Wayne, USA

This presentation briefly traces the progress of Soya oil uses in U.S. foods and the factors leading to its dominant position in the U.S. food fat economy. The unit operations of modern Soya processing plant are explained - how Soya oil is continuously upgraded in quality and modified by the hydrogenation process to custom-fit the exacting requirements of today's sophisticated foods. State-of-the-art processing equipment, technologies and application of the scientific findings are highlighted. In addition to a multitude of uses in foods, Soya oil is well positioned to replace animal fats such as tallow and lard and imported coconut oil as the national dietary/health trends to reduce cholesterol and saturated fats are taking shape. The research areas of interest and challenges faced by Soya oil to maintain its leadership role are indicated.

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NUTRITIONAL CONSIDERATIONS IN SOYBEAN OIL USAGE

E. A. Emken, USDA, ARS/NRRC, Peoria, IL.

Soybean oil provides about 20% of the world supply of edible oils, and a large portion is hydrogenated for use in a wide variety of food products. The formation of cis and trans positional fatty acid isomers during hydrogenation of soybean oil coupled with its widespread consumption has prompted considerable research directed at determining the nutritional value of partially hydrogenated soybean oil (HSBO). Based on isomeric fatty acid content of human tissues, food composition and consumption information, U. S. consumption of isomeric fats is estimated at 7g/capita/day. Various human and animal studies indicate adsorption and turnover of isomers present in HSBO to be similar to the oleic acid present in nearly all nonhydrogenated edible oilseed fats. The results of a number of animal and human studies generally indicate HSBO has no significant effect on heart disease or other physiological parameters, provided adequate levels of linoleic acid are present in the diet. Investigation of specific biochemical pathways has greatly expanded our knowledge of how isomeric fats are metabolized. This research has documented that enzymes recognize the various structural differences between individual fatty acid isomers. However, the effect of this "selective recognition" has not been translated in terms of its impact on health and nutrition. Soybean oil contains 7% linolenic acid, which is a member of the biologically and physiologically important omega-3 fatty acid family. However, available data for man is too sparce to allow assessment of the nutritional importance or value of linolenic acid in soybean oil.

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OXIDATIVE FLAVOR DETERIORATION IN SOYBEAN OIL

E. G. Hammond, Dept. of Food Technology, Iowa State University, Ames, IA. U.S.A.

Soybean oil develops off-flavors at very low levels of oxidation. This rapid flavor deterioration seems attributable to the linolenic acid content of soybean oil, but it is not clear just how linolenic acid confers this instability on oils. Lipoxygenase and photooxidation also may play a role in the flavor deterioration of soybean oil. Glyceride structure is related to oil stability, but it is unclear whether the glyceride structure of soybean and other natural oils is optimum for flavor stability. One of the problems of this research area is measuring accurately the flavor deterioration of oxidized soybean oil. The use of aqueous emulsions for assessing flavor deterioration of oxidized oils promises to relieve some of these problems. There is currently a great deal of interest in predicting the flavor of oxidized oil by measuring by gas chromatography the volatiles released by heating the oil at a high temperature. New techniques for measuring the carbonyl flavor compounds in oxidized oils as trichlorophenylhydrazones will allow us to study flavor deterioration under realistic temperature conditions.

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BREEDING FOR MANAGEMENT OF SOYBEAN SEED DISEASES

E.A. Kueneman, International Institute of Tropical Agriculture, Ibadan, Nigeria.

Resistance breeding for control of seed diseases is discussed with emphasis on sources of resistance and screening methodology. The paper primarily stresses seed diseases having striking effects on seed longevity, which is a limiting constraint to the expansion of the crop in the humid tropics.

Germplasm lines with relative resistance to field weathering of seed and to deterioration of seed in storage have been identified at IITA, but these sources of resistance are very poor agronomically. They have now been crossed to incorporate superior seed longevity into improved genetic backgrounds. Screening selections for seed longevity is done by modified accelerated aging: 40°C, 75% R.H. for 6 weeks followed by a seedling emergence test. Breeding lines are now available with superior seed longevity in improved agronomic backgrounds.

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BREEDING FOR THE MANAGEMENT OF SOYBEAN ROOT AND STEM DISEASES

A. K. Walker, Asgrow Seed Co., Redwood Falls, MN

Breeding soybeans for resistance to root and stem diseases has served an important role in decreasing disease losses. A current account is given for breeding for the management of phytophthora rot, brown stem rot, stem canker, Fusarium blight and Sclerotinia stem rot. Soybean breeders and pathologists have been effective in developing screening techniques for evaluating soybean lines to these root and stem diseases. Genotypic variation exists for these diseases and in the case of phytophthora rot, brown stem rot and stem canker, high levels of re-

sistance have been incorporated in cultivars. The prompt response of breeders and pathologists in increasing disease problems like Fusarium blight and Sclerotinia stem rot will lead to new cultivars and/or the elimination from production of highly susceptible cultivars that will minimize disease losses. There is a continual need for germplasm evaluation to find new sources of resistance in anticipation of new races or isolates of the pathogens. The U. S. soybean germplasm collection has been a reservoir from which breeders and pathologists have been able to select genes for resistance.

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BREEDING FOR RESISTANCE TO LEAF DISEASES

R. L. Bernard, USDA/ARS and Univ. of Illinois, Urbana, U.S.A.

(declined to provide abstract)

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OXYGEN LIMITATION TO NITROGEN FIXATION IN SOYBEAN NODULES

T.R. Sinclair, P.R. Weisz, and D.F. Denison, USDA-ARS, Agronomy Dept., Univ. of Florida, Gainesville, FL.

While much research has focused on the energy requirement of nitrogen fixation, little of it has considered the limitation of the oxygen "substrate". Nodules can be considered as specialized structures to deal with the paradoxical fact that nitrogenase, the key enzyme of fixation, is readily inactivated at low oxygen partial pressures, yet even moderate rates of fixation require substantial amounts of oxygen. A diffusion barrier in the nodule cortex isolates the nodule interior from the ambient atmosphere. The oxygen-diffusion barrier coupled with leghemoglobin allows high rates of oxygen availability at low concentrations. The oxygen limitation has been demonstrated experimentally with increased fixation rates resulting from increased oxygen levels. However, long-term exposures of nodules to increased oxygen have failed to show any response in plant growth. The permeability of the oxygen-diffusion barrier seemingly regulated to balance oxygen supply with carbohydrate supply. An exception that may have important implications, is the great sensitivity of nodule permeability to dehydration. Since the upper soil layers dry first, where most nodules occur, nitrogen fixation may be reduced by nodule dehydration well before carbohydrate supply has decreased. Such a response could have important effects on reducing soybean yield potential.

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NONPHOTO SYNTHETIC CARBON DIOXIDE FIXATION IN SOYBEAN ROOTS AND NODULES

Karel R. Schubert, Monsanto, St. Louis, Missouri, USA

Nonphotosynthetic carbon dioxide fixation plays an essential role in the carbon metabolism of the roots and nitrogen-fixing nodules of soybeans. Phosphoenolpyruvate carboxylase activity is highest during the early stages of nodule development and provides organic acids for amino acid biosynthesis and other functions. The activity of this enzyme declines as the rate of ureide production increases. The distribution of ^{14}C-labeled metabolites changes when plants grown in the presence of nitrate or ammonium are exposed to $^{14}CO_2$. In the presence of nitrate, a greater proportion of the label accumulates in asparagine, the primary organic, nitrogen-containing compound in the xylem of soybeans grown non-symbiotically. Phosphoribosylaminoimidazole carboxylase catalyzes a second key reaction in nodules. The enzyme is involved in the synthesis of purines which are used in production of the ureides, allantoin and allantoic acid. The properties and function of these two enzymes will be discussed.

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ROLE OF CARBON AND NITROGEN DURING PODFILLING

D. R. Nelson, Monsanto, St. Louis, USA

Field measurements demonstrated that 78% of seasonal nitrogen can be assimilated by nodulated plants after R-5 (beginning seed growth) if nitrogen is excluded from the nutrient after flowering. Further, 68% can be assimilated by non-nodulating isolines, indicating that nitrate reductase, which disappears from the leaves late in flowering, must be active elsewhere late in the season. More than 80% of the dry matter assimilated after R-5 was partitioned into the seeds, suggesting a small contribution fro redistribution. Carbon is limiting after R-5, however, percent export from the leaves increases to satisfy the demands of both the seeds and roots. The nodules respond to the carbon limitation by increasing efficiency, suggesting that H_2 lost early in the season is in surplus, not wasted. Decreases in source-sink ratio by defoliation or shading result in enhanced partitioning and redistribution, thereby preventing a decline in carbon to the nodules and severe yield decline. An increase in source with elevated $[CO_2]$ increased partitioning to the seeds and decreased the vegetative: fruiting ratio, however, the effect on yield components depended on the source of nitrogen. There was enhancement of seed weight with nitrate grown plants and pod number with nodulated plants.

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THE INTERACTION OF OXYGEN WITH NITROGEN FIXATION IN SOYBEAN ROOT NODULES.

J. B. Peterson, Botany Dept., Iowa State University, Ames, IA, USA.

Soybean root nodules are specialized overgrowths whose structure and metabolism are geared for the conversion of atmospheric nitrogen to ammonia. The conversion (reduction) occurs in the Rhizobium japonicum endosymbiont via the enzyme nitrogenase. The symbiosis, however, faces an interesting dilemma. Nitrogenase is very O_2 labile and yet the ATP requirement of nitrogenase is only supplied by O_2-dependent metabolism (respiration). The symbiosis has apparently evolved a variety of structural and metabolic solutions to this problem. The effects of oxygen on nodule and Rhizobium japonicum nitrogen fixation and our current understanding of the structural and metabolic solutions to the oxygen problem will be the subjects of these discussions.

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SOYBEANS AND CROPPING PATTERNS IN CHINA

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China is well-recognized as the source of origin of soybeans, yet cropping patterns including soybeans are evolving continuously. Planting and harvest dates; preceding, following, and inter-cropped species; production budgets; yield variability; and motives for including soybeans in a wide range of cropping patterns were reviewed and compared. The duration in years of cropping patterns including soybeans has tended to decline since 1949, compared with ancient and pre-1949 patterns. Cropping patterns were also found to differ according to precipitation, frost-free days, average annual temperature, and other environmental characteristics of five soybean production regions in China. Production functions by province revealed that environmental variables, like material production inputs, are significant determinant of yield. Thus, under centrally-determined prices for labor and credit, each province has different optimal levels of yield and expected profit. A comparison of expected profits by province demonstrates where soybean's productive advantage lies. Soybean production is currently rising in China because the government has raised the relative price of soybeans since 1979. Under the Production Responsibility System (which gives wider freedom in choosing output mix) and intensified soybean research (neglected in the 1950s and 1960s) soybean yields and areas planted will likely continue to grow, as will the key cropping patterns which contain soybeans.

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DISTRIBUTIVE IMPLICATIONS OF THE GROWTH IN SOYBEANS PRODUCTION IN BRAZIL

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This paper analyses the distributive consequences for consumers of the rapid growth of soybeans production in Brazil, a country where a semi-open agricultural economy has long existed. In the domestic subsector of Brazilian agriculture important foods can be found, mainly in terms of budget shares for lower income families. Attention was given to the technological innovations in soybeans, its extraordinary expansion and the resulting transformations in the composition of output. The evidence presented about negative effects of soybeans growth on domestic food crops, lead us to the conclusion that during 1967/79 lower income families suffered the most from the behavior of food prices. The concentration on soybeans production also appeared when analysing the period 1977/84, mainly on the states of Brazil's Center-West region, the so-called agricultural frontier, where new technologies are being adopted by farmers. This indicates the continuation of an unbalanced pattern of agricultural growth favoring exportables crops and against domestic food ones.

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RISK MANAGEMENT IN PRODUCTION AND MARKETING IN THE U.S. MIDWEST.

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(declined to provide abstract)

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RISK MANAGEMENT IN U. S. SOYBEAN PRODUCTION

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Knowledge concerning tradeoffs between risk and returns to various pricing strategies can help farmers make better marketing decisions. The effects of these tradeoffs were determined by comparing the means and variance of net returns for twenty-nine pricing strategies involving cash, futures, cash forward contracts and options markets. During the period 1970-83, soybean producers could have received a higher preharvest mean net return and lower variance of net returns by selecting certain hedging strategies using cash forward contracts, futures and agricultural options than by speculating in the cash market. In "short crop" years, the mean return was higher, but the variance was greater in the cash market than for any of the hedging strategies. In "normal crop" years, most of the hedging strategies increased net returns and reduced the variance compared to the cash market. Significant tradeoffs occurred between net returns and risk for marketing strategies involving post-harvest storage and pricing decisions. In normal crop years, producers could have obtained higher net returns but greater variability from a storage hedge than by storing soybeans unhedged. A deferred price contract increased net returns and reduced variability compared to storing beans unhedged. Selling at harvest was the best marketing strategy to choose in short crop years. Careful selection of marketing strategies can help soybean producers increase net returns and reduce risk.

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ADVANCES IN SAMPLING INSECTS IN SOYBEANS

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Since the publication of the sampling compendium by Kogan and Herzog (1980), considerable additional attention has been given to the development of sampling methodologies that fill certain voids in our abilities to rapidly and/or precisely quantify or classify arthropod populations on soybean. Most notable among those contributions has been the development of precise, though time- and labor-intensive, methods of quantification of absolute populations of soybean arthropods and subsequent calibration of relative sampling methods to absolute population estimates. Mathematical treatment of patterns of insect dispersion facilitate the determination of minimum and absolute numbers of samples necessary to achieve a prescribed level of precision or confidence. Sequential sampling and sequential count plans have been developed for certain additional species of soybean insect pests and certain of their natural enemies that significantly reduce the time and sampling effort necessary to achieve sampling objectives. Innovative methodologies are currently under development that will improve our capabilities for sampling insects in narrow row and broadcast soybean cropping systems. Advances is the development of methods for quantifying lepidopteran adult abundance will provide means useful in the definition of patterns of short-range dispersal and long-range migration.

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INFLUENCE OF TILLAGE PRACTICES ON SOIL-INSECT POPULATION DYNAMICS IN SOYBEANS

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Varying the amount of tillage can influence the population dynamics of many soybean soil arthropods. Changes in the insect's biology usually are a result of the amount of plant residue remaining that elicits modifications in the soil environment, thereby providing favorable or unsuitable habitats for the insect fauna. Changes in abiotic and biotic soil parameters that can affect specific insects are discussed. For example, seedcorn maggot populations can increase when soybean is planted into soil containing freshly-decomposing, partially-buried crop residues. Lesser cornstalk borer populations are expected to be greatly enhanced in doubled-cropped soybeans systems where burned/unburned weed and crop residues can increase populations. Concurrently, carabid and spider predators have been shown to increase in both numbers and diversity in no-tillage systems which provide for more suitable habitats. There are many other arthropod fauna which also will be affected by tillage and are so discussed. Much more research will be needed in the future to better understand the underlying principles involved in the interactions between tillage, soil parameters, and insect fauna. This work needs to be done under many different management systems that use different tillage practices and rotational schemes. We also will need an interdisciplinary approach with expertise from various disciplines.

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ECOLOGICAL EFFECTS OF DOUBLE CROPPING ON SOYBEAN INSECT POPULATIONS

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Most double-cropped soybean hectarage is planted behind spring harvest of small grains. Cultural practices associated with double cropping have ecological effects on insect populations. Reduced tillage results in reduced direct mortality of soil inhabitants. Many pests and beneficials utilize non-crop vegetation in reduced tillage systems for establishment. Crop residue modifies the abiotic environment and influences biotic parameters which impact on insect populations. Reduced tillage and crop residue provides a microenvironment that influences the biology and behavior of soil inhabitants. Late-planted soybean crops associated with double cropping are frequently exposed to large infestations of pod and foliage feeding insect pests that build up during the season. Early-planted soybean crops may be damaged more by large overwintering populations of some pests than later plantings in certain geographical areas. Natural enemy predators may increase to larger populations in early soybean plantings than in late plantings. Populations of herbivore pests and natural enemies respond differently by species to row spacing. In general, highest populations develop in narrow rows. The high populations are attributed to favorable ecological factors. No-till, narrow row spacings associated with double cropping generally have a negative influence on the effectiveness of chemical insecticides.

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DYNAMICS OF PHYTOPHAGOUS PENTATOMIDS ASSOCIATED WITH SOYBEAN IN BRAZIL

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Phytophagous pentatomids (stink bugs) are a major pest component of soybean throughout the world, and are of particular importance in Brazil. Species composition on soybean has increased through the years, and more than 25 species of stink bugs have been collected in Brazil. Only Nezara viridula (L.), Piezodorus guildinii (West.) and Euschistus heros (F.) are major pests, however. N. viridula is more abundant in the south; its abundance and distribution are increasing due to the expansion of soybean in the Central-West and Northeast Regions. P. guildinii is the most widely distributed species, and E. heros seems to be more adapted to warmer regions from north of Paraná to the central and west areas. Populations of all three species peak during the summer when fruiting plants are most abundant. P. guildinii seems better adapted to feed on blooming plants and it is the first species to colonize soybean. Early maturity varieties escape some severe damage, and within the same variety early plantings are more damaged. A drastic decrease in use of insecticides to suppress stink bug populations has occurred in recent years. Use of egg-parasites (mainly Trissolcus basalis (Woll.)) and adult parasites (e.g. the tachinid fly Eutrichopodopsis nitens Blanch.) has increased. Planting of early maturity varieties to avoid stink bug damage is widespread in Brazil. Future research areas include: effect of wild hosts on stink bug biology, development of resistant varieties, parasite introductions and cultural practices (planting time, row spacing, trap crops, no-tillage, etc.).

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IMPROVING SOYBEAN PROTEIN UTILIZATION BY RUMINANTS

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The value of a protein for ruminants is related at least in part to the amount that escapes rumen degradation. Proteins vary considerably in this regard. Protein from soybeans (as well as other oilseeds) is highly degraded. Heating during the desolventizing-toasting process of soybean meal production reduces rumen degradation. However, up to 75% of the protein in soybean meal may be degraded. Heating, treating with formaldehyde and alcohol have reduced apparent rumen degradation. Extra heating in the desolventizer-toaster in a soy processing plant is not likely to further reduce ruminal protein degradation to be of practical significance. Formaldehyde treatment is being used in some parts of the world but will likely not be allowed in North America. More innovative ways of altering soy protein cheaply and effectively are needed to increase rumen bypass of soybean meal. The good amino acid balance of soy protein makes it worthwhile to attempt to increase the amount escaping rumen digestion, especially when fed in combination with grain proteins. Demonstrating a production response to soy proteins of low rumen degradability has been inconsistent. It is difficult to determine if the protein was not altered or if the experimental design was deficient. In many studies, protein has not necessarily been limiting and, therefore, no response was obtained from feeding soybean protein of reduced degradability. Studies are needed to critically evaluate the value of low rumen degradable soybean meal for growing and lactating ruminants.

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DIGESTIBILITY OF CARBOHYDRATE FRACTION OF SOYBEAN MEAL FOR POULTRY

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About 2.5 million metric tons of carbohydrate from soybean meal representing at least 8% of the diet is fed to poultry annually in the U.S. Relatively little direct information is available on the digestibility of the carbohydrate in soybean meal for poultry. On a dry matter basis, soybean meal contains about 4% more gross energy than ground yellow corn (4.69 vs. 4.50 kcal/g) but only about two-thirds as much metabolizable energy (2.48 vs. 3.85 kcal/g). Therefore, energy in soybean meal is about 53% digested and metabolized in contrast to 85% for that in ground yellow corn. Good agreement exists between the determined and calculated metabolizable energy values for ground yellow corn but not for soybean meal. Several research reports indicate that in excess of 90% of the amino acids in soybean meal are digested and metabolized by poultry. If 90% of soybean protein is digested and metabolized, then less than 50% of the nitrogen-free extract can be digested. The poor digestibility of the carbohydrate in soybean meal apparently is due to the presence of poorly digested or undigested stachyose, raffinose and complex polysaccharides (3/4 of total) and potentially digestible sucrose (1/4 of total). In contrast, the carbohydrate in ground yellow corn is composed of starch which is highly digestible. The challenge to render the energy associated with the carbohydrates of soybean meal, which constitutes more than 8% of poultry diets, through an enzymatic treatment or some other process remains.

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EFFECT OF PROCESSING ON UTILIZATION OF SOYBEAN PROTEIN BY THE YOUNG PIG

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Four soybean meals (SBM) classified as under (U), normal (N), over (O) and rumen bypass (RB) were processed in a commercial hexane-extraction plant to provide the range in heat treatments possible under commercial conditions. Arg, Lys and Cys contents decreased with increasing heat treatment (about 7% lower in RB than U). Trypsin inhibitor (mg/g as-fed sample), urease activity (ΔpH) and PDI (%) for the U, N, O and RB meals were 5.3, 4.0, 1.6, 1.8; .19, .11, .01, .02; and 63.7, 54.0, 40.6, 7.3, respectively. Apparent ileal digestibilities of N and individual amino acids were similar for all meals ($P>.05$); however, Lys digestibility was 5 percentage units less in RB than U. Results of three feeding trials with pigs weaned at 4 weeks of age using corn-based diets formulated to be marginally deficient in Lys (.86 to .95%) suggested that extreme heat treatment of SBM (RB) results in only slightly lower pig performance (2.7% and 3.0% less ADG and G:F than the average of U, N and O-containing diets). Two diet preference trials with pigs weaned at 4 weeks of age using corn-based diets (.95% total Lys) containing about 29% of either N or RB meal revealed that pigs consumed 63 and 60% of the N diet compared to 37 and 40% of the RB diet in trials 1 and 2, respectively. These data suggest that rather wide differences in heat treatment of commercially processed SBM have only a small effect on nutrient digestibilities, performance and diet preference of pigs weaned at 4 weeks of age.

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UTILIZATION OF ENERGY FROM SOYBEAN PRODUCTS BY YOUNG PIGS

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A number of products from the soybean processing industry are used extensively in diets fed to swine. Soybean products contain growth inhibitors that are destroyed by proper heat treatment. While soybean meals are used in swine diets primarily as a source of amino acids, they also provide a source of energy. The availability of energy from soybean products has been evaluated in a series of comparative slaughter experiments with young pigs. Metabolism studies were conducted so that digestible, metabolizable and net energy values could be determined. Energy from dehulled soybean meal was efficiently utilized by the young pig. Energy from soybean hulls was not as well digested and was poorly utilized for tissue synthesis. Energy from soybean meal containing hulls was less digestible than energy from dehulled soybean meal, but the available energy was used as efficiently for tissue synthesis as dehulled soybean meal. About 80% of the energy from soybean oil was digested and was used efficiently for tissue synthesis. Energy from whole, extruded soybeans was digested slightly better than the energy from soybean oil and dehulled soybean meal and was used efficiently for growth. The results of these experiments are similar to the average of the available values reported for growing swine.

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SEMIDWARF SOYBEAN CULTIVARS FOR HIGH YIELD ENVIRONMENTS

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With indeterminate soybean cultivars, traditionally grown in the Northern U.S., lodging frequently becomes a barrier to higher soybean yields as the yield potential of the environment approaches 33 q/ha. To overcome this lodging barrier to higher soybean yields, a breeding program was initiated at Urbana, Ill. in 1969 with the specific goal of developing semidwarf cultivars with specific adaptation to high yield environments. The primary approach taken was to cross high yielding indeterminate cultivars adapted to the northern U.S. with high yielding determinate cultivars grown in the southern U.S. and select for determinate genotypes with high yield at Urbana, Ill. Using an Early Generation Testing procedure, two superior yielding F_2-derived lines were identified in 1973 from a cross between Williams, a maturity group III indeterminate cultivar, and Ransom, a maturity group VII determinate cultivar. From these two F_2-derived lines, 5 determinate semidwarf cultivars have been released. Because of their much shorter plant height, a specific semidwarf production system [plant only on land with a history of high yield (>33 q/ha), in 17 cm row width at 75.0 seeds/m^2] has been developed to maximize their yield potential and to minimize risk they will be too short for mechanical harvest. Compared with the traditional indeterminate cultivar production system (75 cm row width at a seeding rate of 37.5 seeds/m^2) the yield advantage of the semidwarf production system ranged from -11% (30.9 vs 27.6 q/ha) to +58.6% (34.8 vs 55.2 q/ha) over a 7-year period at Hoytville, Ohio, with a mean yield advantage of 28.2% (29.8 vs 38.2 q/ha).

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SELECTING FOR NARROW ROW PERFORMANCE IN WIDE ROW SOYBEAN NURSERIES

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Thirty experimental lines and six cvs. of soybeans (Glycine max (L.) Merr.) were evaluated in wide (76-cm) and narrow (18-cm) rows at two locations in 1982 and one in 1983. The objective of the study was to determine if evaluation of lines in wide rows can be used to identify superior lines for narrow-row culture, while determining if key traits can be measured in wide rows to predict superior performance in narrow rows. Entry x row spacing interaction for seed yield was significant at both locations and years. In general, the high yielding entries in wide rows were also the highest yielding ones in narrow rows. Entries which showed the most yield increase from narrowing row spacing were inconsistent over years and locations. However, three entries were consistent in exhibiting a moderate to high yield increase. No trait was associated with the response. High phenotypic correlations were found between wide and narrow rows for yield and all other traits, indicating that selection for yield improvement in wide rows can be applied to entries for use in narrow rows. We conclude that, in general, selection for superior performance in wide rows will identify lines that will perform best in narrow rows.

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BREEDING SOYBEANS FOR ADAPTATION TO DOUBLE CROPPING

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Double cropping of soybeans has become very popular in Virginia and other states. About half of the Virginia soybeans are planted after the harvest of wheat or barley. The late planting usually causes significant yield losses compared to earlier planting. We viewed double cropping as a special environment and began to select for adpatation to it in 1978. Selection and evaluation methods are similar to our regular breeding program except that all plantings are made following harvest of small grain. Progress in breeding can be measured by comparing the proportion of double crop selections vs. full season selections that exceed the yield of a standard cultivar, 'Essex'. Over the years 1980 through 1983, an average of 35 percent of the double crop lines have exceeded the yield of Essex in double crop tests, while an average of only 17 percent of the full season lines have exceeded the yield of Essex in full season tests. The trend was consistent in each year, so it is apparent that selection for adaptation to double cropping has been effective. It is not clear what traits should be possessed by a successful double crop cultivar. Comparisons of determinate and indeterminate lines have indicated no consistant differences from year to year. Experiments for direct comparison of full season and double crop lines are being conducted.

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PLANT IDEOTYPE FOR STABLE YIELD IN SOYBEAN

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Association of adaptability parameters estimated with respect to 36 F_4 derived lines and four other pure lines across five environments of seed yield with those of seed quality structural, phenogical and physiological traits over lines revealed that besides number of pods per plant, responsiveness for higher number of nodes per main stem, taller plant height, larger petiole length , higher number of primary braches per plant, more pod potential per node and high stability for hundred seed weight, hundred seed volume and petiole length, besides responsiveness for pods per plant and pods per main stem were equally important. It was generalized that to breed for a wider adaptability, the efficient plant ideotype in soybean besides higher pods needs to have more number of nodes larger petiole length responding to changing environment and high leaf potential.

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ASSOCIATIONS BETWEEN PHYSIOLOGICAL TRAITS AND YIELD OF RANDOM SOYBEAN GENOTYPES

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Hypotheses on the associations between physiological traits and yield were formulated through sensitivity analyses of a phenomenological model of soybean (Glycine max (L.) Merrill) reproductive growth. The model incorporated the concept of the rate of Dry Matter Allocation (DMAC) into seed, based on the slope of linear Harvest Index (HI) increase during seed filling (estimated disregarding fallen leaves). Reproductive Period Duration (RPD), the ratio of final HI to DMAC, estimates the period of linear HI increase. Simulations predicted positive associations of yield with seed growth rate (SGR) estimated on a land area basis (R^2=0.74), and RPD (R^2=0.14). Negative associations of DMAC with RPD (R^2=0.92), and yield (R^2=0.12) were also predicted. These hypotheses were field tested at Gainesville, Florida, in 1982 and 1983, using 92 random F7 determinate genotypes from two crosses: Roanoke x Hutton and Roanoke x F66-698. Again, positive associations with yield were strong for SGR (R^2=0.64 to 0.87), and weak for RPD (R^2=0.06 to 0.16), and R5-R7 (R^2=0.05 to 0.39). Negative associations with DMAC were strong for RPD ($P<0.01$), moderate for R5-R7 ($P<0.05$ to 0.01), and non-significant for yield.

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PHYSIOLOGICAL BASIS FOR GRAIN YIELD DIFFERENCES IN SOYBEAN CULTIVARS

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Fifteen soybean cultivars selected from a cultivar collection on the basis of their grain yield were grown in a replicated field experiment during 1981-82 at Jabalpur, with a view to investigate critically the physiological basis for yield differences between low and high yielding cultivars. The seed weight (g/plant) was analysed through covariance techniques taking the seed weight per plant as dependant variable (Y) and the other

characters namely, total chlorophyll, specific leaf weight (SLW), leaf protein, harvest index (HI %) and 100-seed weight as the concomitant variables (X). All the correlation coefficient so computed were nonsignificant indicating that the seed weight per plant was not influenced by the rest of the characters under study. Variety Ankur produced the highest seed weight very closely followed by UPSM-19 and JS-2. Varieties Kalitur, JS72-20 and JS75-19 gave the lowest grain yields. An examination of the rank of means revealed that the rank of variety means for seed weight (g/plant) matched best with those of specific leaf weight (SLW). This indicates that seed weight (g/plant) was maximum influenced by specific leaf weight.

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PHOTOSYNTHETIC EVALUATION OF SELECTED SOYBEAN GENOTYPES AND THEIR PARENTS

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Sixteen soybean (Glycine max L. Merr.) genotypes, constituting the parentage of cultivar 'Forrest', were planted under field conditions in a randomized complete block design and replicated four times. An infrared anlayzer was used to determine single leaf net photosynthetic rates for fully expanded, mature and attached leaves enclosed in a plexiglass photosynthesis chamber in full sunlight. Photosynthetic rates were also determined on whole plant basis for plants grown in containers. Samples for growth analysis were taken during vegetative growth stage. In the field experiment, the range in photosynthetic rate was 29.6 to 47.9 $mgCo_2dm^{-2}hr^{-1}$ for 'Haberlandt' and 'Illini', respectively. 'Illini' also showed higher photosynthetic rates (whole plant basis) than all other genotypes grown in pots. Percent dry matter partitioning to leaves during vegetative stage of growth varied from 42.5 to 49.3%. Significant differences in specific leaf weight were observed among the genotypes. The range in leaf area index was 3.4 to 7.0. In mid September, with night temperature 21 C, stomatal conductance was 1.0 and 0.3 cm sec^{-1} for lower and upper leaf surfaces, respectively. Cultivar 'Lee' had higher yield (2580.0 kg/ha) than all the other genotypes. Photosynthesis showed a significant correlation with specific leaf weight.

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FIELD SCREENING OF SOYBEANS FOR METRIBUZIN TOLERANCE

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Metribuzin (4-amino-6-tert-butyl-3-(methylthio)-as-triazine-5-(4H)-one) is a triazine herbicide which can be effective in controlling many broadleaf weeds in soybeans [Glycine max (L.) Merr.]. Some cultivars can suffer yield loss due to metribuzin damage. Breeding soybeans with higher metribuzin tolerance might enhance broadleaf weed control by allowing application of greater metribuzin rates. Several good greenhouse methods for metribuzin screening are in use. Field metribuzin screening is easier than the greenhouse techniques, and it allows observation of other agronomic characteristics. The purpose of this study was to determine if screening soybeans for metribuzin tolerance can be accomplished in the field. Sixteen soybean genotypes were screened for metribuzin sensitivity with a hydroponics technique. Genotypes were ranked based on foliar chlorosis and necrosis. The genotypes were screened in the field with 1.12 lb. a.i. per acre of metribuzin p.e. for three years. The field and greenhouse results were then compared. The correlation coefficient between field injury scores and hydroponics injury scores was 0.95 over all years. With two years (or two locations) of data where injury to sensitive standards was extensive, sorting of genotypes by metribuzin sensitivity was feasible. The use of one rate of metribuzin allows the classification of genotypes into the broad categories of sensitive or tolerant.

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A RAPID METHOD FOR SCREENING SOYBEANS FOR AL TOLERANCE IN NUTRIENT SOLUTION

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Two experiments were conducted in nutrient solution to study the level of Al necessary to separate tolerant and susceptable cultvars. In the first experiment the levels of Al were 0, 5, 10, and 20mg/l and the cultivars tested were Cristalina and UFV-1. The levels were too high: they had a devastating effect on the primary roots within seven days of transplanting. Based on this data, another experiment was conducted using 0, 1, 2, and 4 mg/l of Al and the cultivars Lee, Bragg, Cristalina as well as UFV-1. The results showed that the length of the primary root was the best parameter as compared with the dry weight of the tops and roots: The level of 1mg/l of Al was adequate to separate the susceptable from the tolerant cultivars, whereas the 2 and 4 mg/l level caused drastic reduction in the length of the primary roots of all the cultivars tested. The cultivars Lee and Cristalina were tolerant; Bragg was intermediate, and UFV-1 was the moxt susceptable of all.

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OBSERVATIONS ON THE REPRODUCTIVE BIOLOGY OF A MALE-STERILE (ms4) MUTANT OF SOYBEAN.

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Individuals homozygous for the recessive mutant ms4 are male sterile, but female fertile. We have used light, scanning- and transmission-electron microscopy to study anther development in male-sterile plants. Male sterility is the result of a failure of cytokinesis following the meiotic division of microspore mother cells. A four-nucleate structure (coenocytic microspore) results. Further development of the structure is variable, but may be assigned to one of five pathways: 1) degeneration without pollen wall formation, 2) degeneration after pollen wall formation, 3) pollen wall formation and cytoplasmic enrichment as per normal pollen, 4) pollen wall formation followed by a delayed cytokinesis, resulting in tetrads which then abort, 5) delayed cytokinesis to yield pollen-like cells that persist until anthesis. In type 5, functional pollen may be formed. We have obtained two lines of evidence supporting a role for these cells in self-pollination.

Field-grown ms4 male-sterile plants can produce progeny rows consisting of 96% male-sterile plants, while the maximum frequency based on any random model of cross-pollination is 50%. Also, male-sterile plants will set seed in growth chambers in the absence of insect pollinators, with selfed seed giving rise to male-sterile progeny. The effect of temperature on selfing will be discussed. The ms4 mutant allows for the production of homogeneous, homozygous populations of male-sterile plants.

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CHLOROPLAST DNA VARIATION WITHIN THE GENUS GLYCINE

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Cytoplasmic uniformity is cause for concern among researchers involved in soybean (Glycine max (L.) Merr.) genetics. One measure of uniformity is the degree of base sequence homology within genomes of cytoplasmic organelles. Restriction endonucleases recognize and cleave specific base sequences. These cleavage sites create unique fragment sizes that can be separated by agarose electrophoresis. Thus restriction endonucleases can be used to detect sequence divergence within and between species. We isolated chloroplast DNA (ctDNA) from approximately 25 different cultivars and Plant Introductions (P.I.s) of G. max, and from over 10 P.I.s of G. soja and G. gracilis. ctDNAs were digested with the endonucleases Ava I, Bam H I, Cla I, Eco R I, and Xho I. The enzymes Bam H I and Xho I did not distinguish ctDNAs from any of the sources analyzed. The enzyme Ava I produced two restriction fragment patterns (RFPs), the enzyme Cla I produced three RFPs, and the enzyme Eco R I produced three RFPs. As a rule the enzyme Eco R I distinguished most G. max P.I.s and cultivars from G. soja and G. gracilis P.I.s. The G. gracilis accession P.I. 79593 is unique in that it represents the only member of one of the Ava I pattern groupings and is the only member of one of the Cla I pattern groupings. It is also only one of two members of one of the Eco R I pattern groupings. Our technique will provide a valuable means of identifying unique cytoplasms within the soybean germplasm collection.

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CYTOLOGICAL STUDIES OF TRIPLOIDS AND THEIR PROGENY FROM MALE-STERILE (ms_1) SOYBEAN

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Triploids (2n=60) were obtained from male-sterile (ms_1) soybean (Glycine max (L.) Merr.). Meiosis, pollen fertility and chromosome number of their progeny were studied. Plants were classified male fertile or male sterile on pollen stainability with I_2KI. Meiosis studies of fertile and sterile triploids revealed no distinguishable differences in chromosome associations. Male steriles formed coenocytic microspores characteristic of the ms_1 mutant. Restitution of dyad and tetrad nuclei were observed in male steriles. In general, chromosomes of these triploids tended to occur in trivalents during diakinesis to metaphase I (MI). However, multivalents, bivalents and univalents were observed. Average types and frequencies of chromosome association per cell in diakinesis to MI from 542 cells were 0.004 IX + 0.06VI + 0.002V + 0.005IV + 16.99III + 1.79II + 5.03I. Some secondary associations and non-homologous pairing occasionally were observed. This might provided some evidence for duplicated genomes and the polyploid origin of soybean. Chromosome laggards were observed in anaphase I, prophase II, anaphase II and tetrad stage. Pollen fertility in male-fertile triplod $Ms_1ms_1ms_1$ plants varied from 57% to 82% with average about 70%. Chromosome numbers of progenies obtained from these fertile triploids varied from 2n=40 to 2n=72 and exhibited a nearly random distribution with the majority (about 60%) between 2n=56 to 2n=65. Progenies of these triploids had segregation ratios for the ms_1 locus that confirm genotype Msmsms of fertile triploids.

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GENETICS AND CYTOLOGICAL STUDIES OF CHROMOSOME INTERCHANGES IN SOYBEAN (Glycine max [L.] Merr.) AND RELATED SPECIES

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In this study six lines homozygous for chromosome interchanges (T/T) were used in cross-pollinations with 10 Plant Introductions of G. max and G. soja identified as homozygous for chromosome interchanges. The six known homozygotes have been identified genetically and cytologically. The 10 Plant Introductions gave F_1 plants with 50% pollen and ovule sterility when crossed to cultivars with normal chromosome structure (N/N). Plants with 50% sterility are characteristic of heterozygous interchange genotypes. Thus the 10 lines were tentatively identified as interchange homozygotes. The objectives of this research were to determine if any of the 10 suspected lines a) have one interchange chromosome in common, b) have both interchange chromosomes in common, or c) have no interchange chromosome in common with the six known interchange homozygotes. Plants of the six known T/T genotypes have been crossed with the 10 suspected chromosome interchange lines. Pollen fertility of the F_1 hybrids has been checked and meiosis samples collected from those showing sterility. The following lines have the identical chromosome interchange as one of the six known interchange lines, [Clark T/T(G. max) originally from PI 101404B(G.soja)] with: G. soja PI 212239, PI 407020, PI 468917; G. max PI 274454, PI 468923; and PI 468919 (semi-wild). PI 323551 (G. max) is the only interchange line found that has no chromosome interchange in common with the six known interchange homozygotes. Studies of the remaining three lines are not completed.

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ISOZYMIC VARIABILITY IN SOYBEANS: I. COMMERCIAL VARIETIES AND HISTORICALLY IMPORTANT LINES

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Understanding genetic relationships in cultivated soybean (Glycine max (L.) Merr.) and its wild allies is important to soybean improvement. Electrophoretically detectable isozymic variability can potentially be useful as a system to quantify genetic variability provided sufficient naturally-occuring isozymic variation is detectable. Starch gel electrophoretic techniques have been developed to analyze the isozymic variability of eleven polymorphic enzymes extracted from cotyledons of four days-old soybean seedlings grown under controlled conditions. Inheritance studies suggest that alleles at 21 loci code for the isozymes revealed by this procedure. Additional loci are also expressed in this tissue for some enzymes but appear monomorphic or are not consistently detectable. A total of 38 alleles, summed over loci, were observed in a survey of 174 G. max commercial varieties.

Isozymic fingerprints uniquely identified 134 (77%) varieties. Heterogeneity at one or more loci was observed within 62 (36%) of the varieties surveyed. Heterozygosity is common for heterogeneous varieties. No additional alleles were observed in a survey of 14 historically important parental G. max lines. Our results suggest that isozymic variability detectable using starch gel electrophoresis could be a valuable source of genetic markers for soybean genetics and breeding.

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ISOYMIC VARIABILITY IN SOYBEANS:II.GERMPLASM RESOURCES VERSUS UTILIZATION

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Electrophoresis provides plant breeders with a technique for measuring germplasm resources, distribution, and utilization. Starch gel electrophoresis was used to survey the electrophoretically detectable isozymic variability in soybeans (Glycine max (L.) Merrill) and wild soybeans (Glycine soja). One hundred thirty-five G soja accessions were chosen at random from the USDA wild soybean collection. The G. max lines surveyed were a combination of commercial varieties, historically important lines, and accessions from the USDA soybean germplasm collection.The cotyledonary tissue of 4-day-old seedlings germinated in the dark at 25°C was analyzed electrophoretically for 10 enzymes. The wild soybean accessions contained as many or more zymograms than the G. max lines for each of the 10 enzymes surveyed. The G. max zymograms were found to be a subset of the G. soja zymograms. Only 2 enzymes, aconitase and superoxide dismutase, contained zymograms that were unique to G. max. The Korean G. soja germplasm contained the most isozymic variability. The soybean accessions contained more variability than the historically important lines and commercial cultivars. Some common G. soja zymograms were found at low frequencies in the G. max accessions. Electrophoresis appears to have potential as a method of monitoring germplasm resources and utilization in the Soja subgenus.

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USE OF ISOENZYMES AS MARKERS IN QUALITATIVE GENETIC STUDIES

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The soybean genetics project at Iowa State University has recently begun to use isoenzyme electrophoresis as a tool to supplement our germplasm characterization and qualitative genetic studies. This work has used vertical polyacrylamide gel electrophoresis (PAGE), as well as the starch gel technique. A brief comparison of these techniques will be presented. We are currently conducting inheritance studies of several alleles or loci not previously described, as well as linkage studies between isoenzyme loci and morphological and cytological markers. Results of some of these studies will be discussed.

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THE USE OF EXPERIMENTAL MUTATIONS IN SOYBEAN BREEDING

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In the USSR experimental mutations in soybean breeding for creation valuable initial material are used widely.Four mutant varieties of soybean have been released in this country recently. Universal and Beregovchanka varieties were obtained by method of direct selection of mutant forms, and Rannjaja 10 and Volna varieties were bred by combining the hybridization and mutagenesis. During 1975-1984 we studied the mutagenic effectiveness of N-nitroso-N-ethylurea (NEU), N-nitroso-N-methylurea (NMU), ethyleneimine /EI/, ethylene oxide /EO/, diethyl sulfate /DES/ and gamma-rays for induction of mutations in soybean in order to use them in breeding. The mutation frequency depended on mutagenic agents, their doses, and varieties. The most effective for getting a high frequency of mutations were NMU, NEU, and gamma-rays, which induced 9.2-10.4% visible mutations. EI occupied the intermediate position. EO and DES had practically the same mutation frequency, inducing 4.2-4.6% of mutations. It is very important to note that early-muturing mutants appeared often. Due to the use of mutagens several perspective high yielding mutants with good agronomical values were obtained, one of which was sent to State strain testing.

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INDUCED VARIATIONS IN SOYBEAN VARIETY KALITUR

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Seeds of the locally grown black seeded soybean variety Kalitur were exposed to physical and chemical mutagens. Variations recorded for growth habit, maturity and seed coat color in M_1 and M_2 generations revealed that only 31 plants out of 14957 population in M_2 had green seed coat color. These 31 lines further segregated in yellow, green, brown and black seeded types in M_3. Selections from M_3 for yellow seed coat color, relatively determinate growth habit were subjected to their yield performance for last three years and the promising lines included in the All India Coordinated trials in Central Zone indicate the selections MACS-104, -111 and -112 to be superior in yield over the control in the zone.

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ESTABLISHMENT OF T-DNA CELL LINES OF SOYBEAN

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Tumor-formation by strains T37, B3/73, A208 of Agrobacterium tumefaciens was tested on more than 2000 varieties and forms of Soybean (Glycine max. G. gracilis and G. soja). The crown gall was induced in 94 forms and varieties. The bacteria-free calluses were obtained from tumor tissue. Paper electrophoresis verified the presence of nopaline in these calluses. The cell lines were obtained from these calluses and multiplied, and were transferred more than 50 times in test-tubes. These cell lines have stable integrated T-DNA in their genome and have good regeneration ability. The data of cytological observations verified that they have a stable genome of 2n = 40.

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SEED PROTEIN ELECTROPHORESIS PROFILES OF WILD SOYBEAN (G. SOJA) IN CHINA

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Seed protein abstracts from 178 collections of wild soybean (G. soja Sieb. & Zucc.) in China, originating from 24°-51°N, 97°-132°E, were analyzed by polyacrylamide gel electrophoresis to determine the geographical distribution of the alleles of the Ti (Ti^a, Ti^b, Ti^c, ti) and Spl (Apl^a, Spl^b) loci. 16.3% of the collections had the Ti^b allele and 46.6% had the Spl^a allele. Based on the latitudes, 5 regions were divided: >45°N, 45°-40°N, 40°-35°N, 35°-30°N, <30°N. The frequency of the Ti^b allele in each region was 33.3%, 25.0%, 2.4%, 4.0%, 36.4% respectively and 16.7%, 32.5%, 47.6%, 62.0%, 51.5% for Spl^a. It was interesting to find that the lowest frequency of Ti^b allele was located at 30°-40°N. One collection containing the Ti^c allele was found. One collection containing n either Spl^a nor Spl^b was discovered. The collections of perennial species G. tabacina, G. clandestina and G. canescens had no both Ti and Spl.

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INFLUENCE OF ROOT DISTRIBUTION UPON DIURNAL CARBON FIXATION

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Photosynthetic Carbon Exchange Rate (CER) generally increases as light intensity and leaf temperature increase. The theoretical maximum CER should therefore occur shortly after noon each day, yet experimental measurements of single-leaf CER using soybean plants grown in the Auburn rhizotron showed maximum CER in midmorning. Stomatal closure from water stress reduced CER later in the day. The amount and location of water held in soil reserves varied greatly over time as it was removed by surface evaporation and root activity and periodically replaced by rainfall or irrigation. Root distribution patterns changed markedlyover the growing season as new roots grew into wetter soil regions, replacing those which had removed available water from drier soil regions. The life expectancy of an individual soybean root was relatively short, with new roots continually replacing those which died as water reserves in a given soil region were depleted. To maintain turgor during afternoon water stress, therefore, the soybean root distribution pattern continually adjusted to changing patterns of water distribution within the soil profile. High CER could be sustained throughout the day only when turgor was maintained. Ability to sustain a high CER throughout the day, therefore, is a measure of root system effectiveness in replacing transpiration losses.

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RESPIRATORY CARBON LOSSES IN SOYBEAN CULTIVARS

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Dark respiration rates of soybean plants and organs, grown in the glasshouse, were measured by infrared gas analysis at several stages of growth. Two early-maturing cultivars, Hodgson (high-yielding) and Chippewa (low-yielding), did not differ significantly in respiration rates on either a plant or dry-weight basis for any organ at comparable stages of development. Roots evolved 41 (1982) to 32 (1983) %, leaves 28-43%, and stems 31-25% of total respiratory carbon efflux by whole plants at R2, whereas at R6 comparable figures were 12-19% for roots, 19-28% for leaves, 14-15% for stems, and 55-38% for pods. On a dry weight basis, respiration rates diminished with growth, from R2 to R6, for all organs. Two late-maturing cultivars, A3127 (high-yielding) and Wayne (low-yielding), differed significantly in root, but not shoot, respiration on a plant basis. However, the difference was entirely due to A3127 having a smaller root system, because the cultivars did not differ in respiration rate on a dry-weight basis. A3127 showed about 21 (1982) and 43 (1983) % less root respiration than Wayne at all stages of development. Distribution of respiratory carbon efflux by whole plants also differed significantly for the cultivars, with A3127 showing a greater proportion of its efflux coming from stem tissue in compensation for a lesser proportion from roots.

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RESPONSES TO POPULATION VARIATION IN SOYBEANS

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Plant population is most critical determinant of soybean yield in sub-tropical India. Increase in plant population from 0.2 to 0.4 million plants per hectare decreased light transmission, NAR and plant dry matter but it increased LAI. Different cultivars significantly differed in NAR. During first phase Cv. Shilajeet recorded highest NAR (0.4076 g cm^{-2}/30 days) while Cv. Kalitur lowest (0.2174 g cm^{-2}/30 days). Grain yields of Cv. Bragg and Kalitur at 0.2 million plants per hectare were respectively 31.08 and 23.31 q/ha which were significantly more than yields recorded at 0.3 and 0.4 million plants per hectare. Yields of Cv. Ankur did not differ significantly between 0.2 and 0.3 million plants per hectare. Yields of Cv. Alankar and Shilajeet were 28.97 and 27.57 q/ha at 0.3 million plants per hectare which were significantly more than at other two populations.

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LEGHEMOGLOBINS FROM GLYCINE MAX AND GLYCINE SOJA

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We have compared leghemoglobins from a genetically diverse selection of field-grown plants representing more than 60 G. max cultivars and plant introductions and 18 G. soja plant introductions, all infected by slow-growing Rhizobium japonicum. We also have compared the effects of inoculation with fast-growing (USDA 201) and slow-growing (USDA 110) R. japonicum on the leghemoglobins from greenhouse-grown plants (G. max cv Beeson and G. soja PI407217). Nodule extracts were examined by analytical isoelectric focusing techniques. All four major leghemoglobin components (a, c_1, c_2, c_3) were present and identical in all samples. For the germ plasm we have sampled, leghemoglobin is not a useful genetic marker. The results are consistent with a close phylogenetic relationship between G. max and G. soja. Fast- and slow-growing R. japonicum strains did not elicit expression of different leghemoglobin genes in either G. max or G. soja. The highly conserved nature of leghemoglobin heterogeneity suggests that leghemoglobin heterogeneity is in some way functional. (Supported in part by a grant to W.H.F. from the Dreyfus Foundation.)

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METABOLIC COST OF NITROGEN FIXATION BY CALORIMETRY ON DETACHED NODULES.

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To get a direct measurement of the energy cost of biological nitrogen fixation we measured the heat evolved during reduction of natural and artificial substrates by the nitrogenase system of soybean nodules, using a versatile calorimeter we constructed for this work. A substantial heat output accompanied reduction of all the substrates tested: H^+ (under $Ar-O_2$), N_2, N_2O and C_2H_2. This reflects the often-reported energy inefficiency associated with biological N_2-fixation. Comparing the measured heat with calculated heats of reaction showed a sizeable enthalpy associated with activation of the nitrogenase electron transport system. This $\Delta H'$ of -200Kcal/$2e^-$ leads to a calculated overall N_2-fixation cost of 9.5 g glucose (or 3.8 g C) per g N_2 fixed. This is the direct enzyme cost. In addition, nodule maintenance costs can be estimated at 30% of the maximal metabolic activity. This brings the total cost to the plant to about 12.5 g $[CH_2O]$/g N_2, in good agreement with earlier respirometric measurements of intact root systems.

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PARTITIONING OF NITROGEN IN SOYBEANS AS AFFECTED BY STRAIN OF RHIZOBIA

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Field observations using different strains of rhizobia sometimes indicate more vegetative growth and darker green color of foliage between rhizobial treatments but no difference in seed yield. A field experiment was conducted in which 'Coker 338' soybeans were grown to maturity. The plants were sprayed with ^{15}N enriched nitrogen during the vegetative stage of growth so that translocation of nitrogen contained in vegetative plant parts could be followed to pods. Plants were sampled at approximately weekly intervals and separated into leaves, stems, and pods. Three strains of rhizobia were utilized to represent ineffective, moderately effective, and highly effective rhizobia. Approximately 60% of the nitrogen in effectively nodulated plants was due to nitrogen fixation. The moderately effective rhizobia provided adequate nitrogen to soybeans to achieve the same pod yield as the highly effective strain. But, total nitrogen in the plant shoot was greater for the highly effective strain. Accumulation of ^{15}N labeled vegetative nitrogen in pods occurred at the same relative rate for all rhizobial strain treatments. However, net loss of nitrogen from leaves of plants nodulated by the highly effective strain was delayed. It appears that total N in plant shoots may be an important criterian for rhizobial strain selection in addition to measuring seed yield.

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NITROGEN NUTRITION IN SOYBEAN : EFFECTS OF WATER-STRESS, N-FERTILIZATION AND N-SOIL RESIDUES.

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We studied variations in soybean nitrogen fixation with water-stress, levels of N-soil residues and rate of nitrogen fertilization. In order to estimate the relative part of symbiotically N_2 fixation and the part derived from soil N-assimilation, we compared by ^{15}N isotopic method a nitrogen fixing soybean with a non nitrogen fixing cultivar (a non-nodulating isoline provided by University of Urbana). The N_2-fixing ability of Glycine max cv. Kingsoy was evaluated by the percentage plant N derived from the atmosphere. But due to different levels of N-fertilizers, soil N or water supply, the actual amounts of N_2-fixed by soybean crop varied. A large decrease in N_2 fixation occured when water became limiting (though grain-yields were maintained at high level). Therefore, in that case, much of protein yield proceeded from soil reserves. Adding N-fertilizer at sowing increased total nitrogen uptake but percentage of atmospheric nitrogen fixation was low in well-irrigated conditions and zero in water-stress. In contrast, a late N-fertilization could promote nodule formation and N_2-fixation even under moderated water-stress. The negative relationships between water-stress or soil N-applied fertilizer and symbiotically fixed nitrogen show the limitations in soybean fixation and also in soybean nitrogen contribution to the succeeding crop.

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SOYBEANS IN SATURATED SOIL-A NEW WAY TO HIGHER YIELDS

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Studies in subtropical and tropical Australia show that soybean seedlings readily acclimate to saturated soils provided the watertable is maintained below the surface to leave a shallow aerobic zone. Seed yields have been 2-68% higher with controlled waterlogging compared with well-watered conventionally grown soybeans. Mean yields in locally-adapted cultivars have been ca. 25% higher. Growth in saturated soil is characterised by an initial acclimation phase during which seedling shoot growth is reduced. Root:shoot ratio is

increased as dry matter and carbon are preferentially partitioned to roots and nodules which proliferate in the aerobic zone. After the acclimation phase, crop growth rates exceed those of conventional crops, so that both dry matter and nitrogen accumulation during the period from flowering to maturity are substantially higher in the wet-soil cultured plants. In contrast with conventionally grown plants, new nodules form, roots continue to grow and nodule activity is sustained during podfilling. Profuse development of aerenchyma tissue occurs from lenticels on nodule and root surfaces. Maximum nodule and root mass are usually 2-5 times that of control plants. In some situations, particularly with indeterminate lines, the reproductive period has been extended and maturity delayed. Wet-soil cultured plants are very responsive to nitrogen fertilisation, to yields in excess of 7.5 t/ha. It is suggested that these responses have significant implications for understanding the physiological limitations to yield in soybean, and for extending its area of potential adaptation.

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INCREASE OF SYMBIOTIC NITROGEN FIXATION POTENTIAL IN SOYBEANS

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Experiments were carried out under field conditions to evaluate symbiotic N_2-fixation and the effect of mineral and organic nitrogen, and timing of N-application in soybeans, using the 15-N isotope dilution technique. It was noted that under optimal conditions for nodulation, the symbiotic N-fixation supplies 50-70% of total N to this plant. Distribution of the N_2-fixed in the plant is not uniform, being higher in nodules and pods than in roots and tops. There is an even utilization by soybeans when it is applied either at planting or flowering, the highest percent of N derived from fertilizer being found when 60 kg N/ha were applied rather than 20 kg N/ha. Symbiotic nitrogen fixation was high (70% of nitrogen derived from atmospheric air) when a high content of organic nitrogen was used (6 t of beans and maize crop waste). It is suggested that cultivars with a high potential to use symbiotically fixed nitrogen be developed, and the effect of the starter nitrogen to obtain better yield on a long-term basis discussed.

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THE INTERACTION BETWEEN SOIL N AVAILABILITY, RHIZOBIAL STRAIN EFFECTIVENESS AND NITROGEN FIXATION BY SOYBEAN

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Soybeans were inoculated with one of five strains of Rhizobium japonicum ranging in effectiveness from ineffective (SM-5) to highly effective (USDA 110) and grown in 2.5 kg soil ammended with 1% (w:w) bagasse. Five soil N treatments were initiated by adding 0, 50, 100, 200, 400, g N g soil. Soil N availability ranged from nil to amounts sufficient to completely inhibit the symbiosis. Fixed nitrogen was measured by the difference between SM-5 treatments and the effective symbioses. Dry matter and shoot N increased with every increment of applied N. Nitrogen fixed, nodule mass, and acetylene reduction were enhanced by mineral N even when over 50% of shoot N was soil derived. This enhancement of nitrogen fixation was quantitatively less for strains less effective than USDA 110 but there still was a substantial relative increase in N fixation. Results indicate that strain selection for effectiveness can be undertaken with relatively large amounts of available N. The increase in shoot N, dry weight and N-fixation from mineral N availability indicate the importance of mineral N to maximize yield and symbiotic nitrogen fixation.

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STUDY ON THE PHOTOSYNTHETIC CHARACTERS OF THE HIGH PHOTOSYNTHETIC EFFICIENCY SOYBEAN STRAIN "HA 79-9440"

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The photosynthetic efficiency of a new soybean strain Ha 79-9440, produced by an efficient photosynthetic breeding method, has been studied and compared with that of Heinong 26 (the standard high-yield variety in Heilonjiang Province) and Tokachinagaha (a Japanese variety recognized internationally as photosynthetically efficient). The results show that: (1) The yield of Ha 79-9440 was 3,843 kg/ha, that of Heinong 26 was 2,522 kg/ha, and that of Tokachinagaha was the lowest. (2) Ha 79-9440 exhibits a high photosynthetic rate and a low photorespiration rate. (3) Ha 79-9440 has a DCIP photoreduction activity 33.8% higher than that of Heinong 26, and 65% higher than that of Tokachinagaha. (4) The low temperature fluorescence intensity (77°K) and the variable fluorescence intensity of this strain have been determined. (5) The RuBCase activity of Ha 79-9440 is higher by 36.4% and 53.1% than that of Heinong 26 and Tokachinagaha, respectively. (6) Electron microscopic study of the chloroplast shows that the grana lamellae stack is prominently increased in Ha 79-9440. These results indicate that Ha 79-9440 soybean is a variety of higher photosynthetic efficiency.

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PHOTOSYNTHETIC CARBON METABOLISM DURING ONTOGENESIS OF SOYBEAN LEAVES AND PODS

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Photosynthetic carbon fixation processes were comparatively studied in soybean leaves and pods harvested at different growth stages. Non-nodulated soybean plants (Glycine max L. Merrill cv M 13) were grown in a controlled environment chamber and fed with a modified Hoagland solution containing nitrate as nitrogen source. Blade discs from just fully expanded leaves exhibited both highest $^{14}CO_2$ assimilation rate and ribulose bisphosphate carboxylase levels. Radiocarbon distribution in glycolate, glycine and serine suggested that photorespiratory metabolism increases with leaf age ; activity of glycolate oxidase was found to be significantly lower in younger leaves than in mature ones. Net photosynthesis, chlorophyll content and ribulose bisphosphate activity were low in isolated pods compared to leaves. However the study of metabolites translocation within the pod revealed that the green tissues are able to contribute to the carbon nutrition of the seeds. Soluble compounds labelling after $^{14}CO_2$ incorporation and glycolate oxidase activity indicated that photorespiration and organic acids (i.e. malate, succinate, citrate and glycerate) biosynthesis are relatively higher in pods than in leaves.

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SOYBEAN/RICE CROPPING STRATEGIES IN UPPER GULF COAST OF TEXAS

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Farmers in the Texas Upper Gulf Coast region have traditionally relied on rice as their major crop. Recent changes in government farm policy, export demand, and energy costs, among other factors, have resulted in rice becoming less profitable and more risky, encouraging producers to seek diversification alternatives. Soybeans have become a major crop in the region, reaching a high of 240,000 acres in 1980. A range of existing land tenure arrangements and associated differences of production/price risk borne by tenants and landowners confounds management decisions. This study identifies the effect of crop-share arrangements and crop rotations on the viability of rice-soybean farms in the region. Two typical rotations, soybean-soybean-rice and soybean-rice, and three crop-share arrangements, 1/2 and 1/7th shares for rice and 1/7th share for soybeans, were analyzed. The Firm Level Income and Policy Simulation model (FLIPSIM V) was used to analyze a hypothetical, high level management, Liberty County farm. The model allows for stochastic prices and yields, government farm policy, inflation, interest rates, and income tax provisions to influence probability of farm survival during the period 1984-1993. A soybean-soybean-rice rotation under 1/7th share arrangements for both rice and soybeans offers the highest probability of survival and the highest ending financial position, for producers operating in an environment characterized by the assumptions of the study. This strategy was preferred by all risk averse and risk neutral individuals under stochastic dominance criteria.

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THE PRESENT STATE OF OILSEED'S PRODUCTION IN MEXICO

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Mexico was self-sufficient in oilseed's production before the decade of the 70's, after this the imports were initiate, estimating 2.8 million tons to be imported during 1984, from this 1.6 million will be soybean (Glycine max L. Merr.) and 1.2 sunflowers (Helianthus annuus L.). This deficit has been originated mainly due to: 1) Population growth; 2) Increment in oil and fat consumption, and 3) The lack of a significant economic support in oilseed's research. Soybeans is an introduced crop in Mexico, first cultivated under commercial conditions in 1959, actually an average of 300,000 have been cultivated, from this 90% are under irrigation located in the NW of the country. Some of the limiting factors of soybean's production are: 1) The lack of cultivars to be grown under water limiting conditions, showing drought and salinity tolerance and, 2) The lack of germplasm to select for disease and shattering resistance.

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EFFECTIVENESS OF WATERING METHODS ON SOYBEAN

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The research aims at defining the effectiveness of 3 watering methods: sprinkling by can, flooding and infiltrating watering, on soybeans in Mekong Delta. The average yield in 5 experiments carried out at different locations are: 1900 kg/ha - on sprinkling treatment, 1780 kg/ha - on flooding treatment and 1330 kg/ha - on infiltrating treatment. 2 others experiments were combined with varietal (DH_4 and MTD_{65}) and mulching (with or without mulch) factors. The same tendency of effectiveness of watering methods was observed with both varieties, as well as with or without mulching. Results indicate that both sprinkling and flooding methods of watering give equivalent yields (2658 and 2743 kg/ha), however flood watering results in higher profit, especially, when could be used rising tide to flood the field.

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SOYBEAN ROOT GROWTH UNDER WATER STRESS

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Soybean (Glycine max. L. Merr. 'Braxton') plants were grown in the Auburn rhizotron behind observation windows, so that root growth in relation to water stress could be monitored. Seeds were planted in a uniformly-packed surface soil material from a Marvyn loamy sand (fine-loamy, siliceous thermic Plinthic Paleudults). Water-stressed plants received only natural rainfall, while nonstressed plants grew in soil continuously maintained above -0.15 bar water potential by trickle irrigation. Root growth was recorded two or three times weekly by measuring the length of newly formed roots on the glass surface. Root population was estimated by counting the number of living roots crossing horizontal transect lines at 0.2 m depth increments. Nonirrigated plants exhibited marked increases in root growth during periods of water stress when compared to irrigated plants, and more of their roots grew into deeper soil layers. Irrigated plants generally had fewer roots, which were more evenly distributed throughout the soil profile. After heavy rains, root growth of nonirrigated plants decreased to a rate comparable to that observed for the irrigated plants. By producing a larger root system, nonirrigated (stressed) plants enhanced their capacity to absorb sufficient water from the soil during successive drying cycles. This is a valuable survival mechanism, which enables plants to use more of the available soil water.

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GENOTYPIC RESPONSES OF SOYBEANS TO POPULATION DENSITIES AND FURROWING

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Soybeans are not being grown in Iraq successfully because of two major problems; low yield and shriveled seed. A split-split plot design experiment with four replicates was carried out at the farm of the College of Agriculture, University of Baghdad in 1981 and 1982 to determine the effect of planting methods (rows and furrows) and plant population densities (300, 600, and 900 thousands seed/ha) on yield and other agronomic traits of three soybean cultivars. In 1981, when soil was plowed 10-15 cm deep, planting on furrows significantly increased soybean yields by 50%, while population densities 600 and 900 thousand seed/ha significantly increased yield by 44% and 53%, respectively. In 1982, when soil was plowed deeper (30 cm), planting methods were not significantly different in yield while population densities gave

similar results to those of 1981. Percentage of shriveled seed was not affected by planting methods, but significantly decreased as population density increased. However, cultivars used (S1, S2 and Lee) were significantly different in yield and percentage of shriveled seed.

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MANAGEMENT OF NO-TILLAGE SOYBEAN PRODUCTION IN VIRGINIA

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More than 48% of Virginia's soybean acreage was produced by no-tillage in 1983. Approximately 40% of the total acreage was no-tilled in a straw-stubble mulch after wheat harvest. Field studies show that soybeans grown on Emporia loamy sand coastal plain soils with a straw-stubble mulch gave a significant increase in yields (214 kg/ha) when under-row ripped to a depth of 35 cm. as compared to not ripping. Five other coastal plain and piedmont soils, common to Virginia, yielded no significant response to under-row ripping prior to the planting operation. Tests in 1983 yielded 699 kg/ha more with 25 cm. row spacing than with 50 cm. spacing and 733 kg/ha more with a population of 200,000 plants kg/ha as compared to 294,000 plants/ha. Full season no-tilled soybeans planted in a killed wheat stubble outyielded those conventionally planted by 827 kg/ha. Irrigated soybeans with a population of 200,000 plants/ha responded with a yield of 5,190 kg/ha as compared to 4,168 kg/ha without irrigation. Results of a 6-year study with 9 varieties grown in adjoining fields show that double cropped no-tilled soybeans planted June 20 to July 4, following wheat harvest, yielded only 62.7% as much as those conventionally planted at optimum dates, May 5 to May 15. Based on these tests, an early variety of wheat or barley permitting earlier planting of double-cropped soybeans would be more profitable than the wheat varieties now used.

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AVAILABLE WATER AND PLACE OF SOYBEAN IN CROPPING SYSTEMS.

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On the basis of long term experimental data, we specified the relationships between water and soybean production (World Soybean Conference I), and flowering and fructification (World Soybean Conference II). Afterward we compared the water responses of summer crops competing with soybean : corn, grain sorghum, sunflower. Now, results are combined in a model used to study the place of soybean in cropping systems in S.W. France, as a function of water resources (soil profile, rainfall, irrigation), of soil properties, of the availability of labor and equipement at the farm level, and of price ratios. This research involves cooperation between agronomists, biometricians and economists. With this method we explore a large choice of possibilities of land use assuming different constraints. The optimum proportion of soybean in crop rotations and farm-land use depends on both agronomic and economic constraints. In our conditions, soybean compete with corn and sunflower and the proportion of summer crops in land-use increase with the available water : either reserves of soil and rainfall or resources in water for irrigation. The proportion of each crop depends on the capacity of the farm to carry out the necessary management practices, and consequently on material and labour availability. Therefore, soybean accounts for at most 50 % of farm-land use with irrigation, and that only when material and labour are at an high level of availability. In this optimized conditions, the farmer's gross margin is the best.

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GROWTH AND YIELD OF SOYBEAN UNDER WATER STRESS

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Drought reduces crop yields, and the extent of that reduction varies with the growth stage at which the drought stress occurs. The effects of soil water stress on soybean growth and yield were studied with plants grown in the field and in pots under a rainout shed. Water was withheld during the flowering, the pod formation, or the pod filling stage. In the pot experiment plant heights were significantly reduced by water stress, but all plants recovered considerably after being rewatered. Under field conditions only withholding water throughout the entire growing period significantly reduced plant height. Both experiments showed that the greatest reductions in yield were brought about by soil water stress imposed during the pod filling stage; in the pot experiment seed yield was reduced from 14.8 g per plant to 5.5 g per plant. Much of the reduction in yield could be traced to fewer pods per plant and smaller seed size. Under field conditions the effects of water stress imposed during the pod filling stage were less dramatic, and yield was reduced by only 10%. The reduction in yield was due primarily to smaller seed size.

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SOIL EROSION IN RELATION TO SOYBEAN PRODUCTION

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Rainfall simulation techniques were used to compare soil erosion from areas where corn and soybeans had been grown the previous season. The two year study was conducted on a silty clay loam soil with a 5 percent slope and on a silt loam with a 10 percent slope. Five tillage treatments, ranging from a moldboard plow system to no-till, were evaluated for each crop and slope condition. Tillage and planting operations were conducted up-and-down hill on replicated plots. Soil loss following 63.5 mm of rainfall applied during a 60 minute period was more than 50 percent higher from the soybean production area than from the corn production area for equivalent tillage treatments on the 5 percent slope. For the 10 percent slope, the soil loss ranged from 50 percent to about 7 times greater for the soybeans. Equivalent tillage treatments in soybean residues had about 40 percent less surface cover than corn residues which contributed to the difference in soil erosion. Relationships between residue cover and erosion showed that a 20 percent cover of either soybean or corn residues reduced soil loss by at least 50 percent of that which occurred from cleanly tilled soils. For soybean residue, only no-till consistently left more than a 20 percent residue cover.

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EFFECT OF MINIMUM TILLAGE AND CROP ROTATION ON SOYBEAN PRODUCTION IN THE SOUTHEASTERN COASTAL PLAIN

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Crop rotation and minimum tillage and their effects on yield, weed ecology, and various soil parameters were studied for three years, 1978-81. Corn and soybeans, the top two acreage crops in the southeastern coastal plain, planted with minimum tillage in both old crop stubble and rye mulch yielded the same as with conventional tillage practices. Rotation schemes did not influence crop yield, but significantly affected weed ecology. Broadleaf weeds such as sicklepod and morningglory were worse with continuous soybeans, while perennial weeds such as johnsongrass increased with minimum tillage, regardless of rotation. Soil fertility factors in the upper 60 cm were not affected by tillage systems. Crop residue amounts were significantly greater in corn and soybean minimum tillage plots. Establishment of rye as a cover crop appeared to be of questionable value. Old crop residue and weed growth appeared to function well as mulch for minimum tillage. With good management involving rotation and timely weed control practices, optimum yields of both corn and soybeans are possible with minimum tillage in the southeastern coastal plain.

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END USES OF U.S. SOYBEAN OIL

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Since 1977/78 the amount of soybean oil produced in the United States that has been exported has varied from 13 percent to 22 percent. Soybean oil is the dominant vegetable oil used in the United States in edible oil products. Soybean oil use in edible products has increased from 54 percent of the total fats and oils to 76 percent in 1982/83. The most dominant use of soybean oil in the United States is in salad and cooking oils, followed by baking and frying fats and margarine. Soybean oil use in inedible products has declined to only 2 percent in 1982/83.

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HEXANE-ETHANOL MIXED SOLVENT EXTRACTING SOYBEAN OIL AND REMOVING FLAVORS

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Many authors in the literature have reported on extraction of soybean oil from soybean flakes by using commercial hexane with the result that little, if any, of the beany, green flavors being removed. Further extraction of defatted flakes with aqueous ethanol solutions or hexane-ethanol azeotrope removes complex mixtures of lipids and most of flavors. This requires extraction twice, and therefore the investment, labor and operating cost would become much higher. This paper reports a new method of using commercial hexane and ethanol as a mixed solvent to ascertain the optimum conditions under which soybean oil and unpleasant flavors can be extracted at the same time i. e. in a single process of extraction instead of the two-step extraction. A better composition for the extraction seemed to be 30% (by weight) ethanol (95% vol.) and 70% hexane as a mixed solvent so that meal with lower residual oil and higher PDI will be produced.

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A COMPARISON OF FEEDING VALUES OF LOCAL OIL MEALS FOR MILKING COWS

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Eight wether lambs and twenty Holstein cows were used in a 4 x 2 switch over digestibility experiment and a feeding experiment to investigate the feeding value of soybean oil meal(SBOM), perilla oil meal(POM), sesame oil meal(SOM) or rapeseed oil meal(ROM) as protein supplements in an experimental ration for the milking cows. The results obtained are as follows; (1) Apparent digestibility and TDN values of the experimental ration were similar each other except the protein digestibility of rations containing SOM or ROM was slightly lower($p < 0.05$) than SBOM or POM. (2) Milk production was gradually decreased as the experiment progressed, however, the total milk solid content was maintained at the initial level for all the treatments except for the SOM group. (3) For all the treatments milk fat content was slightly increased as the experiment progressed but milk protein and solid-not-fat content was not affected by the sources of plant protein. (4) Overall results indicated that milk production was the only significant difference ($p < 0.05$) among the treat ment and it was higher for the SBOM and RSM group than POM or SOM treatment. Milk fat, milk protein and solids-not-fat production showed similar tendency to that of milk production among treatments with no statistical significance.

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EFFECT OF LEVEL OF SOYBEAN OIL MEAL ON THE RATION DIGESTIBILITY, MILK PRODUCTION AND MILK COMPOSITION

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Using 8 wether lambs and 20 Holstein milking cows a 4 x 2 switch over digestion trial and a feeding trial were conducted to investigate the effect of protein level as increased by soybean oil meal on ration digestibility, milk production and milk composition. Dietary protein levels of experimental concentrate rations were 13, 15, 17 and 19%. The results obtained are as follows; (1) Apparent digestibility of the concentrate ration were not affected by the protein level expect the protein digestibility which increased gradually as the protein level increased ($p < 0.05$). (2) Daily milk production of cows fed the ration containing 13% protein was gradually decreased while others increased and reached about 20% increase by the 5th week of feeding experimental concentrate, then gradually decreased. (3) The composition of the milk produced by cows fed the rations containing 15, 17 or 19% protein was not changed although their weekly milk production was varied greatly during the experimental period. (4) Overall daily milk production was significantly higher for the cows fed the ration containing 15% protein than those fed the 13% protein ration. (5) The protein of milk fat, milk protein and solids-not-fat were higher for the 15% protein than for the 13% protein group.

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ARTHROPOD FAUNA AND THE POPULATIONS OF SPILARCTIA CASIGNATA IN SOYBEANS.

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Arthropod fauna were compared in 3 varieties of soybeans, Sathia, Ransum and Hill using pitfall traps and 10 whole plant samples/plot/2 weeks and the seasonal variations of arthropod populations including that of Spilarctia casignata Koller which is considered a major pest in the region, were also estimated. Of 46 species in 43 families, 28 insect species, 8 spider families and 3 non-insect arthropod have been identified. Major activities were seen in August. This complex of arthropods was composed of sheltering (13), soybean feeding (19), weed feeding (9) and natural enemies of above all (5 families). The number of arthropod identified by family was not significantly different on plots of 3 varieties of soybeans at 5% (LSD) level. Shannon and Weaver's diversity indices were 2.6812, 2.2655, 2.3298, and evenness 0.7329 and 0.7151 in Sathia, Ransum and Hill, respectively. Pitfall traps were useful for 15 species of crowlers, mostly sheltering species. Although 5 colonies of S. casignata were observed at different times in July and August on Sathia and Ransum, only 5 larvae were caught during this sampling period (June - September 1983). This species seems to have 3 generations/yr in the field.

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EFFECT OF WILD PARSNIP ON SOYBEAN PEST PARASITISM IN IOWA. L. A. Buntin, Iowa State University, Ames, Iowa.

Wild parsnip, Pastinaca sativa, is a common biennial in fencerows that is noted for supplying nectar and pollen to beneficial insects. The effect of wild parsnip on parasites of soybean pests in central Iowa was investigated in three components: through examining the impact on natural pest populations, assessing the possible contribution of wild parsnip to parasite longevity, and confirming parasite visitation at wild parsnip flowers. Populations of green cloverworm (GCW), the predominant pest, were 10% higher in check fields. Parasitism generally occurred more frequently in parsnip-bordered fields than in soybeans without parsnip borders, but the difference was not statistically significant. Many important GCW parasites were trapped at wild parsnip flowers, including Rogas nolophanae (Hymenoptera: Braconidae), Cotesia marginiventris (Hymenoptera: Braconidae), and Winthemia sinuata (Diptera: Tachinidae). The laboratory feeding studies with the three major GCW parasites, however, demonstrated no significant prolongation of parasite life. The combined results suggest that wild parsnip may play a beneficial role in the soybean ecosystem, however, if weed control is a necessity, elimination of wild parsnip from soybean fencerows should not have a significant impact on GCW natural control.

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ADAPTATIONS OF AGROMYZID STEM MINERS TO SOYBEANS INVOLVE RESOURCE PARTITIONING

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Insect-resistant soybean cultivars could be especially useful in Asia and Africa where agromyzid (Diptera: Agromyzidae) stem miners commonly destroy the plants in absence of insecticides. Resistance has been identified in four varieties of wild (Glycine soja Sieb. and Zuec.) soybeans. The interrelations among several species of beanflies and these resistant soybeans, as compared to two highly susceptible Glycine max (L.) Merrill cultivars, were further detailed in field conditions in 6 locations in Taiwan. Results supported the hypothesis that resistance involves an evolved complex of soybean traits that have been largely lost in commercial G. max. This situation has reduced the multiple factor-based resistance to levels which have allowed not just one species of beanfly, but several, to utilize commercial soybeans as a host. Commercial breeding has so drastically altered soybeans that the several invading beanfly species are able to share the same plant in some highly susceptible G. max cultivars through a process of partitioning the plant resource so as to meet their specific individual needs in a host. Such co-habitation was not seen in resistant G. soja.

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POPULATION DYNAMICS MODEL FOR THE BEAN LEAF BEETLE ON SOYBEANS

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Adoption of improved management practices for soybean insect pests in the Midwestern U.S. depends on development of reliable forecasting of outbreaks. Forecasting systems require good crop phenology models and population dynamics models for the major pests. A temperature dependent population dynamics model for the bean leaf beetle, Cerotoma trifurcata on soybean has been developed and used in forecasting programs in Illinois. This model serves as a prototype for an IPM program operating under this forecasting mode. The biological information for the model has been gathered over a 14 year period but there are still information gaps. The conceptual bases of the model, its validation and potential applications in IPM programs will be discussed.

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A BIBLIOGRAPHIC ANALYSIS OF THE WORLD LITERATURE OF SOYBEAN ENTOMOLOGY

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The Soybean Insect Research Information Center, (SIRIC) is in the final stages of preparation of a comprehensive world wide survey of the literature of soybean entomology. Publication of this bibliography is expected within the near future. The bibliography will include over 4,000 references. About 70 percent of this literature has been published in the past 20 years. The publication trends, reflecting research effort, have followed very closely oscillations of the economic importance of soybean in the various regions of the world. Analysis of this bibliography provides an indirect index of the economic importance of major pests in each region and major directions in research. The extensive coverage of the literature from China, Japan, Korea, Indonesia and Asian USSR provides a valuable historical resource.

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COMPUTERIZATION OF THE WORLD LITERATURE OF SOYBEAN ENTOMOLOGY

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The Soybean Insect Research Information Center (SIRIC), established in 1969 probably was one of the first bibliographic data bases in agricultural entomology to undertake computerization of its storage and retrieval operations. The backbone of the system is a thesaurus of Hierarchical Code Descriptors (HCD) that has grown to include more than 8,700 descriptors organized in 4 hierarchical levels. This HCD structure allows retrieval of a superordinate category to include documents indexed by any of its subcategories. SIRIC's bibliographic records and HCD data bases are searched, changed, and increased by running specialized FORTRAN IV program designed specifically for these files. Most of these programs run as batch jobs from a timesharing terminal. Initial data entry is handled through an interactive program combined with corrections to the entry file using the system line editor. With rapid changes in computer technology specialized programs quickly become obsolete and inefficient. We are currently exploring the use of commercially available general purpose data base management software as a method of providing improved and expanded capabilities without a very large investment of resources. One feature expected to be developed for the system is the capability to produce bibliographies such as the World Soybean Entomological Literature in copy-ready format for ease of publication and updating.

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SOYBEAN GERMPLASM PRESERVATION

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The soybean is the world's number one source of edible vegetable oils, providing nearly 15,000,000 metric tons of oil in 1983 from some 95,000,000 metric tons of soybeans. The United States produced about two-thirds of those soybeans on 28,600,000 hectares. With the possible exception of the Chinese production, this exceptionally widely adapted crop is also widely genetically uniform and genetically vulnerable at the present time. It is urgent that material held in genebanks be screened for duplicates and evaluated for genetic diversity on an ecogeographic basis. This evaluation work will provide the information needed for future acquisition, preservation, and use of genetic diversity of the soybean.

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TOWARDS AN APPRECIATION OF BIOTECHNOLOGY AND ITS IMPACT ON ON FUTURE DEVELOPMENTS IN SOYBEAN PRODUCTION AND USES

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The application of recombinant DNA, cell and tissue culture, cytogenetics, and novel methods for moving and expressing foreign genes in plants is beginning to have an impact in basic and applied research on major crop species. However, developments with soybeans have been slower than with others. Nevertheless, soybeans have been important already in development of our understanding of stress responses and of plant gene structure and gene expression in heterologous systems. Moreover, several goals of soybean improvement programs, including oil characteristics, protein quality, antinutritional factors, disease and pest resistance, stress tolerance (including drought, salinity, heavy metal, temperature and pH), and herbicide compatibility are amenable to genetic engineering solutions. New advances in transformation technology and in soybean cell and tissue culture will increase the pace of soybean genetic engineering. Finally, the major advances of the past few years in our understanding of the *Rhizobium*/legume symbiosis will potentially have a major impact on soybean production economics.

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BREEDING FOR IMPROVED PHOTOSYNTHETIC CAPACITY

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Photosynthetic capacity in soybeans is dependent upon leaf area, leaf rate, and leaf duration; selection for any one of these traits separately, or for other traits associated with one of these three (such as specific leaf weight), may not increase photosynthetic capacity. Selection for photosynthetic capacity integrated over time should be more successful than with 'instantaneous' measurements, however, such selection is not economically practical at the present time. It appears that selection for yield in the past has resulted in a tendency for many improved varieties to have an increased photosynthetic rate but selection for increased leaf rate may not result in increased yield or dry matter production. Very little information is available for genetic correlations involving photosynthetic traits in breeding populations. There is an indication that canopy photosynthesis and leaf rate measured several times, especially during podfill, is correlated with yield. Selection for high yield should continue to provide improvement in photosynthetic capacity coupled with a favorable harvest index. The soybean is a C_3 plant in which the enzyme RuBisCO functions in the fixation of CO_2 and in photorespiration. There is the future possibility of improving photosynthetic capacity of soybeans through genetic engineering but considerably more needs to be learned first about the biochemical and physiological genetics of soybeans and potential donor species.

SOYBEANS ADAPTED TO COOLER REGIONS ?

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For various reasons, the cultivation of soybeans may be of interest for parts of middle and northern Europe as well as Canada. Daylength is not anylonger considered to be a limiting factor. Since cool temperature responses continue to limit soybean yield and production in these regions, it appears that temperature is the main limiting factor. Cold tolerance in soybeans varies considerably depending on the growth stage. A selection for cold tolerance should not only be based on the dry matter accumulation of the various plant parts but

also on physiological traits which reflect the response of coldstressed plants.
An efficient breeding program for cold tolerance must rely on selection criteria which can be identified at an early stage. The fact that the influence of low temperature is mainly quantitative and not qualitative makes selection for cold tolerance rather difficult.
The temperature variation from year to year during critical developmental stages of the soybean leads to the need to evaluate the natural environmental variability within each region of potential soybean production and the response of genotypes to this variation.

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INTERCROPPING: COMPETITION AND YIELD ADVANTAGES

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Intensive intercropping culture of more than one crop species has produced food for subsistence farmers over centuries in the developing world. Component research on cereal-legume mixtures has shown yield advantages from zero to 50% or more under different levels of technology in the U.S. and elsewhere. Appropriate mixtures of species make maximum use of available water, light, and nutrients. Overyielding (greater total production by intercrops than by component crops in monoculture) occurs when intraspecific competition in monoculture is greater than interspecific competition in a mixture of species. Crop components are selected to complement each other either in the time or the physical space dimension or both. Soybeans in a sorghum-soybean intercrop in narrow strips have shown a yield advantage of 5 to 10% over monoculture soybeans in Nebraska. Sorghum yields were reduced by less than this amount, and the total production from the intercrop was greater than monoculture. The component crop in this mixture which is favored depends on the difference in plant heights and on whether light or water is the most limiting factor. There appears to be a potential for increased production in the sorghum and soybean growing areas of the U.S. through the appropriate selection of cultivars, the testing of cropping systems and agronomic practices for intercropping, and the further study of crop interactions and competition.

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STRIP AND RELAY INTERCROPPING OF SOYBEANS

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Maize and soybeans have been evaluated in strip intercropping systems with mixed results. With normal precipitation, maize yields were increased by 20% in strip intercropping compared to sole cropping. During a dry season the maize yield increases were limited to 10%. Soybean grain yield suffered when grown between strips of the taller maize crop. Soybean yield reductions of 15% occurred with normal precipitation and 30% during a dry season. When maize population densities were increased soybean yields decreased. Land equivalent ratios (LERs) for maize and soybean strip intercropping in the U.S.A. have indicated little or no advantage of strip intercropping compared to sole cropping. However, tropical and subtropical strip intercropping of various crops with soybeans have resulted in LERs which favored strip intercropping. Relay intercropping has been an established cropping practice in many areas of the world for centuries. In the U.S.A. cool season cereal crops were usually the first crops planted in relay intercropping. Soybeans were then planted directly into the cereal crop prior to heading. Later planting resulted in mechanical damage to the reproductive structure of the cereal crop. Earlier planting of soybeans resulted in mechanical damage to the soybeans during harvesting of the cereal crop. The earlier the cereal crop was removed from the field, the less the stress to soybeans, which resulted in more favorable soybean yields. LERs usually favored relay intercropping compared to sole cropping.

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DOUBLE CROPPING

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Double cropping soybeans after small grain is a common production practice and generally is successful in the South and Southern Corn Belt in the United States and Brazil and Argentina. Various production systems are used such as seeding no-till in small grain stubble, planting in a prepared seedbed, interseeding soybeans into immature small grains, planting into a burned stubble or into a seedbed prepared after burning. Production usually is highest where (a) soybeans are planted as soon as possible after small grain is harvested; (b) planting practices result in a good stand of soybeans; and (c) straw is managed so that weeds are controlled and there is minimum damage from disease and other pests. Narrow rows (less than about 60 cm) generally increase yield of double cropped soybeans because of late planting. Also, stands of soybeans generally are improved and yields are higher when no-till planting is in a stubble that is 23 cm or less in height. Phytotoxic materials are present in wheat residue and can slow growth and potentially reduce soybean yield. Soybean growth during the first 4 to 6 weeks can be reduced 20 to 30% in soil containing 2% wheat straw. Soybean cultivars differ in their reaction to this growth retardant with 'Davis' and 'Centennial' being much more tolerant than 'Dare' and 'Mack'. The success of double cropping generally is associated with the ability to control weeds adequately. If weeds can be controlled, no-till planting in a small grain stubble usually is the best practice to follow.

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ECONOMICS OF INTERCROPPING

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Intercropping is the growing of two or more crops simultaneously in the same field. It has a long history and is widely practiced around the world today. It is mostly associated with the diversified farming systems and labor intensive technologies found in the numerous small farms of tropical LDC's. Before the introduction of mechanization and chemical nitrogen fertilizers, intercropping systems, especially with legumes, were common in the temperate zone. Recent studies have considered the possible advantages intercropping may offer to mechanized agriculture. While intercropping with soybean is principally encountered presently only in Asia, soybeans for forage and green manure were frequently intercropped with maize in the US before W.W.II. Production for in-

dustrial use has favored monoculture but there has been some interest in seeding soybeans in small grains prior to harvest. Recent studies of intercropping have also focused on the proper evaluation of a system were more than one commodity is produced. Benefits identified for intercrop systems include flexibility in the use of resources, profit maximization, risk minimization, reduced soil deterioration and reduced pest incidence. Incorporation of intercrop systems into mechanized agriculture, present many problems, however.

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SOYBEAN ROOT GROWTH IN RESPONSE TO SOIL ENVIRONMENTAL CONDITIONS

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Growth and morphology of soybean root systems often are greatly modified by soil environmental conditions. Understanding how soil environment influences root systems may permit development of better crop management systems. This paper reviews current research concerning these interactions. Soil temperature can modify both growth rate and shape of soybean root systems. In general, soybean roots elongate most rapidly at soil temperatures between 22 and 29°C. Taproots, however, respond differently to soil temperature than laterals and the response of both changes with time. Temperature also influences the direction of growth of laterals. Soil conditions that reduce gas transport also inhibit root growth. Flooded soils or soil volumes below water-tables have few, if any growing roots. Response of soybean plants to water-tables depends on when roots are flooded and whether the water-table is static or fluctuating. Soil compaction reduces root elongation because of increased soil strength and reduced gas diffusion. Lastly, in many soils root growth is limited by aluminum toxicity. The effect of aluminum ions on root growth decreases as calcium concentration and pH increases.

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SOYBEAN CROP RESPONSES TO SOIL ENVIRONMENTAL STRESSES

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Physiochemical stresses of naturally and mechanically compacted soils are drastically reducing the worldwide production of soybeans. Field and laboratory experiments were designed to determine the shoot and root responses, nutrient absorption and yield responses of several soybean (Glycine max L.) cultivars to adverse soil conditions. Roots of 15 varieties were evaluated for their ability to penetrate artifically compressed soils during their first two weeks of growth. Root penetration ratios from these tests were highly correlated with crop yields (r^2=0.96 at P=0.05). Soybean plants of the varieties Corsoy, SRF-101 and Weber, grown on soil with minimum compaction, absorbed greater quantities of N, P, K, Mn and Zn than plants grown on compacted soils. Soil compaction reduced the yields of soybeans on coarse textured sand soils by 21% when no fertilizer was added. The addition of fertilizer (220 kg/ha of 9-44-0, 5% Mn and 2% Zn) to compacted soils increased soybean yields. Although the addition of fertilizer improved crop yields of some varieties, the increase seldom equaled the yields achieved on noncompacted soils receiving less fertilizer. Soil compaction also reduced the biological nitrogen fixation of soybean varieties by 64 and 35%, 72 and 83 days after planting, respectively. Total root lengths were reduced by the greater mechanical resistance of compacted soils. Although the spacial root length densities were related to soybean variety and soil type, soil compaction by excessive secondary tillage and traffic had the greatest adverse affect on root growth.

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FERTILIZER RATE AND PLACEMENT EFFECTS ON NUTRIENT UPTAKE BY SOYBEANS

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Fertilizer placement affects the efficiency of fertilizer use. Nutrient uptake is influenced by both the soil supply and the root absorption properties. A mechanistic mathematical model, developed to describe the uptake process and verified for accuracy was used to predict the effects of P placement on P uptake by soybeans. Phosphorus was mixed with volumes of soil varying from 2 to 75% of the soil volume. Root growth stimulation in the P-fertilized soil was accounted for. When volume of soil increased from 2 percent, predicted P uptake increased, reached a maximum, and decreased. The placement for maximum predicted uptake varied with soil and rate of application and was between 6 and 20% of the soil volume. As volume fertilized increases, more roots are contacted and P uptake increases. However greater distribution of P in the soil leads to more tie-up by the soil, so a fertilized volume is reached beyond which increased tie-up by fertilizing additional soil has a greater effect on decreasing P supply than fertilizing more roots for increasing it. Similar results occur for K, however placing K does not stimulate soybean root growth in the K fertilized zone. Using a combination of P and K will allow K uptake to benefit from the stimulation of the P fertilizer on root growth.

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STRUCTURAL CHARACTERISTICS OF SOYBEAN GLYCININ AND β-CONGLYCININ

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Glycinin and β-conglycinin constitute 65-80% of the protein in soybean seeds. These proteins play a key role in off-flavor retention, texture, heat stability and nutritional quality of soy foods. The structure of the two proteins contribute to these properties. Primary structure analysis of glycinin and β-conglycinin is partially completed. The amino acid composition of the two proteins has been widely reported. The secondary structure of the two proteins has been predicted by several spectrophotometric methods and one computer prediction algorithm. The events occurring during translation of these proteins have been elucidated and are useful evidence for supporting the structure predictions. Glycinin has a proposed three-dimensional (3-D) structure. The 3-D configuration of β-conglycinin is far less clear. Amounts of both proteins in soybean seeds vary with variety, environment and time after anthesis. Glycinin, a dodecemer, and β-conglycinin, a trimer, display microheterogeneity in their polypeptide makeup. The correlation of structure with off-flavor binding, heat stability and texture will be discussed.

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STRUCTURE AND FUNCTIONAL PROPERTIES OF SOY PROTEINS

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Knowledge of the structure and physicochemical properties of soy proteins is very desirable to successfully develop protein rich products and functional ingredients from soybeans. A wide range of functional properties are required to enable soy protein to be used in widely different food products. In addition, for use in baby foods improved digestibility is desirable. We will review knowledge of the composition and structure of soy proteins and describe physical properties of the major components and how these interact in model systems, especially upon heating. In heated systems the basic subunits of the 11S which are insoluble at pH 6-8 interact with 7S electrostatically and prevent precipitation. Some thermodynamic aspects of soy protein gelation indicating the importance of H-bonding will be discussed. The importance of quaternary and tertiary structure in digestibility of soy protein will be summarized in the context of improving this important property.

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FLAVOR-BINDING AND THE REMOVAL OF FLAVORS FROM SOY PROTEIN

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The flavor of soybeans is one of the major drawbacks of using soybeans in human foods. The undesirable flavors of soybeans are characterized as the "green", "beany", "painty", "grassy" and "bitter" flavors that can be developed by lipoxygenase activity or oxidative rancidity in the raw crushed soybean or soybean flours. These flavors interact with soy protein and are often released when these flours, concentrates and isolates are used as ingredients, extenders or fabricated foods. This off-flavor release decreases the consumer acceptability of these products and marketability of these foods. Past research has centered on (1) the identification of these off-flavors, (2) the source of the off-flavors, and (3) empirical processing methods to remove or mask these flavors. More recently, research in model (gas/solid; aqueous) systems and food systems has centered on understanding the mechanism(s) involved in the binding and release of these off flavors or added desirable flavors. However, problems with differing analytical methodologies, and the interpretation of the data using binding models has slowed the understanding of these mechanisms. These problems must be overcome if we are to increase the marketability and utilization of soy protein in human foods.

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CHEMICAL, FUNCTIONAL AND NUTRITIONAL PROPERTIES OF PHYTATE-REDUCED SOY PROTEINS

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Phytate, the hexaphosphate form of inositol, effects the chemical, physico-chemical, functional and nutritional properties of soy protein isolates (SPI). A combination cation/anion exchange process removed $\geq$ 95% of the Ca, Mg and phytate from SPI, but a second approach using up to 5% (w/v) Ba, Ca and Zn salt solutions to selectively remove phytate ions from SPI was not feasible due to low protein yields of 10-85%. The phytate content of fractionated 7S and 11S soy protein components was found to be 1.40 and 0.07%, respectively. Most of the phytate from the soybean was recovered in the soy whey precipitate fraction. Freeze dried, phytate-reduced soy protein isolate (PRSPI) had its maximum solubility of 84% at pH 3 and its minimum solubility of 12% at pH 6. PRSPI functioned best in terms of foamability at pH 3, protein concentration 5% (w/v) and 25°C preheat treatment. PRSPI produced average maximum foam expansion of 1336% compared to 956% for control SPI and 320% for commercial SPI. Major shifts were produced in the molecular weights of soy proteins by removal of phytate as determined by Sepharose 6B gel chromatography. PRSPI exhibited a minor but significant improvement in Fe bioavailability compared to commercial SPI as determined by chick hemoglobin repletion.

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SOYBEAN HERBICIDE DEVELOPMENT

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The development of new herbicides for weed control in soybeans on a worldwide scale follows a pattern of adapting products developed for the large soybean market in the United States to other soybean producing countries. The high cost in terms of time, capital and human resources to discover, develop, register and commercialize new products dictate that a new product have an established or potential commercial base in the United States before expanding commercialization to other countries. New product development outside the U.S. for use in the soybean producing countries will continue to lag behind the U.S. because of uncertainties in protection of patents and property rights, regulatory requirements and economic outlook. Herbicide use patterns in the U.S. show that the percent of soybean acres receiving a herbicide treatment increased from 68% in 1971 to 93% in 1982. Product use patterns have not shifted significantly during the 1976-1982 period for established products. The major increase has taken place with products introduced in the mid-70's which are used as mixtures or sequential treatments with the established products. The majority of new products under development or just recently introduced into the soybean market offer the grower alternatives to the already established products. There are few remaining niches for new products except to offer alternatives or more flexibility to the grower to solve his weed problem. An economic deterrent for new product development is the pending patent expiration of several of the widely used soybean herbicides.

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HERBICIDE-SOIL INTERACTIONS

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Numerous chemical, physical, and biological factors are known to affect the behavior and fate of herbicides in soils. The interactions of these various factors ultimately determine the overall efficacy and persistence of each chemical under any given set of conditions. The recognition and identification of these factors are important in establishing recommended usage patterns for each chemical. Chemical and physical characteristics of both the soil and the herbicide; soil moisture; soil organic matter and clay contents; positioning of the

herbicide in relation to both the crop seed and the weed seed; photodecomposition; volatilization; incorporation; and application timing are but a few of the vital factors which must be considered in the use of herbicides in soybeans. Although considerable attention has continually been given to the efficacy and persistence of individual chemicals in the soil environment, only scant attention has been given to the effects of multiple applications of either individual or combinations of pesticides on their performance or behavior in soil. The objective of this presentation is to examine and briefly review several pesticide-soil interactions known to affect herbicide efficacy and persistence in soil and to present additional information which illustrates the relative importance of other interactions.

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RECENT DEVELOPMENTS IN POSTEMERGENCE SOYBEAN HERBICIDES.

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The use of postemergence herbicides in soybeans had an accelerated development during the last twenty years. Dinoseb and 2,4-DB had limitations regarding selectivity and time of application. Chloroxuron although effective as an early postemergence herbicide often caused excessive soybean injury.
The development of bentazon and acifluorfen postemergence herbicides brought about the control of a broad spectrum of broadleaf weeds which was equal or superior to that of preemergence herbicides. The effectiveness of postemergence broadleaf herbicides aided the increase in solid seeding soybeans from about 3% in 1975 to over 20% in 1983.
A simultaneous discovery of two distinct chemical classes of compounds, the cyclohexanediones and phenoxy-phenoxy graminicides gave a new perspective to postemergence grass control in soybeans. Controlling grasses and broadleaf weeds using postemergence applications has become a reality. More recent developments in the graminicide area as well as in the chemistry of diphenyl ethers increase the postemergence weed control spectrum making total postemergence weed control possible for various types of soil management practices varying from no-till to conventional till soybeans.

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LOW VOLUME APPLICATIONS OF POSTEMERGENCE HERBICIDES USING ELECTROSTATICS, CDA'S, AND SOYBEAN OIL

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Low volume applications of herbicides were evaluated using rotary nozzles, electrostatic sprayers, and air-assisted flat fan nozzles. Water and soybean oil were compared as carriers in volumes of 18 to 37 L/ha. The viscosity of soybean oil-herbicide mixtures was much higher than that of water-herbicide mixtures especially at low temperatures. Flow rates of soybean oil through regular flat fan nozzles were similar to those of water although higher spray pressures were required to develop a full fan angle when spraying oil. Flow rates through flooding nozzles decreased when spraying soybean oil as compared to water. Soybean oil increased the flow rate through hollow cone nozzles as compared to water with a decreased flow as temperature increased from 10°C to 40°C. Spray patterns were erratic from both flooding and hollow cone nozzles. In field applications, grass control was about the same when postemergence herbicides were applied with water at 37 L/ha or when applied at 187 L/ha. As oil was added to the water, grass control decreased, especially at the 50 percent concentration of oil. There was very little difference in weed control when using either water or soybean oil as the carrier in 18 L/ha applications of postemergence herbicides. Trends indicated improved grass control and decreased broadleaf weed control when using soybean oil as a carrier as compared to water.

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BREEDING FOR DROUGHT AND HEAT RESISTANCE - PREREQUISITES AND EXAMPLES

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Much of the annual variability in soybean [Glycine max (L.) Merrill] yields is due to fluctuation in seasonal precipitation and temperature. There is thus a need for cultivars with greater yield stability to drought and heat stress. Four prerequisites must be met in breeding for genetic resistance to stress. The first is to rigorously define the stress conditions that, based on the climatological record for the region, have significantly reduced yields. The second is to identify the traits to use as selection criteria, whether these are "integrative" (seed or dry matter yield) or "constitutive" (morphological or physiological). The third is to develop effective screening techniques involving either "empirical" selection (based on performance) or "mechanistic" (based on some formulated ideotype) selection. The fourth is to assemble appropriate germplasm with sufficient heritable variation in the trait. The major advantage of empirical selection for integrative traits is that yield performance is the ultimate criterion; however, controlled stress is difficult to apply uniformly and consistently in the field test environment. The major advantage of mechanistic selection is that expression of the constitutive trait may not require rigorous control of or even the presence of the stress; however, there is usually insufficient evidence to verify that the trait is related to performance in a stress environment. These problems will be illustrated with examples from our research involving cellular membrane thermostability, plant pubescence density, and a line-source sprinkler system.

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NITRATE METABOLISM OF SOYBEAN - PHYSIOLOGY & GENETICS

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Nitrate metabolism in soybean is unique in that both a nitrate-inducible nitrate reductase (iNR) and a constitutive nitrate reductase (cNR) are present. A mutant line selected by chlorate screening of seedlings has been isolated which lacks the cNR enzyme. Biochemical and genetic characterization of the two NR isozymes have been conducted. The cNR isozyme occurs in physiologically young tissues, including cotyledons and leaves, but does not occur in roots or older vegetative tissues. The iNR is present in all parts of wild-type plants if the plants are given nitrate, and this enzyme accounts for approximately 75% of the total plant NR activity. Soybean cell cultures exhibit iNR but not cNR activity. Purification of the NR isozymes from leaves have revealed biochemical differences; pH optimum is 7.5 for iNR and 6.8 for

cNR, bicarbonate is a competitive inhibitor of nitrate for cNR but not for iNR, cNR has greater affinity for alternate reductant sources (FADH, NADH) than does iNR, and cyanide is more inhibitory to iNR than to cNR. The cNR enzyme appears to be associated with the evolution of nitrogenous gases during in vivo NR assays of wild-type soybeans; the nr_1 mutant lacking cNR activity also lacks the ability to evolve nitrogenous gases. Genetic characterization of the nr_1 mutant indicates that loss of cNR is controlled by a single recessive nuclear gene. Nitrate accumulation, reduced-N accumulation, and N_2 fixation were not affected by the deletion of cNR. The overall importance of this enzyme to nitrate metabolism in soybean remains to be established.

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HERBICIDE TOLERANCE IN SOYBEANS

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Significant progress has been made in the development of new and more selective herbicides for control of weeds in soybeans since the last World Soybean Research Conference. This paper will focus on the research and development in recent years by the chemical industry and soybean breeders. There is much better recognition of varietal differences in herbicide selectivity within most all crops. It has become very common, if not standard policy, for the chemical industry to screen many major commercial soybean varieties and genetic lines for sensitivity to a new herbicide before it is introduced for commercial use on this crop. Likewise, plant breeders often test all new soybean introductions for sensitivity to major commercial herbicides early in their development. The rapid replacement of the variety Tracy by Tracy-M, a metribuzin-tolerant selection, is evidence of the great importance this single characteristic can play in soybean breeding. With the phenomenal progress made in the areas of biotechnology, genetic engineering, and our understanding of herbicide action and selectivity mechanisms, we are now able to more readily create crops with herbicide tolerance or resistance as a unique and specific characteristic. There is no doubt that a soybean having resistance to atrazine, glyphosate or other important herbicides is among the major objective of many scientists and laboratories. The breakthroughs necessary for such objectives to become realities are just a matter of time, and they will likely bring revolutionary changes in herbicide selectivity of future soybean varieties.

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PHYLOGENETIC RELATIONSHIPS AND HOST STRAIN INTERACTION IN SYMBIOTIC NITROGEN FIXATION

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The symbiosis of soybean and rhizobia is essential to normal growth and yield on most soils. Symbiosis evolved early in legume phylogeny as evidenced by its occurrence in two major subgroups of the Leguminosae, the Mimosoideae and Caesalpinioideae, both of which had developed by the end of the Cretaceous period. Soybean, in the subfamily Papilionoideae, forms desmodioid type nodules with a closed vascular system similar to other genera in the tribe Phaseoleae, which is thought to be of tropical/subtropical origin. The combination of export of fixed nitrogen as ureides and nodules with a closed vascular system is postulated to be an adaptation to a warm tropical environment. However, the commercial soybean is derived from Northeast China, an area of temperate climate suggesting a complexity of selection pressures during coevolution of symbiosis. Ecotypic differentation of host compatibility with rhizobial strains has been reported. The nodulation compatibility of 'Peking' soybean with the fast-growing rhizobial strain USDA 205 is controlled by a single recessive allele. The frequency of compatibility with strain USDA 205 varies with geographic origin of plant introductions from Asia. The question of whether the fast-growing and slow-growing types of rhizobia evolved by radiation from a common ancestor or by convergent evolution from disparate ancestry is raised here.

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MACHINERY FOR CROPPING SYSTEMS

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In the United States the relatively uniform set of tillage practices of the past have evolved into more complex management systems. Optimum tillage practices for soybeans [Glycine max (L.) Merrill] have become site specific much like fertilizer and pesticide recommendations. Tillage systems differ, not only from one region to another but from field to field, and, in some cases practices within a filed change from one year to the next. Use of conservation tillage has tripled during the past decade to the point that about 7, 38, and 55% of the 1982 U.S. soybean area was in the no-, reduced-, and clean-tillage categories. When considering machine options for conservation tillage, the manner in which an implement is equipped and operated can be as important as selection of the particular implement. Capability to operate in and maintain surface residue as well as integration of pesticide application are all important aspects of machines used in conservation tillage. Planting devices need to be chosen based on seedbed condtions as well as row width and cost requirements. Uniform straw distribution behind the combine aids in successful conservation tillage. As long as crop yields are similar no one tillage strategy has shown a clear economic advantage over others.

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ROTATIONAL BENEFITS TO SOYBEANS AND FOLLOWING CROPS

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Extensive research has established that rotating crops generally results in higher yields than monoculture. The cause of this effect is not nearly so well established. The broad possibilities are that there are beneficial effects from other crops and/or inhibitory effects from the same crop. This paper is concerned with (1) the effects of preceding crops on soybean (Glycine max L.) yields, and (2) the effects of soybeans on succeeding crops. As compared to continuous soybeans, yields of soybeans following corn (Zea mays L.) were 14, 6, and 19% higher in studies conducted in Illinois, Indiana, and Nebraska, respectively. As compared to corn following corn, yields of corn following soybeans were 17, 9, 25, 8, and 7% higher in research conducted in Illinois, Indiana, Minnesota, Wisconsin, and Iowa, respectively. Corn in the preceding studies had adequate amounts of nitrogen fertilizer applied. Where no nitrogen fertilizer was applied for corn, yields of corn following soybeans were 51, 60 and 113% higher than continous corn in Minnesota, Wisconsin, and Iowa, respectively. In addition to nitrogen supplied by a legume in the rotation, other possibilities why rotations often increase crop yields include the effects on physical properties of the soil, reduced

toxic materials from crop residues, decreased infestations of insects, diseases, and weeds, and undoubtedly other effects yet unknown.

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IRRIGATION WATER MANAGEMENT OF SOYBEANS

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Growth and development of soybeans reflect the integration of temporal and spatial variations in the soil and atmospheric environments. The effects of water stress on yield vary according to growth stage, adaptation to previous stresses, growth habit, and to the severity and duration of the stresses. These effects may be expressed in decreases in dry matter and leaf area production and plant height during vegetative growth, and in one or more of the yield components during reproductive growth. Optimization of seed yield requires that management practices be developed that allow soybeans to grow under non-stressed conditions. Seed yield responses to irrigation in humid climates ranging to 3000 kg/ha have been reported. Techniques such as risk analysis were used to quantitatively compare two irrigation management situations. Results using long-term rainfall probabilities show that water deficits increase during the soybean growing season regardless of the initial water deficit of planting and that the effects of the initial water deficits of planting are not linearly translated to higher deficits during the growing season. Two distinct research pathways are recommended in the future. The first involves the selection of genotypes with high yield potentials. The second pathway involves the development of management schemes that brings actual productivity closer to potential. Irrigation is a management option which can be used to achieve these goals.

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SOYBEAN CROP MODELING FOR PRODUCTION SYSTEM ANALYSIS

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The specialization of agricultural research into disciplinary areas has led to significant advances in our basic understanding of production constraints. However, the systematic integration of disciplinary knowledge into improved systems for crop production has lagged behind its development. The reason for this lag is that relatively little attention has focused on methodologies for research integration until recently. At the University of Florida, an interdisciplinary research team began addressing this problem about five years ago with a goal to determine optimal strategies for soybean irrigation and pest management practices. The objective was to develop a soybean production system model to integrate crop, soil, insect, weather, and management components. The level of detail to include in the model was based on: (1) major stresses on crops that may be reduced through improved management and (2) ability to quantify model parameters based on field measurements. In the soybean crop growth model SOYGRO, soil, weather, and pest stresses interact to affect photosynthesis, respiration, transpiration, growth and senescence of plant parts. Plant carbon and nitrogen partitioning is dependent on growth stages which vary among cultivars. The model has been used in the synthesis of crop physiological research and in research on irrigation, pest management, and early season cultivar evaluation. The strengths of the model are based on its focus on a selected set of major stresses and management options and on the ease with which model state variables and processes can be verified by field measurements.

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DEPOSITION AND EFFICACY CHARACTERISTICS OF OIL APPLIED PYRETHROIDS

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In recent years, vegetable oil applications of insecticides, particularly pyrethroids, have become accepted for many major agricultural crops. This acceptance has arisen from increased efficiency due to characteristics involved in droplet size, canopy penetration, uniformity, and spray integrity, as well as delivery volumes. Aerial application sprays of Pounce® 3.2EC (permethrin) and Ammo® 2.5EC (cypermethrin) have been extensively examined using water, oil, and oil-water dilutions in a number of leading crops. Canopy penetration was greater with oil diluted sprays applied at 2.3 liters/ha total volume and were more uniform in deposition when compared to water diluted sprays applied at 9.4 and 28.0 liters/ha total volume. The addition of vegetable oil adjuvants to higher volume water applications were shown to have a significantly increased volume median diameter (VMD) when compared to applications of the same volume using water alone. Efficacy data correllated to application efficiency indicate that oil diluted applications will improve pest control on most major insects of major crops.

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EVALUATION OF INOCULATIVE RELEASES OF *Pediobius foveolatus* AGAINST THE MEXICAN BEAN BEETLE IN MIDWESTERN SOYBEANS.

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Pediobius foveolatus (Pf) was introduced from India in the 1960's to suppress Mexican bean beetle (MBB) in soybeans. High parasitism and dispersal rates, and overwintering inabilities prompted the development of an annual inoculative release program. Commercial implementation of the release program is occurring in the east, but midwestern evaluations have been less positive. Early season releases of Pf do result in high dispersal and parasitism rates, but these characteristics do not necessarily indicate economic MBB suppression. Since Pf attacks late instars, second generation MBB adult densities and defoliations are more affected than those of the larvae. Soybean maturity during the second adult generation is usually beyond where defoliation seriously affects yield. Also, adult MBB dispersal may offset larval parasitism. However, within the season of release, Pf did economically suppress MBB in some early planted fields. There are relationships between first and second MBB generation densities, and between first MBB generation density and degree of Pf establishment and control, but they are not adequately quantified to reliably recommend the release of Pf in individual fields. It is concluded that Pf releases cannot be practically justified in the midwest at this time. The results and conclusions serve as examples of requirements for the development of other inoculative release programs.

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PESTICIDE COMPATIBILITY IN SOYBEAN PEST MANAGEMENT

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Virtually all soybean production in the United States today includes the use of pesticides, with more than 90% treated with herbicides and more than 10% treated with insecticides. Use of fungicides and nematicides is much lower. Certain combinations of pesticides belonging to different classes can adversely affect soybean growth and yield. The widely-used herbicide metribuzin has been shown to interact synergistically with several soil-applied, organophosphate insecticides or nematicides causing soybean injury. This occurred even at recommended usage rates which cause no apparent problems when each pesticide is used alone. Postemergence applications of bentazon in combination with foliar applications of certain organophosphate insecticides have also produced similar adverse interactions. Carbamate insecticides or nematicides have rarely produced adverse effects in studies of possible interactions between herbicides and other pesticides. Repercussions of pesticide application beyond the soybean plant and target pests have been documented. Increases in pest insect populations may result from foliar applications of particular insecticides, and under certain conditions following soil applications of aldicarb at planting. Also, certain herbicides have been shown to influence insect reproduction and the size of nematode populations. Conversely, several hypothesized interactions and nontarget effects of pesticides have proven to be unfounded, of limited significance, or important only under specific circumstances.

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BIOLOGICAL CONTROL OF SOYBEAN LEPIDOPTEROUS INSECTS IN BRASIL

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The velvetbean caterpillar, Anticarsia gemmatalis, is the most important lepidopterous insect of soybeans in Brazil, even though other species may occasionally damage the crop. Natural enemies are abundant, contributing in many instances to maintain pest populations below damaging levels. Even though predacious hemipterans, carabid beetles, and spiders as well as parasitoids such as Microcharops bimaculata, Patelloa similis, Copidosoma truncatellum and Voria ruralis, contribute significantly in reducing lepidopterous-insect populations, the fungus Nomuraea rileyi may be considered the most important natural control agent in the soybean agroecosystem, since it has been responsible for the absence of insecticide applications against defoliating caterpillars in years with high humidity levels during insect occurrence on the crop. Recently, a program for farmer utilization of a nuclear polyhedrosis virus of A. gemmatalis has been implemented in Brazil with the objective of replacing chemical insecticide use against the insect. The virus, produced "in vivo" in the laboratory at CNPS/EMBRAPA or on naturally occurring larval populations, has been applied by farmers as a crude preparation, showing efficacy comparable to chemical insecticides, if application is directed against small larvae. It is estimated that over 10,000 ha was treated with the pathogen in the 1983/84 season and that sufficient virus is stored in grower cooperatives or farms to initially treat 50,000 ha of soybean in the next soybean season.

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NONFOOD USE OF SOY PROTEIN PRODUCTS

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Nonfood use of soy protein products refers to specially processed protein products other than the usual soybean meal used for animal feed. Specially processed flakes are used to make soy flour and grits, isolated soy protein, soy protein concentrate, textured soy flour and partially hydrolized proteins. Some of these products are used in specialty animal feeds, such as pet food and milk replacers for new born animals. They are also used in certain fermentations to produce antibiotics, etc., and in a variety of products and processes to take advantage of their functional properties, such as emulsifying, film forming, adhesive, fat binding, dough forming, stabilizing, water holding, detergency, dispersing, foaming and viscosity control. Over the past 20 or 30 years, there has been a considerable change in useage of some of these products. in some cases the manufacturers have decided that it was not economic for them to continue to produce because of the competition from other polymers and the high cost to replace obsolete plants and processes. It is estimated that of the soy protein utilized in the United States in the crop year of 1981-1982, about 90% was as meal for animal feed, 7% for nonfood use and 3% in human food.

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SOY PROTEIN PRODUCTS IN PROCESSED MEAT & DAIRY FOODS

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Use of soy proteins in meat and dairy foods allows better use of raw material and equipment, reduced ingredient cost, increased plant production, and new market opportunities. When soy protein products are properly utilized, there is no compromise of yields or finished product quality. There is normally no need for special process equipment. Applications are adaptable to any meat or dairy plant situation. Selection of the proper soy protein(s) is most critical. Current plant products and processes, ingredient availability, marketing requirements, and goals, nutrient composition, legal guidelines, economics and good judgment and also important considerations. These guidelines often determine protein selection and finished product formulation. In processed meats the unique functionalities of soy protein allow significant cost reduction, superior yields, maintenance of nutrient composition, and texture. In patty, (e.g. hamburger) emulsion (e.g. bologna), and coarse ground (e.g. sausage) products replacement of up to 30% of lean meat equivalents is possible. Whole muscle meat applications are increasing in importance and new non-meat products offer new opportunities. Special care is needed when applying soy proteins in dairy foods. Properly selected soy proteins allow formulation of protein fortified fluid and frozen products, soy beverage concepts, non-dairy frozen desserts, yogurts and cheeses, and non-traditional tofu. Total or partial replacement of milk solids or traditional soymilk solids is possible.

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FEASIBILITY FOR A SHELF-STABLE SOYBEAN BEVERAGE

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In order for soybean beverages to be distributed in areas where refrigeration is not available, a "shelf-stable" product is needed. Feasibility of development of an intermediate moisture soybean beverage concentrate without evaporation, using instead formulation of blanched cotyledons with sugar and salt, was studied. The first step in producing whole soybean beverages from blanched cotyledons involves milling of hydrated blanched cotyledons. There was a linear increase in milling efficiency as the tenderness of the blanched cotyledons increased. Addition of sucrose to the blanched soybean cotyledons prior to milling had three beneficial effects:1) increased the milling efficiency independently of the blanched cotyledon solids content, 2) lowered the water activity of milled cotyledon suspensions linearly from 0.99 to 0.86, and 3) lowered viscosity of milled cotyledon slurries enabling them to be homogenized. Homogenization of the milled cotyledon slurry with added surcose resulted in a beverage concentrate. The beverage concentrate was moderately psuedoplastic. The reconstituted product showed good suspension stability. Preference tests showed no significant differences between the soy beverage concentrate and sweetened condensed cows' milk with regard to flavor, color, or mouthfeel. Both the soybean beverage concentrate and sweetened condensed cows' milk had a water activity of 0.86 and were shelf-stable.

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ECONOMICAL PROCESSED BLENDS OF SOYBEAN AND CEREAL AS HUMAN FOODS

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Soybeans combined with cereal foods consumed in less developed countries (LDCs) can cost-effectively increase their protein quantity and quality and caloric density. Interest has grown in LDCs in precooked nutritious foods for young children and pregnant and lactating mothers. The cooking extruder combines and heats food blends in a single operation, increasing their nutritional value, palatability and utility. Small-scale low-cost extrusion cookers (LECs) have been evaluated with a variety of ingredients. Friction between the turning extrusion screw and the food produces the heat necessary to cook at 170°C for 10 s. The LECs' low capital and operating costs allow the manufacture of precooked foods that can reach the most vulnerable segments in LDCs. LECs have produced blended foods similar to Title II Food for Peace products using local grains. An extruded blend of 70% cereal/30% whole soybean can be reconstituted instantly, has high caloric density (400 kcal/100 g), 6 mo shelf life, and low bacterial counts. Blended foods are manufactured and packaged in 0.5 kg bags for $0.55-0.65/kg. LEC plants producing 500-1,000 kg/hr have been designed, constructed and operated in Sri Lanka, Tanzania, Costa Rica, and Guyana. Operating records document capital/operating costs and the beneficial impact of the foods produced. In addition to blended food applications, extruded soybeans have augmented human foods as full-fat soy flour in bakery goods, sweetened cereal/soy beverage bases, enriched cereal/bean soup mixes and precooked tortilla flour.

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THE ROLE OF SEED DORMANCY AND GERMINATION IN DEVISING WEED CONTROL METHODS

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Weed seed dormancies provide mechanisms for continued infestation of agricultural lands. It is estimated that of the approximately 100 million seeds that typically infest an acre of agricultural soils, 10% of the total seed population emerges in any one crop-year. Herbicides act chiefly on only the small germinating population and leave the much larger dormant seed population unharmed. New technologies based on attacking the dormant seed population to reduce soil infestations are needed. To accomplish this objective, knowledge of seed biology and dormancy mechanisms are required. Under field conditions, dormancy in many kinds of seeds may be controlled by phytochrome or by impermeable seed coats. Often, a cyclical pattern of dormancy intensity occurs. Weed control strategies based on influencing dormant seeds could use approaches related to either prevention of germination or a release from dormancy. Currently, methods of overcoming dormancy are receiving the most research interest.

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TILLAGE EFFECTS ON ANNUAL WEED GERMINATION

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Germination of buried weed seeds is stimulated by various natural factors. Stimulation by these factors can be deliberately increased by tillage of the soil. Tillage not only brings seeds nearer the surface, but can also provide light, aeration and increased temperature fluctuation, which can all trigger weed seed germination, especially in those which have been long buried. Combinations of factors can increase the proportion that germinate. The time of year that the soil is tilled relative to the germination periodicities of the weeds present will determine which will occur in the crop being planted. Increasing the frequency of tillage will increase the number of seeds encouraged to germinate and so the seeds in the soil will be reduced more rapidly. In England, no-till crops often have a predominance of grass weeds, partly because their seeds require light for germination and partly because chemical control in cereals is not always satisfactory. Conversely, plowing appears to favour dicotyledonous weeds because their long-lived seeds are continuously being brought up from below. Although tillage can be an excellent aid to weed control it is relatively slow in reducing the number of seeds in the soil. It is consequently concluded that chemical stimulants such as ethylene would be more effective in reducing weed seed populations.

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METHODS FOR CROP-WEED COMPETITION RESEARCH

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There have been no major changes in the general methods of crop-weed competition in the last two decades. Weed scientists are still determining when competition begins for specific species at specific densities and the converse, the determination of the required weed-free-period for maximum yield. The latter is most important for preemergence application and the former most important for postemergence herb-

icides. The arsenal of new herbicides available for both pre- and postemergence application in soybeans has renewed greater interest in weed competition. Much activity is now underway to determine how weeds modify the microenvironment of the crop and how the crop respond to the changed environment. New and more versatile instruments to measure light and moisture stress have helped to clarify the nature of competition. With greater base data on environmental changes along with crop and weed growth responses, predictive weed competition models appear more feasible.

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ASPECTS OF WEED-CROP INTERFERENCE RELATED TO WEED CONTROL PRACTICES

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Interference involves both allelopathy and competition. The competitive aspects are probably the most important of the two in most soybean-weed relationships. Weeds compete with soybeans for limited resources such as light, moisture, nutrients, and perhaps growing space. Competition for these resources is influenced by the crop, cultural practices, the weed species, and environmental (weather) factors. Research on weed competition in soybeans has primarily involved additive experiments that investigated (a) weed density and (b) duration of weed competition. The reported research indicates that increasing either weed density or duration of competition result in losses in soybean yield that are a continuous function of either factor. Data are available on the effect of density for several weed species, however, data are lacking for the low densities present in most fields and for multiple weed species. Results from one type of duration study show that soybeans need several weeks of weed-free conditions following planting to avoid suffering a yield loss; weeds emerging thereafter cannot compete successfully with a good stand of soybeans. Results from another type of duration study have shown that a moderate stand of weeds can compete with soybeans for several weeks after planting, and then be removed (or killed with herbicides), without causing significant soybean yield reductions. Fairly good economic thresholds can be calculated for postemergence control of weeds as related to crop yields.

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SELECTION FOR COLD TOLERANCE DURING THE REPRODUCTIVE PHASE

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We have found that some varieties of soybeans are able to flower and produce seed under temperatures as low as 15/9°C day/night regimes in growth rooms. Similar trends in variety performance have been observed under natural conditions at high altitudes in central France. Plants sensitive to low temperatures flower but produce mainly parthenocarpic pods similar to those on male-sterile plants. Varieties also differ greatly in internode elongation under low temperatures.

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SELECTION FOR LOW TEMPERATURE GERMINATION IN SOYBEANS

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Soybeans (Glycine max (L.) Merr.) able to germinate at low temperatures could permit earlier spring planting and might promote full and uniform stands. The U.S. World Soybean Collection for Maturity Groups 00, 0, I, and II were screened for germination at 10°C. The mean number of days for 10 of 15 seeds to germinate ranged from 2.5 to 7.4 days. Seventy lines were selected to represent a wide range in speed of germination at 10°C and tested under field conditions for 3 years. Lines chosen for rapid germination at 10°C generally emerged faster, showed more vigorous seedling growth and yielded better than those chosen for slow germination. F_2 progeny of 7 crosses involving slow and fast germinating cultivars indicated that cold germinating ability was under complex genetic control. Additive effects were of most importance. Pedigree and single seed descent breeding schemes were used to select for cold germinating ability in 8 families. Estimates of genotypic variance components as well as maternal and cytoplasmic effects have been investigated. Results of these studies will be presented.

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HERITABILITY OF COLD GERMINATION RESPONSE IN TWO SOYBEAN POPULATIONS

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Crosses were made to estimate the heritability of cold germination response. Cold tolerance was measured as a germination index at 10 C in the growth chamber. The germination index was then compared with the actual field performance of selected lines. Seed from F_2 derived F_3 and F_4 lines were evaluated from two locations and two years. Heritabilities of lines were low to intermediate with large standard errors. Field performance of selected lines was not significantly correlated with the germination index. The differences between the lines in field performance were not large enough to affect yield. The confounding effect of seed source environment made the detection of genetic differences in early season cold tolerance difficult.

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HERITABILITY OF COLD TEMPERATURE EMERGENCE AND ITS RELATIONSHIP TO SEED YIELD IN SOYBEANS

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Reduced tillage practices, early planting, and post-planting cold snaps may result in the exposure of emerging soybean [Glycine max (L.) Merr.] seedlings to sub-optimal temperatures, leading to reduced stands, seedling vigor, and disease resistance. For each of four soybean crosses, 50 F2 progeny were advanced to 200 F4 lines, maintaining F2 and F3 identity. Seed of each line were planted in coarse sand and placed in a constant 10 C chamber. Cold temperature emergence (CTE) was determined after six weeks. In a separate study, 17 cultivars were tested for CTE in the field and laboratory for two years. Significant genotypic variation was found among the F4 progeny of each

cross. Transgressive segregation and dominance toward the high parent were observed. Narrow sense heritability estimates ranged from 12 to 23% , with an average of 18%. The average broadsense heritability, based on three reps in the lab screening test, was 91%. Significant genotypic variation for CTE was also observed among the 17 adapted cultivars in each test. Laboratory performance was predictive of field performance in early planted tests. The average seed yield of early planted tests was related to CTE percent in the field and lab (r = .78 and .69, respectively). CTE screening in the laboratory is effective, and accurately predicts field performance at sub-optimum temperatures.

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DEVELOPING DAYLENGTH-NEUTRAL SOYBEANS--A METHOD OF OBTAINING HEAT TOLERANCE

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This paper reviews a long-time program of developing varieties adapted to the high temperatures and low humidity of Arizona. Early results showed that the varieties, supposedly adapted according to Maturity Groups, were uneconomical because of their long growing season and high water use. In 1969, a date-of-planting experiment with nine dates of planting, from April 15 to August 15 and with representative varieties from all Maturity Groups showed that certain varieties from some Groups were daylength-neutral and would mature in approximately 95 to 100 days regardless of the date of planting. Other varieties which were photoperiodic, matured in October and November. In a program to develop daylength-neutral varieties, Acme and Portage from Group 00 were crossed with non-shattering Arizona lines. Two techniques were used to evaluate segregating populations for the daylength-neutral character. The most efficient system was planting the segregating lines in four dates of planting. A more exacting system was the use of artificial lights, but this was very expensive and thus limiting. Data from date-of-planting nurseries show that photoperiodism affects three stages of growth, flowering, pod setting, and normal maturity. Daylength-neutral lines will flower, set pods, and mature normally during the highest summer temperatures.

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SOYBEAN GENOTYPE SELECTION FOR DRY AND WET SEASONS IN THE TROPIC

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Soybeans (Glycine max Merr.) are grown during dry and wet seasons in the tropics. To maximize the yield, cultivars suitable for each season should be developed. One hundred F_5 derived lines were evaluated during the 1982-1983 dry and wet seasons to identify the most productive lines in each season. The same location was used for both tests to avoid genotype - location interaction. The average yield was 1968 kg/ha for the dry season, and only 1609 kg/ha for the wet season. The yield correlation between the two seasons was r = 0.4**. The best dry season line yielded 2974 kg/ha, while that for the wet season yielded 2420 kg/ha. Interaction between genotype - season was significant, indicating a differential adaptation of the genotypes to the seasons. Selection of the 10 highest yielding lines based on the average yield over the two seasons, however, identified the five highest yielding lines for the dry and wet seasons. Separate breeding programs for specific season adaptation, therefore, may not be justified.

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INVESTIGATIONS OF BREEDING CRITERIA FOR DROUGHT TOLERANCE IN SOYBEANS

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Drought tolerance is one of the most important breeding objectives for soybeans in France. In order to find breeding criteria, 15 varieties were observed in drought boxes, with 2 water treatments. Among canopy characters, leaf area index and relative water content of leaves were the most rapidly affected parameters. For the yield components, the number of pods per plant was the most affected parameter.

Drought tolerance level, measured by the relative yield decrease in the drought treatment showed significative varietal differences. It was very well related with a rapid specific leaf weight decrease at the end of the vegetative period. Drought tolerant varieties were also well identified by a lower effect of drought stress on hundred seeds weight and leaf size. Thus, 2 phenomena appeared to be important in drought tolerance processes : cell elongation rate and assimilates translocations.

In an other experiment, morphological and anatomical leaf paramèters were investigated with 3 varieties of different drought tolerance level. A thin spongy parenchyma, and a high vascular tissue proportion in the petiole, associated with a high leaf growth rate seemed to be a promising basis for future drought tolerance criteria.

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AGRONOMIC RESPONSES OF SOYBEAN LINES TO DROUGHT STRESS

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Agronomic responses were measured for 128 soybean lines to soil moisture deficit in a semi-arid environment (Leeton). The purpose was to disclose genetic variation for drought avoidance among lines from the cross Williams/Calland. Replicated field plots were irrigated at intervals defined by 75 mm, 150 mm and 225 mm class A pan evaporation. The reduced irrigation frequencies resulted in mean yields 71% and 53%, respectively, of the mean yield for the 75 mm irrigation frequency, indicating severe stress. In both stress regimes there was genetic variation for seed weight, maturity, plant height, degree of stem indeterminacy, and harvest index. Seed weight, plant height and degree of indeterminacy appeared best criteria for selection of lines with drought avoidance. Selected lines displayed a diurnal pattern of slower decline and quicker recovery of leaf water potential, compared with Clark 63.

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HERITABILITY OF PROLINE ACCUMULATION IN WATER-STRESSED SOYBEANS

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Proline accumulation as an indicator of drought stress has been of limited use in breeding programs, primarily due to lack of information on its inheritance pattern and heritability. Two soybean [Glycine max (L.) Merrill] cultivars, 'Adelphia' and 'Chief' and their F_2 progeny were evaluated for proline accumulation at seedling stage following 8 days of water stress in the greenhouse. Adelphia and Chief, although previously determined to be high and low proline accumulators respectively in preliminary tests, were not significantly different in this experiment. Some F_2 plants accumulated more and others less proline than their parents. The F_2 appeared to segregate into 8 phenotypic classes including the parental ranges. The phenotypic distribution of proline accumulation in the F_2 progeny indicates additive gene action and transgressive segregation. The broad sense heritability determined from this experiment was 0.57 which is sufficient for breeding progress to be made. Proline accumulation is a heritable character and may be used to select for drought tolerance. However, the broad sense heritability for proline accumulation was intermediate indicating that the trait is influenced by environmental factors. Since it is important to have strict environmental control for reliable detection of proline accumulation, growth chamber conditions should be more reliable than those of the greenhouse or field.

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SCREENING OF SOYBEAN GENOTYPES FOR COLD--TOLERANCE DURING FLOWERING

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Low temperatures are one of the main factors limiting soybean cultivation under climatic conditions of Poland. The results of studies on soybean resistance to low temperatures during flowering are presented. Tests were done on 45 soybean genotypes from our breeding Programme and world collection. In 3 years field tests, number of flowers and pods per plant were counted. Temperatures during flowering were average /15-19°C/ during a day and /10-14°C/ during a night. After harvesting biometric measurments were done in order to determine potential productivity of plants. It showed that some genotypes e.g. I4/10 were tolerant for low temperatures existing during flowering. Soybean forms characterized by high flowering efficiency were more tolerant to unfavourable wether conditions during flowering. Number of flowers per plant was higher in late ripening forms than on early once. Number of flowers per plant was positively correlated with summ of temperatures and precipitation during the wevetation period.

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Seasonal adaptability of soybean strains newly selected at Taichung

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Thirty soybean strains selected from 10 different crosses through 'disruptive seasonal selection' (successive selection in different cropping seasons) were tested for yielding potential and other agronomic traits in the spring and summer seasons of 1979 and 1980 and in the fall season of 1981, with 4 established varieties used as the controls. The regression coefficients on environmental means and mean values were negatively correlated in pod number per plant, branch number per plant, single plant dry weight, and days to maturity, suggesting that plant vigor and stability are associated in the vegetative phase of growth. In bean yield and harvest index, the regression coefficients and strain means were positively correlated showing the tendency of high performance to bring about greater seasonal fluctuation. The pattern of character correlations greatly differed according to the cropping seasons. Probably, the responses of vegetative growth and those of seed ripening to temperature and day length, if suitably adjusted to keep up a balance as the result of selection under different environments, can realize a high and stable performance under different environmental conditions.

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PHYSIOLOGICAL CRITERIA FOR A BETTER CLIMATIC ADAPTATION IN SOYBEANS

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The selection of varieties well-adapted to their environment conditions can be based upon physiological criteria. Although responses to climatic constraints are complex and correlated, essential parameters can be determined. Differences in photosynthetic responses and in assimilates translocation observed at low temperatures between cultivars allow selection criteria to be proposed for a better adaptation of soybean to cold climates.

The capacity of some genotypes to maintain their stomatas open during water stress and keep active photosynthesis when leaf water potential is low, may be considered as a factor of resistance to drought in soybean. Selection for soybean varieties adapted to dry areas may be proposed through analysis of correlations between stomatal resistance and leaf water potential.

The stomatal conductance of the upper leaf surface is more involved in the maintenance of photosynthesis during a water stress than that of the lower leaf surface. The genotypes that keep a high stomatal conductance of the upper leaf surface at low water potentials and later exhibit a nearly simultaneous closure of the stomatas located on both surfaces, appear to have the highest water efficiency during the water stress and the highest drought resistance.

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STUDY OF VARIANCE IN OIL AND PROTEIN IN SOYBEAN (Glicine max)

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The soybean has an average of 20% oil and 40% protein. The varied uses of both these components in human nutrition has resulted in a constant increase in soybean production in our country , with a yield of over 930,000 tons in 1983.

In this study the quantity of oil, protein, fatty acid, lysine aminoacid and triptophane were evaluated for 19 genotypes of planted soybeans at six different sites .
The average values for the studied components were : 24.65% for oil: 35.95% for protein, 23.61% for the main acids, such as oleic ; and 54.55% for linoleic .

Jumiss was the genotype with the greatest oil content. The outstanding site for oil content was Cayal, with an average of 29.10% . A significant negative correla tion was observed between oil and protein, content , as well as between oleic acid and linoleic acid content. A significant positive relation was observed between protein and triptofano content, as well as between linoleic acid and oil content .

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VARIATION IN CONTENT OF SUCROSE, STACHYOSE AND RAFFINOSE IN SOYBEAN

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The genetic basis of variation in soybean seeds for content of sucrose, stachyose and raffinose was studied by measurement of these carbohydrates in seeds of inbred lines (F4) from two crosses. Measurement by the HPLC method enabled simultaneous estimation of the seed contents of sucrose, stachyose and raffinose. Mean seed contents of sucrose, stachyose and raffinose were in the proportions 55:35:10, respectively, of the mean total oligosaccharide contents of 10.6% for 90 lines from cross 1 (Sen Nari/Dare) and 9.7% for 89 lines from cross 2 (Harosoy 63/Hardoo 137). The range of variation was approximately twofold for each of the oligosaccharides in each cross. There was significant genetic variation among lines within crosses and broadsense heritability estimates were: Cross 1 (Sen Nari/Dare) h_b^2(sucrose)=.66, h_b^2(stachyose) =.83, h_b^2(raffinose)=.52 and Cross 2 (Harosoy 63/ Hardoo 137) h_b^2(sucrose)=.65, h_b^2(stachyose)=.57, and h_b^2(raffinose)=.61. These are high broadsense heritability estimates. In both sets of lines there was a significant correlation of sucrose and stachyose contents (r=0.47 and r=0.54, respectively), but no correlation of sucrose with raffinose content. There was no correlation of stachyose with raffinose in cross 1 and a low (r=0.26) correlation of these sugars in cross 2.

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RADIATION INDUCED ALTERATION IN SEED QUALITY OF SOYBEAN (Glycine max (L.) Merr.)

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Sixteen advanced generation mutants of a soybean CV. Birsa Soy-1 were evaluated for protein, oil and fatty acid composition. The protein varied from 36.9 to 46.3 per cent and oil from 16.3 to 22.2 per cent. An experimental stock M-7 had lower linolenic (6.5 %) and linoleic acid (49.9 %) and elevated oleic acid (23.7 %) content as compared to check. This study showed that considerable alteration could be achieved in fatty acid composition of soybean through induced mutations.

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GENETIC ELIMINATION OF SOYBEAN LIPOXYGENASES

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The lipoxygenase actions that oxidize oil and develop undesirable beany flavors are significant problems to direct use of soybean seeds for human foods. The three types of mutants, L-1 less, L-2 less (identified very recently) and L-3 less soybeans did not give L-1, L-2 and L-3 protein bands on an improved SDS-PAGE gel, respectively. The immunological analyses using an anti L-2 serum that reacted partially with L-1 and L-3, and the column chromatographic analyses have revealed that L-1, L-2 and L-3 isozymes disappear completely in the L-1 less, L-2 less and L-3 less type soybean seeds, respectively. The genetic analyses of F_2 and F_3 seeds from the cross Suzuyutaka X the L-2 less soybeans have demonstrated that absence of L-2 is under the control of a single recessive allele.
So far, two types of double less seeds were identified that lacked both L-1 and L-3, and both L-2 and L-3, respectively, from the crosses Wasenatsu (L-3 less) X P.I. 408251 (L-1 less) and Wasenatsu X the L-2 less soybeans. They normally germinated, grew and produced seeds in the green house. Sensory tests of the seeds indicated that L-2 isozyme might be most responsible for the formation of beany flavors. Beany flavor levels of L-2 · L-3 double less seeds were very low.

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POTENTIAL FOR NARROW LEAVES IN VEGETABLE SOYBEANS

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Several comparisons indicate that narrow leaf in soybean is associated with more seeds per pod. Vegetable type soybean may often be shelled by hand. Therefore any significant increase in weight of seeds per pod would be an advantage. Data were collected on seed yield of six narrow and six broad leaf genotypes in 1982 and on yield, seed and leaf characteristics of six pairs of near isogenic lines differing in leaf

shape in 1983. In 1982 yield differences among genotypes were nonsignificant. In 1983, the six pairs of lines differed in yield, but yield of broad and narrow leaf genotypes did not differ significantly. In 1983, narrow leaf genotypes had 7%** smaller seed but 8%** more seeds per pod. These differences tended to cancel each other resulting in no significant difference in mg of seed per pod. In 1983, LAI for broad leaf genotypes at V7-9 and R4-5 was 2.42 and 5.38, respectively. Values for narrow leaf genotypes were 0.33** and 0.38 ns (16 and 8%) less for the two measurement dates, respectively. Broad leaves were larger in area. Data indicate no difference in number of leaves produced, but leaflet counts suggest that narrow leaf genotypes retained an average of 2.6 more leaflets on the main stem at R4-5. This reduced the percentage difference in LAI between broad and narrow leaf genotypes. Narrow leaves in vegetable soybeans may be a useful marker. Otherwise they appear to have no advantages or disadvantages.

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STUDIES ON THE CHARACTERISTICS OF SOYBEAN VARIETIES FOR COOKING WITH RICE

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Some of soybean varieties have been favored as the use of cooking with rice for long time in Korea. However, scientific information on the characteristics of those varieties has not been accumulated yet.
In the present study, 76 local collections and 14 varieties were studied to elucidate characteristics common to those varieties for cooking with rice.
The results are summarized as follows:
Most of soybean varieties for cooking with rice were local collections and those were large and black coloured in seeds.
The amount of water absorbed and following seed swelling were greater and alkali digestibility of the seeds was exceedingly high in those varieties.
The varieties for cooking with rice also showed relatively higher reduced sugar content than other varieties.
Some varieties for cooking with rice such as SNUALC 7614 and SNUALC 7809 showed higher content of amino acids such as glutamic acid, aspartic acid, alanine and leucine.

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SOYBEAN YIELD RESPONSE TO REDUCED INTER-ROW COMPETITION.

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Light enrichment studies with soybeans have shown increases in seed size in addition to increased pods per plant. Seed size also changes in response to source-sink manipulation. Our research has shown these changes to occur similarly across nodes. Since changes in canopy architecture may improve light relations within the canopy an understanding of pattern and timing of yield component response to an improved environment is important to the design of best soybean ideotype. Altona and Evans soybeans were planted in 1983 in rows 25 cm apart. Commencing 3' days after emergence and then at 2 week intervals alternate soybean rows were totally removed manually. Row removal treatments from emergence through mid-to-late flowering did not significantly lower seed yields compared to the control. At maturity these treatments had greater pods per plant than control plants, while later lower yielding removal treatments had similar pod numbers to the control. Increases in pod numbers occurred across all nodes. Seed size decreased for removal treatments up until the start of flowering, then increased in later removal treatments. Changes in seed size were similar across all nodes. These results suggest seed size is adjusted to the balance between pod loading and environment and that ultimate seed size is not determined until the first pods on lower nodes have commenced seed filling.

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AGRONOMIC PERFORMANCE OF ULTRA-SHORT SEASON SOYBEAN CULTIVARS IN MISSOURI

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Ultra-short season maturity group 000, 00, 0 and I cultivars were planted in central Missouri and compared to single-crop, full-season cultivars. The ultra-short season cultivars were planted at 484,000, 968,000, and 1,452,000 seeds/ha in early April about one month before planting typically begins. Most ultra-short season cultivars reached R7 by mid-July and were harvested by late July. Another planting of the cultivars was made at this time. In 1982, 'Hardin' (mat. grp. I) sown at 1,452,000 seeds/ha yielded 2,841 kg/ha as the best early soybean crop. For the late July planting, 'Evans' (mat. grp. 0), at the high-seeding rate, yielded 1,663 kg/ha. The best full-season single crop cultivar yielded 3,362 kg/ha. With adequate rainfall in 1982, the ultra-short season cultivars performed better at the two higher seeding rates. In 1983, the drought resulted in only two cultivars responding to increased seeding rates. 'Ozzie' (mat. grp. 0), the top yielding short-season cultivar, produced 2,695 kg/ha at the highest seeding rate, however. This yield was nearly double the yield of the best full-season cultivar. No second crop grew in the dry soils. These results suggest that ultra-short season varieties planted early on well-drained soils may perform better than full-season cultivars in dry years by having their reproductive period occur during the long, moist days of early summer. A second soybean crop may be possible in years with adequate summer rainfall.

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AN EVALUATION OF CONTINUOUS WHEAT-SOYBEAN DOUBLE CROPPING PRODUCTION SYSTEMS ON CLAY SOILS

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Double crop soybeans accounted for 16 percent of the total U.S. soybean acreage in 1982. Projections indicate the acreage will increase in areas where adequate growing seasons and irrigation capabilities exist. Objectives were to determine the effect of continuous wheat-soybean double cropping on yields of wheat and soybeans, weed species, and cost of production and net returns. Treatments included monocrop soybeans and three wheat-soybean double crop systems with either conventional, minimum, or no till land preparation in both an irrigated and non-irrigated environment. Wheat yields ranged from 2497 to 2998 kg/ha and were not significantly different. Soybean yields increased with irrigation and averaged 2789, 1916, 1724 and 1318 kg/ha, respectively. Whereas, yields from comparable, non-irrigated treatments averaged 918, 692, 763, and 494 kg/ha, respectively. Weed levels were highest in the no till treatments. Net returns from the irri-

gated monocrop and double crop treatments with conventional land preparation were considerably higher than from the minimum and no till double crop treatments. For the non-irrigated treatments, the cost of production of monocrop soybeans exceeded the gross returns, whereas, each double crop treatments gave a net-return--mainly due to returns generated by wheat.

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DOUBLE CROPPING SOYBEANS AFTER PEAS IN WISCONSIN.

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For three years, soybeans (Glycine max (L.) Merr.) were planted after harvest of canning peas (Pisum sativum L.). Lack of rain and an early frost resulted in no harvestable yield the first year. The second year, non-irrigated yields from both June 10 and 17 plantings were about 75% that of the May 20 check, averaged over Mat. Gp. 0 and I cvs and row spacings of 18 and 76 cm. July 1 average yield declined to 46% of May 20. Narrow rows averaged 38% higher yield than wide, and irrigated plots yielded 21% more than non-irrigated. The third year, June 22 non-irrigated yields averaged 39% of the May 12 check, over Mat. Gp. 00, 0 and I cvs, 20 and 76 cm rows, and on plots fallowed or from which peas had been harvested. June 29 yields averaged 58% of May 12, and declined sharply thereafter. Frost killed the Mat. Gp. I cv from the July 13 planting before it matured. Narrow rows averaged 20% higher yield than wide. Irrigated plots yielded 13% more than non-irrigated. Soybeans on fallow land yielded 12% more irrigated and 23% more non-irrigated than following a pea crop. Even in the short growing season of Wisconsin, soybeans can be successfully double cropped following peas if adequate moisture is present and there is sufficient time to reach maturity before frost. There is a yield advantage to narrow rows.

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EFFECT OF CULTURAL PRACTICES ON SOYBEAN ESTABLISHMENT IN RICE-SOYBEAN CROPPING SYSTEM.

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Soybean is planted after rice in rice-soybean double cropping pattern in Northern Thailand. It is grown in the paddy field after rice crop between December to April. Results of the experiments in cropping system conducted in the farmer fields indicated that no-tillage planting was suitable for soybean establishment. Burning rice stubble resulted in better control of weeds and enhanced better crop stand. Flooding the field prior to planting resulted in poor and ununiform soybean stand. The most suitable planting technique was to allow soybean seed to germinate in moist soil until reaching unifoliate leave stage before first irrigation should be given. Broadcasting soybean seeds was not suitable for practices. Other cultural practices such as plant population requirement for soybean after rice was discussed.

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AUTUMN PLANTING SOYBEAN IN MULTIPLE CROPPING SYSTEMS

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A crop of autumn planting soybean, planted in late July to early August and harvested in late October to early November, in triple cropping systems was studied in order to increase soybean acreage to meet the requirements on protein nutrition and soil improvement in the lower Yangtze valley where the multiple cropping systems usually were barley (or wheat, green manure) followed by early season rice and late season rice (or corn, cotton). Experiments have been conducted since 1977. (1) The cultivars suitable for autumn planting may be found in the collection of summer planting soybeans. There existed a significant positive correlation between days to maturity of the two planting types among cultivars. (2) A light irrigation prior to planting soybeans both in paddy field and on upland, interplanting soybeans in the forecrop, and harvesting the forecrop as soon as soybeans emerged on upland are key points for a good stand under the high temperature and fast evaporation conditions in July and August. (3) Transplanting soybean seedlings in paddy field was successful and proved to ensure a good stand and enable the soybeans utilizing a longer growing period and maturing one week ealier than direct seeding. (4) A cropping system of barley-rice-autumn soybean in paddy field and barley-corn-autumn soybean on upland were promising, and they have been extended at a certian amount in this area.

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A STEP FORWARD IDENTIFYING OTHER SOYBEAN CULTIVARS SUITABLE FOR INTERCROPPING WITH CORN.

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Forty six soybean varieties and lines were grown with "Cairo 1" the most suitable corn variety for intercropping in Egypt. Solid planting and three intercropping patterns were used. The intercropping patterns were achieved by growing each of corn and soybeans in alternating one, two or three ridges. On the average, intercropping reduced soybean yield to almost 60% in comparison with solid planting. Alternating three ridges of corn with three of soybean gave higher soybean yield than alternating single ridges. Soybean varieties differed significantly in their individual plant-characters and yield allover the utilized cropping systems. Soybean varieties chestnut, Crawford, Cutler 71, Franklin, Columbus maintained their superiority in intercropping, while other varieties Fuji, Lincoln, Sciote and Scott were relatively less tolerant to intercropping. The intercropping tolerance of the different cultivars ranged between 18.7% and 44.3% relative to the solid soybean cultures.

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EFFECT OF MAIZE INTERCROPPING ON SOYBEAN

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Maize association significantly decreased the LAI of soybean as compared to pure soybean. At 30 days, maximum LAI of soybean was recorded in maize at 60 cm + 1 row of soybean and was at par with that in pure stand. Maize significantly decreased NAR of soybean at stage II (45-60 days), giving rise to minimum NAR (239 x 10^{-6}g cm^{-2} day^{-1}) in maize at 60 cm + 1 row of soybean. Maize association significantly decreased the yield and yield attributes viz. branches and pods per plant. Reduction in grain yield of soybean were 68.54% due to maize association in soybean + maize intercroppings.

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SOYBEAN: AN INTERCROP IN RUBBER AND OIL PALM PLANTATIONS

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Soybean can be a potential intercrop for immature rubber and oil palm. Nevertheless, in order to reduce damaging the roots of rubber and oil palm trees, minimum tillage is recommended for planting soybean. Problems associated with this cropping system and the economic viability of growing soybean in Malaysia are discussed.

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SOYBEANS AS GREEN MANURE IN A CORN INTERCROPPING SYSTEM

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High corn yields require high levels of the plant nutrient nitrogen. In recent years, with increasing energy costs, fertilizer nitrogen has increased in price. Secondly, its timely availability is sometimes lacking in the local market for the small farmer in developing countries. Thus, there is continued or renewed interest in the use of organic sources to provide nitrogen needs of crop species such as corn. Three experiments were conducted over a two year period at IRRI in the Philippines to evaluate the effect of a soybean green manure intercrop on the grain yield of corn. Three rows of soybeans were interplanted at 50 cm spacings between corn rows, 1.5 m apart. At 42 days after planting the two outside soybean rows were plowed into the corn rows in a traditional "hilling up" operation. Sub plots were inorganic nitrogen rates of 0, 25, 50, 100, and 150 kg/ha. At the zero and lower N rates, the soybean green manure provided significantly higher corn grain yields than corn grown without green manure. The soybean grown manure provided the equivalent of 30 kg N/ha on the zero nitrogen level plots. Allowing the center soybean row to grow to mature seed provided additional yield and protein. This practice may be useful to small farmers with low capital but high labor availability. Secondly, the rainfall must be high to provide quick release of the organic N and to prevent competition for soil moisture between the two crops.

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EFFECT OF PLANTING DATE, DENSITY, AND DISTRIBUTION PATTERN ON SOYBEAN YIELD IN SUBTROPICAL REGIONS OF MEXICO

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Although low winter temperatures in subtropical climate do not limit plant growth, short day length is the primary cause for low yields in soybeans. From June of 1980 to August of 1982, a total of 7 experiments (4 on planting date and 3 on density and plant distribution pattern) were established at CSAEG Research Station, Iguala, Guerrero, México, in search of adecuate practices that will increase the yield (mainly of BM_2 cultivar) at critical short day planting. Yields were raised from 500 kg to 3200 kg/ha in the same planting date of December. Yield component's variables taken into account in order to increase the beans harvested will be discussed in this paper.

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INTERACTION OF DETERMINATE VARIETIES WITH ROW WIDTH RESPONSE

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Thirty-one replicated field trials were conducted throughout North Carolina during 1979 through 1983 comparing seed yields of various combinations of three determinate soybean varieties (Maturity Group V through VIII) in four different row widths (25, 50, 75 and 90-100 cm) with both early and late planting dates. Seed yields of all varieties generally increased as row width decreased from 90-100 cm to 50 cm, regardless of planting date. Yields were similar in 50 cm and 25 cm row widths with both planting dates. The magnitude of the yield increases, however, differed among varieties, and the differences depended upon which planting date was considered. Narrowing the row width with May ("early") planting dates improved the seed yields of Essex more than Coker 156, of Coker 156 and of GaSoy 17 more than Coker 237, of Coker 237 more than Ransom, of Lee 74 more than Forrest and of Forrest or of Centennial more than RA 604. In somewhat of a contrast, narrowing the row width with June ("late") planting dates improved the seed yields of Forrest more than Lee 74, of Lee 74 more than Essex or Ransom, of Ransom more than RA 604 or GaSoy 17, of Bragg more than Coker 237, of Coker 237 more than Coker 156 or RA 604, of Coker 156 more than Essex, GaSoy 17 or Centennial, of Forrest more than RA 604, and of FFR 557 more than Coker 156. Other variety pairs compared did not differ substantially or consistently in their yield increase with narrower row width.

SOYBEAN CULTIVAR RESPONSE TO IRRIGATION TIMING

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Soybean [Glycine max (L.). Merrill] yield in irrigation culture is strongly influenced by irrigation timing during reproductive ontogeny. In a 3-year field exper-

iment, 8 cultivars were tested with a factorial set of 8 irrigation treatments, where the 'factors' were the flowering (F), pod elongation (P), and seed enlargement (S) stages and the 'levels' were either a single or no irrigation at the given stage. An F irrigation increased seed/plant (+5.8), but led to reduced 100-seed weight (-0.9g), with resultant neglible yield increase (+20kg/ha). Substantial yield increases occurred with the P (+379kg/ha) or the S (+384kg/ha) irrigation; the former solely from increased seed/plant (+7.9), and the latter solely from increased 100-seed weight (+1.4g). In a second 3-year experiment, 16 cultivars were subjected to a serial set of 7 irrigation treatments, each consisting of a single irrigation but differing in timing by 10-day intervals during reproductive ontogeny (mean R stages were 1.1, 2.5, 3.7, 4.7, 5.5, 5.9, and 6.4). Seed/plant was substantially increased by irrigation at R1.1, but this increase declined linearly as irrigation was delayed, becoming neglible at R6.4. 100-seed weight was greatly reduced by irrigation at R3.7 or earlier, but greatly increased at R4.7 or latter. Highest yield enhancement occurred with irrigation at R3.7 (+268kg/ha) due to increased seed/plant (+22.3) in spite of reduced seed size (-0.9g), and at R4.7 (+200kg/ha) due to increased seed size (+1.2g) and a slight increase in seed/plant (+5.6). Irrigation-induced yield responses can thus be attained with increases in seed number or seed size depending on the timing of irrigation at about stage R4.0.

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SOYBEAN IN CROPPING SYSTEMS IN INDIA

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Soybean is fast making a place for itself in the Indian agricultural scene. With 105-120 days for maturity, it can very well fit in 300 percent crop intensity rotations in 4 different zones of the country viz. northern hill zone, northern plain zone, central zone and southern zone. As a rainy season crop, soybean can be grown in all these zones, as a spring season crop, under irrigation it can be raised in northern and central zones and as a winter season crop under irrigation or on residual moisture it can be grown in parts of central and southern zones. In the Northern hill zone it is replacing the poor yielding, low income fingermillet crop and also grown mixed with maize and fingermillet. In the northern plains, it is grown either on fallow land or replaces poor yielding crops of maize and sorghum. It fits well as mixed crop with pigeonpea, cotton and maize. In Central India, it is grown on the fallow lands. In southern zone, it is grown as an inter-crop with sorghum, cotton, sugarcane and redgram. The most common rotations involving soybean are with wheat, potato, barley and gram. Economic analysis of soybean production reveals that it provided maximum profits as compared to other upland rainy season crops hence gaining increasing popularity.

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CULTIVAR X TILLAGE RESPONSES IN SOYBEANS IN EASTERN AUSTRALIA

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Soybean cultivars from Groups VII to IX were sown for three years into either cultivated soil or by no-till methods on the east coast of New South Wales, Australia. All trials were conducted without irrigation in a double cropping regime (wheat or triticale during winter) and were sown in narrow rowspacings, 30 to 35 cm. In two seasons, when moisture stress limited growth for part of the season, later maturity cultivars yielded higher under no-till than under cultivation, whereas earlier maturity cultivars responded in reverse. In the third season, with no moisture stress, there was no yield response from cultivars or tillage method. In a second experiment the effect of years under cultivation or no-till on response of four cultivars at two sowing dates was studied. Only in the first season of cropping soybeans after pasture was early soybean growth and grain yield lower in no-till than cultivation. Tillage method had no effect on early growth or grain yield in the second and third year of the rotation.

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FACTORS RESPONSIBLE FOR VARIABLE GROWTH OF SOYBEANS IN THE NIGERIAN GUINEA SAVANNA

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Soybean growth in the Southern Guinea Savanna of Nigeria varies greatly with soil texture. An experiment was conducted to determine if superior growth on finer-textured soils was due to better fertility or to better moisture status on fine than on coarse-textured soils. Soybeans were grown on five soils differing in texture, with and without a complete fertilizer treatment and with and without supplemental irrigation. There was no response to irrigation. Fertilizer increased growth and yield at all sites. The ranking of plant growth in fertilized plots reflected the amount of clay and silt in the soil. Leaf tissue Mn concentrations and soil Mn:Ca equivalence ratios suggested that Mn toxicity may explain poor growth on some coarse-textured soils.

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SOIL ACIDITY, N, P AND K EFFECT ON SOYBEAN CYST NEMATODE POPULATION, SOYBEAN YIELD AND NUTRIENT COMPOSITION.

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Research was initiated in 1981 on an acid, low fertility and SCN infested Tiptonville silt loam (fine-silty, mixed, thermic Typic Argiudoll). Lime treatments of 0, 8.96, 17.92 and 26.88 $Mg \cdot ha^{-1}$; 0, P, K, PK and N year 1 and 2 and only a K variable during year 3. Counts of cyst of the SCN were recorded annually from preplant and R_8 soil samplings. Cyst counts were significantly lower from the unlimed plots, but, yields were increased with lime application. Yield increase with lime appears to be a function of an increase in seed size. It was not determined if soil acidity was the direct result of lower cyst numbers in unlimed soil, or if this was a result of reduced root growth in an acid soil. Fertility had no effect upon cyst count and yield decreased at higher K levels during 1983. The decline in yield at the high K levels appear to be a function of shorter plants, fewer pods and seeds per plant. Leaf P was affected by lime or fertilizer treatment. Leaf N was increased with lime and N fertilizer. Leaf K was decreased with liming and increased with K fertilization indicating a Q/I effect. DRIS evaluation of lime, nematode and fertility treatment effect will also be reviewed.

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SOYBEAN RESPONSE TO NUTRIENT STRESS

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The study was conducted to determine the extent of varietal differences among soybean cultivars in the ability to use soil nutrients, native and added, in a rice paddy situation in which there was no land tillage prior to seeding and the crop subsisted mainly on residual moisture. Varietal differences in the ability to utilize nutrients existed. In total N, P, and K absorption from a unit land area, Clark 63 and Improved Pelican, were the highest ranking on account of their high dry matter production. In terms of bean yields, Clark 63 ranked highest and Improved Pelican, fourth. On the other hand, CES 16-38 ranked poorly in nutrient accumulation at only 4.40 percent in the plant tissues. However, it produced the highest total dry matter of plant tissues and, subsequently, ranked third in total NPK absorption. In terms of bean yield, CES 16-38 ranked second.

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CHLORINE IN KCl FERTILIZER CAUSES PHYTOTOXICITY IN SOYBEAN

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Recent field research by the authors has shown that leaf scorch of soybean (Glycine max (L.) Merr.) was induced in some cultivars by application of normal amounts of KCl fertilizer. This research was conducted on the poorly-drained (non-saline) Atlantic Coast Flatwoods soils of Georgia. About one-half of the 75 cultivars evaluated developed leaf scorch and the remainder were normal. A susceptible cultivar 'Bragg' was grown in pots in a Flatwoods soil (Leefield sand - arenic Plinthaquic Paleudults) with 0, 100, 200, 400, and 800 ug g^{-1} K as KCl and K_2SO_4. Leaf scorch developed 1 month after planting on soybean plants receiving 200, 400, and 800 ug g^{-1} K as KCl (180, 360, and 720 ug g^{-1} Cl) and were killed before maturity with the 400 and 800 ug g^{-1} rates. Soybean plants grown with 100, 200, and 400 ug g^{-1} K as K_2SO_4 were normal, but growth was retarded for the 800 ug g^{-1} rate. Concentrations of Cl in tops and seeds increased with KCl rates. Leaf scorch is caused by excessive uptake of Cl. Apparently Cl from KCl fertilizer which has not leached below the rooting zone in the poorly-drained soils is the source of Cl causing leaf scorch of soybeans in growers' fields.

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EFFECT OF MICROELEMENT FERTILIZERS ON THREE SOYBEAN CULTIVARS

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The effect of microelement fertilizers on growth and yield of different field crops in Egypt, has become a subject of intensive study during the last decade. This was mainly due to the expand cultivation in the newly reclaimed areas and the continuous cropping of the traditionally productive area (two or three crops in the year). The response of the three soybeans cultivars (Harosoy, Clark and Williams) to foliar spray with the two microelement fertilizers viz. Bayfolan (BF) and Folifertil (FF) was studied during 1982 and 1983 seasons in the farm of the Faculty of Agric., Kafr El-Sheikh. Foliar spraying of soybeans with microelement fertilizers increased significantly the total dry matter accumulation per plant and the leaf area index compared with the control. The data also indicated a significant increase in crop growth rate, relative growth rate and net assimilation rate as a result of microelement fertilizers application, however the effect was more pronounced in FF treatment. Foliage microelement application significantly increased the number of pods per plant and the final seed yield. The three cultivars were affected in similar way with the two fertilizers used.

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RESPONSE OF SOYBEANS TO COMBINED FOLIAR AND SOIL FERTILIZATION.

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The requirements of soybeans for nitrogen (N) and phosphorus (P) and other micro-nutrients should be met in order to obtaine a satisfactory yield. The effect of foliar fertilization with 5 x 10^{-2} ppm $CuSO_4$, 10 ppm $(NH_4)_2MoO_4$ or their mixture on growth and yield of soybean cv. Clark 63 grown under different levels of N and P was investigated. Foliar fertilization with Cu, Mo or Cu + Mo enhanced vegetative growth, increased the content of photosynthetic pigments and the number of nodules on the root. Cu + Mo treatment was more effective than separate treatments especially at 150 kg N and 60 kg P_2O_5/ha. The yield of soybean seeds and its crude protein content were raised by foliar spraying with Mo and Cu and to a greater extent with Mo + Cu especially at relatively high level of both N and P. It was concluded that foliar spraying with Mo, Cu and especially with their mixture may increase the efficiency of N and P utilization for enhancing the vegetative growth and increasing the yield of soybean plants.

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NUTRIENT UPTAKE BY SOYBEAN UNDER RELAY CROPPING SYSTEM

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M.P. is the largest soybean producer state in India, and is being saturated with the variety JS 72-44. Long term fertilization experiments since 1971 on a permanent site with maize-soybean-wheat relay cropping system included exotic varieties. Although the varieties of soybeans differed, the 3-year data on the choice soybean in the system was examined for nutrient uptake. The different treatments included fertilization with NPK in different levels and Zn. The addition of N, K and Zn did not show any difference, except that of P, suggestive of the fact, that naturalized rhizobia were meeting out the N need of soybean. Allelopathic effect of the fertilization on the uptake of P was found to merit attention.

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ACCEPTABILITY OF SOY-FORTIFIED POZOL.

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Consumption of soybean has been widely promoted as a means of improving the diet in developing countries. This is not easy in regions where soybean is not a part of the traditional diet, due to problems with acceptability. One way to overcome these problems is to use soybean to fortify traditional foodstuffs. Pozol is a refreshing drink prepared from maize in the south of Mexico. After soaking in lime-water, the maize is cooked, ground, mixed with spices and shaped by hand into balls of about 80 grams. Prior to consumption, the pozol is suspended in iced-water and sugar is added. Soy-fortified pozol was prepared by adding cooked, ground soybean (5% - 25%) to the ground maize used in pozol preparation. Acceptability was measured using a 5 point hedonic scale, with unfortified pozol as a control, and an untrained panel of students (n = 80). The results show that pozol fortified with up to 25% of soybean is as acceptable as the unfortified pozol.

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EFFECTS OF PROTEOLYSIS ON FUNCTIONALITIES OF SOY PROTEINS

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A soy protein isolate, prepared by the conventional procedure, was treated with five commercially available bacterial proteases (Proteolytic-200, Alkalase, pronase, and proteases IV and IX) under their optimum reaction conditions. Effects of enzyme species, enzyme and substrate concentrations, and degree of hydrolysis on changes of selected functional properties of the isolate were monitored. Enzyme hydrolysis resulted in soy protein products with unique functional properties depending upon the reaction conditions used during the modification. Specifically, protein solubilities at acidic pH's, heat coagulability, oil absorption, calcium-precipitability, whippability and emulsion capacity of the isolate were markedly altered.

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KALITUR (BLACK SOYBEAN) PROTEIN AND PROSPECTS OF UTILISATION TECHNOLOGY IN INDIA.

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Importance of Soybean as food and feed is well known. Kalitur (black Soybean) an indegenous material is profitable enterprise with Cultivators of Madhya Pradesh (Central Provice of India) being grown in bulk quantity as Compared to Yellow variety. This may be used in food formulation, the way Soybean is used. Simple dehulling would provide 'dhal' devoid of black seed coat. Studies on basic protein chemistry were conducted to differentiate kalitur with Bragg (Yellow). It revealed from the studies that they differ in protein fractions. Bragg has more of 11S protein, where as kalitur has more of 7S protein. Functional properties did not differ much though protein fraction differed. Chemical composition, aminoacid profile and antinutritional factors were comparable. Physicochemical properties of 11S and 7S protein were also comparable. Increasing Uses of Soybean in Indian culinary can be highlighted.

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THE USE OF SOYA BEANS IN WEANING DIETS IN NIGERIA

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Most babies in Nigeria grow well on brest milk alone for the first four to six months of life. Nutritionally, however, problems begin after this age as supplementary foods of thin porridge made from such staple grains as guineacorn,rice,millet and maize are low in protein content. Since whole soya beans have a good balance of the essential amio acids, and are an excellent source of calories as well as certain vitamins and minerals, this could be incorporated with other cereals or root vegetables or fruit for the preparation of various weaning diet, without a change of original taste and texture. Many other forms and uses of soya beans can also be envisage within the context of weaning diet, especially for those infants with a low tolerance to cow's milk. The use of soya beans in weaning diets of infants amonge the Nigerian family has become very necessary since prices of infant formulars has increased drastically in the last one year. During experimentation various soyabean enriched porridges were produced using either soya bean paste, the flour itself and bean paste, the flour itself and the milk (as a liquifier for vegetable and fruit purees). Various items such as soyabean akakmu, soyabean akara, soyabean moinmoin and soyabean custard have been tried and tested in order to ascertain their taste,flavour,colour,texture and ease of preparation. These aspects are especially important as the aim is to later incorporate these new dishes into the eating habits of the children of the rural areas of Northern Nigeria.

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A DIRECT USE OF SOYBEAN IN ENRICHING THE EGYPTIAN CORN BREAD

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Comparison between:Farmer's corn bread and when supplemented with soybean

Analysis	Farmers corn bread	Supplemented with 20% soybean seeds
1-Carbohydrates	84.04 %	73.35 %
2-Protein	8.10 %	14.20 %
3-Fat	3.53 %	6.65 %
4-Ash	1.51 %	2.25 %
5-Fibers	2.82 %	3.55 %

Fenugreek seed "Trigonella Foenum-graecum L."

is added before milling to corn and soybean corn mixtures at the rate of about 4% to improve the dough quality.

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FLUAZIFOP-BUTYL AND FOMESAFEN FOR SELECTIVE POSTEMERGENCE WEED CONTROL IN SOYBEANS

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Fluazifop-butyl, a selective, postemergence grass herbicide, first became available for commercial use in soybeans in the USA in 1982 under an EPA Section 18 Emergency Use Registration. The product has become available commercially in a number of countries throughout the world. Fomesafen, a selective, postemergence broadleaf herbicide, is being developed worldwide by ICI. It became commercially available for the first time in 1983 in Argentina.
Currently, there is a national focus in the USA on soil conservation through reduced or minimum soil tillage. In soybeans, the development of new postemergence herbicides and the highly competitive vigor of the crop are key factors in the success of this effort. Fluazifop-butyl and fomesafen are highly effective for postemergence weed control in minimum or no-till cropping systems where incorporated herbicides can not be used or where crop residues reduce the efficacy of preemergence herbicides. They are effective in conventional tillage systems for weeds which escape control with preplant or preemergence herbicides, or where the reduction or elimination of the use of preplant or preemergence herbicides is desired. Both herbicides have exhibited soil residual activity on subsequent weed flushes.
Tank mix and sequential application of these herbicides have been used to provide broad-spectrum control of annual and perennial grasses, volunteer grain crops, and broadleaf weeds. Both herbicides are highly selective to soybeans.

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SCEPTER* HERBICIDE: A NEW BROAD-SPECTRUM COMPOUND FOR SOYBEANS

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SCEPTER herbicide, 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-quinolinecarboxylic acid, is a new selective compound developed by American Cyanamid Company for use in soybeans. It can be applied as a preplant incorporated, preemergence, or early postemergence treatment. Broadleaved weeds are the major species controlled, although some important grasses, such as foxtails (Setaria spp.), are also controlled. Control of other grass species, such as signalgrass (Brachiaria spp.) and crabgrass (Digitaria spp.) has been achieved by using rates higher than those employed for control of broadleaved weeds. SCEPTER is absorbed by the foliage and roots of plants and is translocated via both the xylem and phloem to the rest of the plant. Soybeans have shown tolerance to either soil or foliar applications of SCEPTER herbicide at dosages ranging from 125 to 275 g a.e./ha with all three methods of application. Because tolerance of soybeans to postemergence applications of SCEPTER increases with age, the compound can be used as a later postemergence or rescue treatment. For optimum postemergence activity the addition of a nonionic surfactant is necessary. SCEPTER has been field tested since 1981 in the United States and Brazil. Additional tests are under way in other countries.

*Trademark of American Cyanamid Company

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PHYSIOLOGICAL BASIS FOR HERBICIDAL ACTIVITY AND SELECTIVITY OF SCEPTER*

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SCEPTER, a new imidazolinone herbicide, can be used either by soil or foliar application. Susceptible plants first show a cessation of growth followed by necrosis starting at the meristems. Studies with radiolabeled material showed that SCEPTER can be absorbed by roots and foliage and translocated in the xylem and phloem to meristematic regions. Selectivity of SCEPTER is due to differential rates of metabolism. The order of tolerance of broadleaf species is directly correlated in young plants with the half-life of SCEPTER in the tissues. SCEPTER kills plants by disrupting the biosynthesis of valine, leucine and isoleucine. The mechansim of this disruption will be described.
*Trademark of American Cyanamid Company.

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SD95481-A NEW PREEMERGENCE HERBICIDE FOR USE IN SOYBEANS-PERFORMANCE IN BRAZILIAN FIELD TRIALS

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SD95481 (CINCH® Herbicide) is a novel cineole herbicide which has shown promise as a soil applied treatment for broad spectrum weed control in soybeans. The compound's structure represents a unique class of herbicides being composed of oxygen, carbon and hydrogen atoms. Extensive testing in Brazil since 1982, applied at a rate range of 0.5 to 1.25 kg/ha, has demonstrated that SD95481 provides excellent gramineous weed control and good dicotyledonous weed suppression. Soil herbicidal activity is observed for at least 6-8 weeks after application under most conditions. Preemergence applications have resulted in best weed control performance and soybean selectivity. Research has indicated SD95481 to be compatible with other soil applied herbicides. Results suggest metribuzin to be an excellent combination candidate for SD95481, without adverse effects on soybean selectivity. SD95481 is not readily leached from the soil because of its low solubility and soil absorptivity, and tends to remain at the zone of application. SD95481 is rapidly metabolized by plants, soil microbes and animals, and does not persist in the environment for more than one season. The primary emphasis of future development will be with a 840 g/l EC; however, SD95481 is miscible in oil and suited to a variety of formulations.

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SOIL ORGANIC MATTER SENSING FOR HERBICIDE RATE CONTROL

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Varying soil organic matter content (omc) is often a cause of erratic response to soil-applied herbicides. Research began over a decade ago at the Universities of Illinois and Arkansas to identify suitable sensing techniques for determining soil omc. Work has centered on the sensing of the spectral reflectance characteristics of soils. Studies have included soils with a range of omc, soil textures, and soil moisture contents. At Illinois, phototransistors and an artificial light source system estimated soil omc for 10 soils over a range of omc from 1.5% to 5.5%. Derivative techniques gave a correlation coefficient of 0.92. Expansion to a set of 30 Illinois soils with an omc range of 1.1% to 5.8% reduced the correlation coefficient to 0.29, indicating that the derivative model was inadequate over the wide range of Illinois soil omc. A second model, based on two primary colors and on unfiltered light, used an exclusion algorithm to predict a range of soil omc, which averaged 1.4% omc, for each of the 30 soils. At Arkansas, photovoltaic cells and filters were used with sunlight and artificial light. A linear correlation of the ratio of the signals from the sensors for sunlight and reflected light produced correlation coefficients of 0.54 to 0.71 for the 18 soils tested. Soil texture ranged from 0.19% to 3.70%. An inexpensive phototransistor sensor system produced a correlation coefficient of 0.75 for the 18 soils studied.

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EFFECTS OF TEMPERATURE AND HUMIDITY ON DEVELOPMENT AND EMERGENCE OF TELENOMUS CHLOROPUS,

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The egg parasitoid Telenomus chloropus Thomson has been imported from Japan to be evaluated as a possible biological control agent for the southern green stink bug, Nezara viridula (L.), a major pest of soybean in Louisiana. The effects in development and emergence of T. chloropus at the following constant temperatures: 15, 18, 21, 27, 30, 33, 36°C and constant humidities: 64, 72, 76, 80, 85, 92 and 100% RH were determined. The dominant native parasitoid Trissolcus basalis (Wollaston) was also used in this study for comparison to T. chloropus. The optimal developmental temperature for T. basalis was 33°C while that for T. chloropus was 30°C. T. chloropus successfully completed adult development over a narrower range of temperatures (15-30°C) than T. basalis (15-36°C). T. basalis had a shorter developmental period than T. chloropus at all coinciding temperatures except 15°C. Percent daily development of T. basalis increased more rapidly with increasing temperature than T. chloropus. Optimal RH for adult development of T. chloropus was from 76-85%, and from 64-92% for T. basalis. Maximum adult emergence of T. chloropus occurred at 92% RH and at 72-92% for T. basalis. Both species experienced decreased adult development and emergence at 98 and 100% RH although more pronounced for T. chloropus. T. chloropus was unable to tolerate the high temperatures and humidities similar to those encountered during Louisiana summers as well as T. basalis. These may be contributing factors in preventing this parasitoid from becoming established in the state.

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LARVIN® THIODICARB INSECTICIDE PERFORMANCE ON SOYBEAN

J.L. Allen and J.D. Palmer, Union Carbide Agricultural Products Company, Inc., Research Triangle Park, North Carolina, U.S.A. ©1984 Union Carbide Agricultural Products Company, Inc.

LARVIN® Thiodicarb is a new "second generation" oxime carbamate insecticide developed by Union Carbide Agricultural Products Company, Inc. Worldwide testing on soybean shows effective, long residual control of Lepidopterous insect pests. Under large scale Experimental Use Permit and small plot investigations in the U.S.A., LARVIN thiodicarb provided excellent control of Podworm (Heliothis spp.), Velvetbean Caterpillar (Anticarsia gemmatalis), Green Cloverworm (Plathypena scabra) and Armyworms (Spodoptera spp.) at a minimum dosage rate of 0.25 kgs ai/ha. LARVIN thiodicarb effectively controlled the soybean looper (Pseudoplusia includens) at 0.45 kgs ai/ha. Control of these pests was equivalent to or better than that obtained by the synthetic pyrethroid or methomyl insecticides. Control of certain Coleopterous pests has also been noted. In Central and South America, effective control of worm pests on soybean has been accomplished with rates of LARVIN thiodicarb as low as 0.15 kgs ai/ha. At this rate, effective control of Anticarsia, Colias spp. and Plusia spp. was obtained in aerial trials conducted in Argentina, Mexico and Brazil. Other tests conducted at 0.25 kgs ai/ha show effective control of Rachiplusia spp. and Spodoptera spp. LARVIN thiodicarb has also been shown to have a minimal impact on most beneficial arthropods at dosage rates up to 0.5 kgs ai/ha. As a result, LARVIN insecticide will have significant potential for incorporation into pest management programs.

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AMBUSH® INSECTICIDE AS A SOYBEAN INSECT MANAGEMENT TOOL

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AMBUSH, a pyrethroid insecticide, has an extremely high level of activity against a broad spectrum of soybean insect pests. Unlike natural pyrethrins, permethrin is comparatively stable to ultraviolet light and hence is persistent on plants. The compound is not systemic and has no fumigant or translaminar activity. It is both a stomach and a contact insecticide.

AMBUSH provides good to excellent control of many insect species on soybeans including: green cloverworm, Mexican bean beetle, bean leaf beetle, soybean looper, cabbage looper, potato leafhopper, velvetbean caterpillar, corn earworm, and beet armyworm. Application rates normally range from 0.05 to 0.2 lb ai per acre depending on the pest.

Laboratory studies on the inductive effects of host plants on detoxication systems in the corn earworm found that cotton-reared corn earworms were less susceptible to permethrin compared with those reared on soybeans. This effect is attributed to increased oxidative metabolism and has potential for exploitation in pest management programs.

Permethrin is available in two unique formulations. AMBUSH 4EC (emulsifiable concentrate) designed to be diluted in soybean oil for low volume applications (ULV) and AMBUSH 2EC which is manufactured with once refined soybean oil. The latter formulation is the only pyrethroid available that uses the soybean growers by-product in its formulation.

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GUIDE TO INCREASE SOYBEAN YIELD THROUGH PEST MANAGEMENT

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A campaign to increase soybean production in Thailand has been intensively made since the inclusion of this crop in the five year plan (1972-1976) of Thailand's National Economic and Social Development Program. Since then, crop protection researches on soybean have been done concurrently. In addition to the direct pest control tactics, a number of supportive tactics such as planting date, population dynamics and assessment of pest damage have been conducted for many years. In this context, efforts to bring about and summarize all the works done previously have been made with a view to recomment how to increase soybean yield through pest management. For instance, soybean planted during December 15 to January 15 in dry season and July 1 to August 1 in wet season was found less number of insects attacking and thus given higher yield. Simulated mechanical defoliation showed that, defoliation of about 33 % at vegetative stages slightly effected on yield but seriously at the podset and podfill. More over defoliation of 66 % onward would cause an eventual significant reduction in yield in all stages of development. Besides only 3 spray applications of insecticides firstly with Cygon 0.05 % at 20 days of age secondly and thirdly with Azodrin 0.03 % at 40 and 60 days of age respectively would increase soybean yield up to 20-32 % with an average of 25.58 %.

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EFFECT OF IONIC STRENGTH ON THERMAL DENATURATION OF GLYCININ AND β-CONGLYCININ

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Changes occurring to the two main seed storage proteins during the manufacture of soy food products (e.g. tofu) were analyzed. The proteins were extensibly purified and the analytical technique employed was of high specificity and resolution. Solutions of 1% glycinin, of 1% β-conglycinin and of mixtures of 1% of each protein with different ionic strength (μ) were heated at 80°C for 10 min. Denaturation was analyzed by immunoelectrophoresis. Potassium phosphate buffer stabilized glycinin at μ=0.5-2.0. Extensive denaturation of glycinin took place in heated solutions at μ=0.02-0.08 (loss of 80% native structure) in phosphate buffer. Although glycinin tended to precipitate more in $CaCl_2$ than in phosphate buffer at μ=0.02-0.08, its native structure was more stable. Loss of glycinin native structure was greater at μ=0.5 and 2.0 (50%) in $CaCl_2$ before heating. After heating, all glycinin samples expressed loss in native structure between 45 and 75%. No trend was apparent. Experimental error for turbidity was large. The ratio of basic subunits to total glycinin in the supernatants or precipitates was not affected by heat treatment. All β-conglycinin samples without NaCl showed a different antigenic response from samples containing NaCl (e.g. standards). Potassium phosphate had also a stabilizing effect on β-conglycinin. The new antigenic form was more heat stable at μ=0.02-0.08 in phosphate buffer and at 0.02 only in $CaCl_2$. Increasing denaturation and precipitation was observed in β-conglycinin in $CaCl_2$ at μ from 0.02 to 0.08. Heat stability of one protein was not affected by the other in phosphate buffer or $CaCl_2$.

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TOFU FLAVOR DIFFERENCES DUE TO SOYBEAN VARIETY AND PROCESSING METHOD

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Flavor has been one of the major obstacles to the acceptance of soybeans as food in the United States. Little is known about the influence of soybean variety on the flavor of traditional soy foods such as tofu. This paper reports on the flavor characteristics of tofus produced from five varieties of soybeans (Amsoy 71, Prize, Vinton, Vinton 81, Weber) using two processing methods (traditional, hot grind). Sensory panels and gas chromatography/mass spectroscopy were used to detect and quantify the differences in flavor between tofus produced from different varieties of soybeans or using different processing methods. There are statistically significant differences in panel scores for flavor and aroma of tofu due to soybean variety and processing method. Gas chromatography/mass spectroscopy also identified differences in the tofus due to variety and processing methods.

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STRUCTURE OF THE TGM1 SOYBEAN INSERTION ELEMENT

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Soybean seed lectin protein, which is encoded by a single nuclear gene, is not expressed in some cultivars of soybean. We have shown that in these null lines the recessive allele forseed lectin, lel, results from the insertion of a 3550 bp segment of DNA into the coding region of the gene. This event blocks transcription from the lectin gene by some as yet undetermined means. The insertion element, Tgml, is nearly four times the size of the lectin coding region and displays features which are characteristic of transposable elements--that is, it has 30 bp imperfect inverted repeat termini and a 3 bp duplication of the lectin target site flanking each end (Cell 33:465-475 34:1023-1031, 1983). The sequence of Tgml reveals an extensive highly structured border with homology to the lectin gene. The border consists of tandem repeats of various forms of a basic 54 bp repeating unit. This 54 bp unit is comprised of a stem-loop structure and interhairpin sequence which occurs 13 times in the leaft arm and two times in the right arm of Tgml. While the dyad symmetry remains highly conserved, increasingly degenerate forms of the repeat unit loop and interhairpin sequence appear toward each end of Tgml. Within each dyad symmetry and at each terminus is a 7 nt signature sequence (ACATCGG and its complement) which also appears as a subset of inverted repeats found in the lectin gene flanking the target site. The remaining 1.4 kb in the right arm is predominantly 80-90% A+T while the 1.3 kb midsection is largely 60-70% A+T. No open reading frames larger than 63 codons were found.

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RESPONSE OF MAIZE AND SOYBEANS GROWN IN MONOCULTURE AND IN ASSOCIATION

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A field trial of maize (Zea mays) and soybeans (Glycine max L. [Merrill]) grown in monoculture and

in association was conducted at Bunda College of Agriculture. A maize variety, MH 12, and five soybean varieties, Davis, Gaysoy, Gedult, Hardee and Improved Pelican, were used. The treatments consisted of maize and soybeans in pure stand and in mixture. Maize and soybeans in association were grown on the same ridge. The plant density of both crops in pure or mixed stand was the same. LAI for soybeans grown in monoculture, pooled over cultivars, was 2.80 compared to 1.54 in association. Soybeans in pure stand produced about twice as much dry matter as those in mixed stand. LAI for maize in monoculture and in association was the same. Cropping system significantly affected the number of branches/m^2 and pods/m^2 from main stems and branches. Soybean seed yields in monoculture and in association with maize were 1200 and 427 kg/ha, respectively. The aggressivity of Davis, Gaysoy, Gedult, Hardee and Improved Pelican relative to maize was 0.34, 0.31, 0.32, 0.40 and 0.41, respectively. Planting maize in association with soybeans had no significant effect on LAI, DM, seed yield, energy (megacolories/ha), crude protein yields and revenue; presumably because of the high competitive ability of maize conferred by its height. A model to explain reduced DM production, weak plant frame, low LAI, reduction in yield components and yield of soybean when grown in association with maize will be presented.

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INSECT PESTS CONSTRAINT FOR INDONESIAN SOYBEAN PRODUCTION AND MANAGEMENT

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Indonesia imported more than 450,000 tons of soybean in 1982 to cope with rising consumer demand. The average soybean yield up to 1982 was 0.865 t/ha. An intensification and extensification program to increase yields and total production started in 1983. Insect pests are one constraint lowering yield. From 1978 to 1982 annually more than 27,000 ha/year were infested by insects, causing 15% damage. Insects often causing damage include leaffeading such as Spodoptera litura, Lamprosema indicata, Plusia chalcites and Stomopterix subsecivella, beetles such as Longitarsus suturellinus, Phaedonia inclusa. Young stems and shoots are attacked by Ophiomya phaseoli and O. sojae. Pod-damaging insects are the borers Etiella zinckenella and E. hobsoni and the podsuckers Nezara viridula, Riptortus linearis, and Piezodorus rubrofaciatus. Four insecticide sprayings increase the yield up to 1.20-1.90 t/ha. Use of insecticide as seed treatment, soil application or spray at 7 to 10 days after planting is to reduce damage by beanflies. Spraying at 30 to 40 days after planting is to protect the plant from leaffeeder damage. At podsetting and during further development at 45 to 50 days and 60 to 65 days spraying reduce damage by podborers and podsuckers. Insecticides recommended as sprays are cyanofenphos, isoxathion, methamidophos, endosulfan, monocrotophos and some others. For soil application granular carbofuran is used.

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STUDIES ON SPERMATOGENESIS AND FERTILIZATION OF GLYCINE MAX L.

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Detailed studies on the spermatogenesis in five soybean varieties. Two sperms of soybean are come into being in the pollen tube or the pollen grains, so mature pollen grains are 2- and 3-celled. The development of pollen grains in the same anther is in most cases highly synchronized. In the same flower, the development of pollen grains in nine fused stamens is in most cases highly synchronized, but the development of pollen grains in one separate stamen is later than in nine fused stamens. The soybean embryo sac is of the Polygonum type. The mature pollen grains fall on stigma to germinate in 30 min. The pollen tube passes through the micropyle, penetrates the embryo sac through a degenerate synergid, releases two sperms, 6 hrs. after pollination. The fusion of sperm nucleus and secondary nucleus is earlier and faster than the fusion of sperm and egg nucleus. The two essential morphological processes of fusion are similar, all undergo contact and fusion. The fusion of the sperm nucleus and the egg nucleus occurs 8-16 hrs. after pollination. The fusion of the sperm nucleus and the secondary nucleus occurs 8-11 hrs. after pollination. The rest period of the zygote is 8 hrs. The zygote starts dividing 24th hr. after pollination. The rest period of the primary endosperm nucleus is 3 hrs. The first mitotic division of the primary endosperm nucleus occurs 14-16 hrs. after pollination.

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SOYBEAN MEAL TEMPEH

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The possibility of fermenting soybean meal to produce a tempeh like product, an oriental food originally made of cooked soybean grains, was tried. The technological process has shown the necessity of addition of a minimum of 30% of the supplement as carbohydrate (cassava flour, maize flour and rice bean) 3.5% of citric acid to decrease the pH to 4.5, and also 150% of distilled water considering the weight of the mixture soybean meal-supplement. The mixture was fermented in Petri dishes at 35-37°C during 24 hours using the mold Rhizopus oligosporus. After fermentation a product named soybean meal tempeh (TFS), which is like a compact white cake with a pleasant fruit smell and showing also a peasant alcoholic smell, is obtained. The TFS was analysed in relation to tempeh and soybean meal for its biochemical, biological, and the most importantly, sensorial characteristics. The results have shown that the TFS has a similar content of total protein, less oil content and higher quantities of crude fiber, ash and carbohydrates than the tempeh. The fermentation neither changed the percent composition, except for lipid content, nor improved the crude protein content of the dispersible protein was increasted 3.3-3.5 times. This suggests that digestibility of the TFS was similar to soybean meal, and that of standard casein, and was superior to that of tempeh. The sensorial analysis has shown that TFS is regularly accepted.

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A DIPLOID STRAIN OF WILD SOYBEAN (G.SOJA) WITH FOUR-SATELLITED CHROMOSOMES

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Jilin Academy of Agricultural Sciences initiated a survey of wild soybeans (G.soja Sieb. & Zucc.) on a large scale in 1978. Following the studies on morphology and ecology of G. soja, cytological observations were done in 1981. 35 collections of G.gracilis and 98 collections of G. soja from ten provinces in China were checked for somatic cell chromosomes. Hypotonic wall degradation method developed by Nankai University was used for root tip preparation. A diploid strain of G.soja with four-satellited chromosomes was found. Two satellites were located on a pair of longer chromosomes. The other two were located on a pair of shorter chromosomes. This material is valuable for the studies of ploidy and evolution of soybeans. It is also a precious source for the biochemical research on the nucleolus and nucleolus organizer region.

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POPULATION DENSITIES AND FERTILIZATION IN MAIZE-SOYBEAN MIXED-CROPPING SYSTEMS.

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Maize-legumes cultural association is really widespread in Cameroon and research seems to be important to understand these cropping systems and improve them by adapted cultural practices. First of all, "optimal" population densities of each specie were determined in associations including two maize varieties with different phenotypes. The most interesting combination in terms of productivity, Land Equivalent Ratio and income was chosen for fertilization experiments: large development maize at 40,000 plants/ha and soybean at approximately 240,000 plants/ha. Effects of 2 nitrogen levels and 2 N.P. levels on intercropped and sole systems were studied in 2 types of soils, ferrallitic and andovolcanic LER were good, between 0.93 and 1.58; they decrease when the applied nutrient rate increases and when soil becomes richer (andovolcanic). The higher LER and seed nitrogen content is obtained with mixed-cropping conducted in ferrallitic soil without any fertilization: So, maize-soybean association shows this remarkable aptitude for exploiting low fertility conditions. Applications of 80 N or 60 N-100 P were profitable on the ferrallitic soil. Mixed cropping reduced disease intensity on the two crops, and increased the nodules production by soybean. In all the mixtures, maize was the dominant crop with increased seed size and soybean the dominated one with decreased pod production, in comparison with sole crops.

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GENOTYPIC DIFFERENCES IN POTASSIUM ACCUMULATION IN SOYBEAN (Glycine max) UNDER WATER STRESS

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The effect of water stress on potassium accumulation of 15 soybean varieties as studied at Jabalpur during the 1982-83 season. Varieties Kalitur, JS2 and Amss25 accumulated maximum potassium under stress followed by other strains like, JS72-20, JS76-205, Cocker Stuart, JS72-44 and PK73-92, respectively. The cultivars UPSM19, T49, JS75-46, Ankur, Bragg and JS715 gave minimum values. Based on the potassium accumulation under water stress, soybean cultivars have been divided into three groups.

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USE OF SOY PROTEIN IN STAPLE FOODS

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Bread, steamed bread, spaghetti, and noodles are important staple foods. They are a major dietary source of calorie and protein for a large portion of the world population. Because of their high-consumption and low-cost, they are ideal foods to be fortified with soy protein to improve the nutritive value of human diets. The presentation mainly deals with our findings concerning effects of soy fortification on the quality of these staple foods and modifications which we have made in formulations and processing conditions in order to improve their qualities. It also reports the organoleptic evaluation and the nutritional assessment of these soy-fortified staple foods. A variety of soy products including soy flour, extrusion-cooked soy flour, soy protein concentrates and isolates have been tested to produce acceptable fortified staple foods. Among them, full-fat soy flour, high in protein and fat, is attractive to be used as a fortifier for staple foods in poverty areas where diets are deficient in both protein and calories.

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SOYBEAN BREEDING PROGRAM OF INTA IN ARGENTINA

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Soybean breeding activities of INTA began in 1973 at Marcos Juarez Exp. Sta., when the crop was promising and its acreage was increasing yearly. Since then, two different periods can be described for the type of work that was done. The first period (1973 to 1977) was characterized by the introduction (and testing) of varieties and lines from U.S.A. and Brazil. As a result of these introductions two varieties were released, and three lines are going to be released as varieties this winter. From 1977 up to date runs the second period for soybean breeding activities at INTA, with an important impulse given by the Convenio for Technical Cooperation signed between INTA and JICA (Japan International Cooperation Agency). In this second period, artificial crossing was initiated, as well as individual plant selection, using pedigree selection as the major method for breeding. At the same time, the crop was expanding and increasing in

importance, so many other Exp. Sta. of INTA became interested in the program. That interest led to the creation of a National Soybean Research Program in 1979, including breeding as well as other research activities. The breeding program was organized as a cooperative network, with Marcos Juarez Exp. Sta. as the centre and other Exp. Sta. interested in the subject as subcentres.

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EFFECT OF AUTOCLAVING ON THE NUTRITIVE VALUE OF SOYBEAN SEED AND MEAL

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Chemical composition and amino acid contents of raw soybean, raw autoclaved, extracted and extracted, autoclaved soybean have been determined. Studying the effect of autoclaving, at 121 C for 5 min. on the amino acid content of soybean showed no significant differences between samples. In vitro experiments were used to determine trypsin inhibitory activity and protein digestibility of different types of soybean samples. The results revealed that fat extraction and heat treatment reduced the trypsin inhibitory activity and increased protein digestibility. The same trend of protein digestibility was confirmed by in vivo experiments. Heat treatment of both raw soybeans and extracted soybeans improved live body weight gain and efficiency of energy and protein utilizations. Mortality rate was much less in chicks fed extracted, autoclaved, soybean than other rations.

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PHOTOSYNTHESIS IN RELATION TO CHLOROPLAST NUMBER AND QUALITY IN SOYBEAN LEAVES.

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Variation in the photosynthetic rate of leaves may be caused by variation in the capacities of more than one component of the photosynthetic system. The objective of this experiment was to determine (a) whether the amounts or rates of several photosynthetic traits varied together and with rate of total photosynthesis per unit leaf area (TPs) and (b) whether differences in photosynthetic capacity could be explained by differences in chloroplast number per unit leaf area (CHLP) or in the capacity per chloroplast. Six soybean [Glycine max (L.) Merr.] cultivars were grown in the field. TPs, CHLP, and the per-unit-leaf area amounts of soluble protein (PRO) and chlorophyll (CHL), and activities of ribulose 1,5-bisphosphate carboxylase (RuBPCase--EC 4.1.1.39) and uncoupled photosynthetic electron transport (PET) were determined for leaves of similar age and nodal position on seven dates. Among plants within cultivars and among cultivars, TPs was correlated with RuBPCase, PRO, and CHL; significant correlations with PET occurred only late in the leafs' lives among cultivars. The correlations suggested that these traits generally vary together and with TPs. Differences in chloroplast quality explained capacity differences among plants within cultivars; the cause among cultivars is unclear. During senescence the onset and rates of decline in PET, RuBPCase, and TPs were closely coupled. PRO and CHL began to decline 3 weeks later. CHLP did not decline during senescence, so the loss of photosynthetic capacity appeared to be caused by a decline in chloroplast quality rather than number.

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CLIMATIC AND EDAPHIC ENVIRONMENTS FOR SOYBEAN IN ARGENTINA

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Oceanic climate, reduced latitudinal range, and east to west edaphic and climatic gradient are amongst the main features of the Argetinian soybean growing areas. Efforts to develop cultivars fully adapted to those special conditions are just beginning, and they may benefit from an adequate understanding of their nature. Ecological description of soybean growing areas has been carried out, both on macro and on meso scales. Methods for evaluating cultivar adaptation to climatic and edaphic stress are being developed, and world areas which may provide germplasm sources for improving adaptation are being searched. The Argentinian agricultural region is subject to long term climatic fluctuations. Soybean production records are still too short to show climatic impact, but it must be remembered that spread of soybeans into Argentina took place during a period when favorable conditions prevailed, and there is a certain risk that this situation may be reversed in the future.

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Motels
Blocks of rooms have been reserved at eight motels in the Ames area: (see map for locations)

1. Holiday Inn-Gateway Center. P O Box X, Welch Station, Ames, Iowa 50010; (515) 292-8600. Indoor pool, whirlpool, sauna, air conditioning, color TV, restaurant, lounge. Located at Elwood Dr and U S Highway 30, south of campus Rates· $44 single/$50 double

2. Silver Saddle Motel. Highway 69 and New Highway 30, Ames, Iowa 50010, (515) 232-8363. Swimming pool, air conditioning, cable TV, free Home Box Office Located at the junction of U.S. 69 and U.S 30, one mile west of I-35, Frontage Road. Rates $29 single/$35 double.

3. Ramada Inn. 1206 S. Duff, Ames, Iowa 50010, (515) 232-3410. Color TV, air conditioning, restaurant, lounge Rates: $35 single/$43 double

4 Ames Travelodge. 229 S Duff, Ames, Iowa 50010; (515) 233-1714. Air conditioning, color TV, swimming pool. On U S. 69 Restaurant and lounge nearby Rates: $30 single/$34 double.

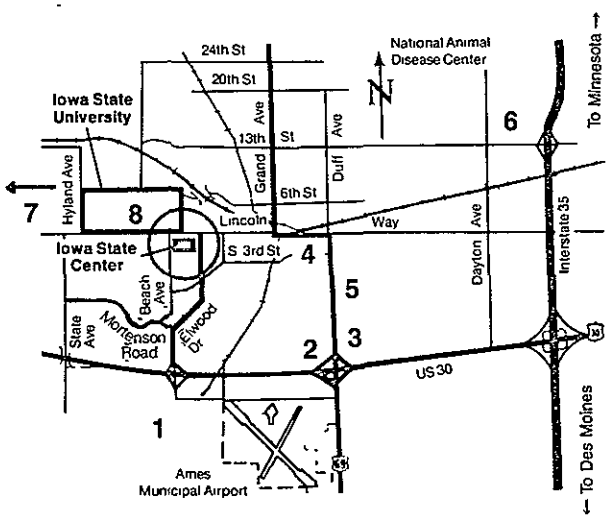
5. University Inn. 316 S. Duff, Ames, Iowa 50010, (515) 232-0280. Swimming pool, cable color TV, air conditioning, dog kennels, babysitters available, restaurant. Located two miles west of I-35 on U S. 69. Rates. $24 single/$28 double.

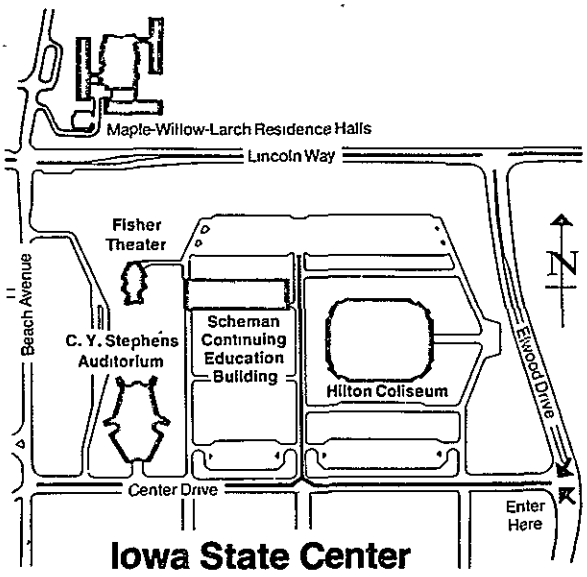
6. Starlite Village, Best Western Motel 13th and Dayton, Ames, Iowa 50010, (515) 232-9260 Indoor swimming pool, color TV, air conditioning, restaurant and lounge. Located near junction of 13th and I-35, east of campus Rates: $30 single/$39 double

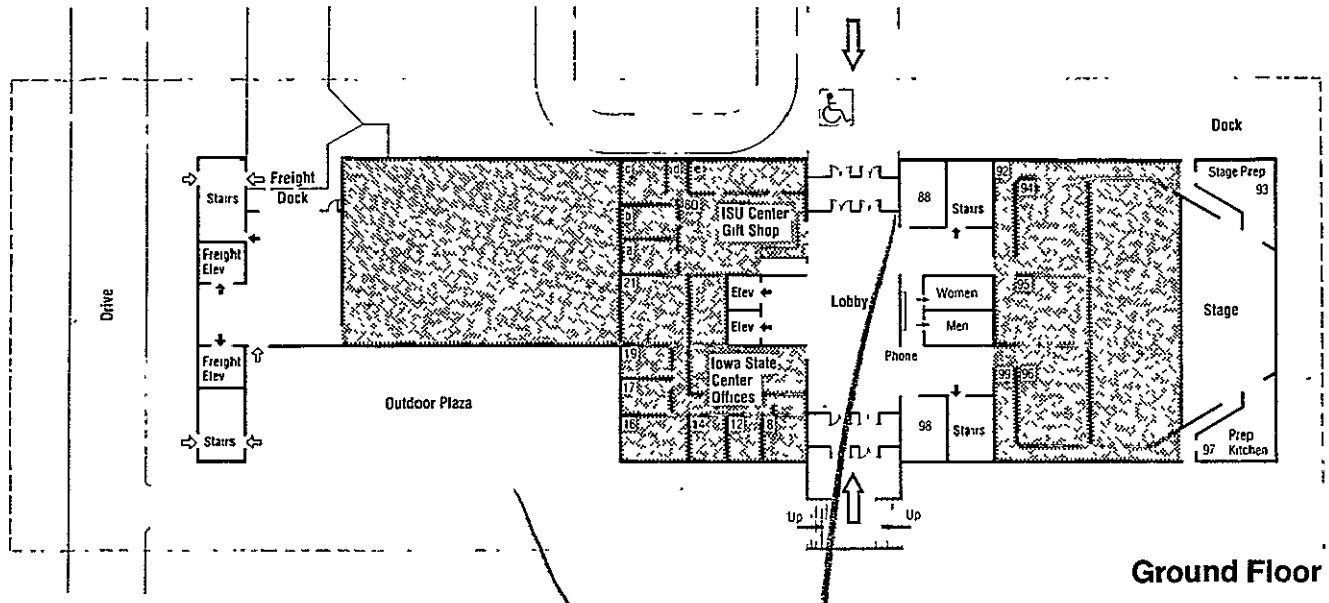
7. Koelker Motels (New Englander and New Frontier). R.R 3, Ames, Iowa 50010; (515) 292-1551 or (515) 292-2056 Swimming pool, cable TV, air conditioning, and large rooms Restaurants and lounge adjacent Miniature golf, shuffleboard, and game room Truck parking available. Located on W. Lincoln Way, west of campus. Rates. $23 single/$29 double

8. Memorial Union. Iowa State University, Ames, Iowa 50011. (515) 292-1111 Color TV, air conditioning, cafeteria, snack bar, bowling alley, game room. Located on ISU campus Rates: $28 single/$34 double.

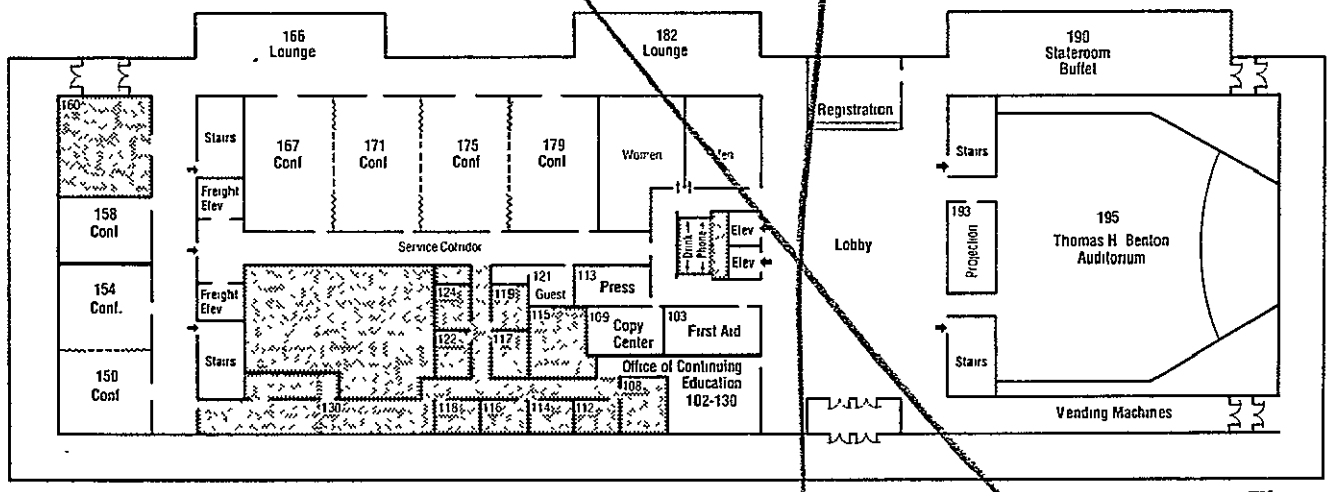
All motels are located within 5 miles of the Iowa State Center A shuttle bus will run regularly during the meetings between the Iowa State Center and the following motels: Holiday Inn-Gateway Center, University Inn, Ames Travelodge, Ramada Inn, and Silver Saddle. Those who stay at the Starlite Village Best Western or the Koelker Motels must provide their own transportation to and from the Scheman Building. The Memorial Union is within walking distance of the Iowa State Center.



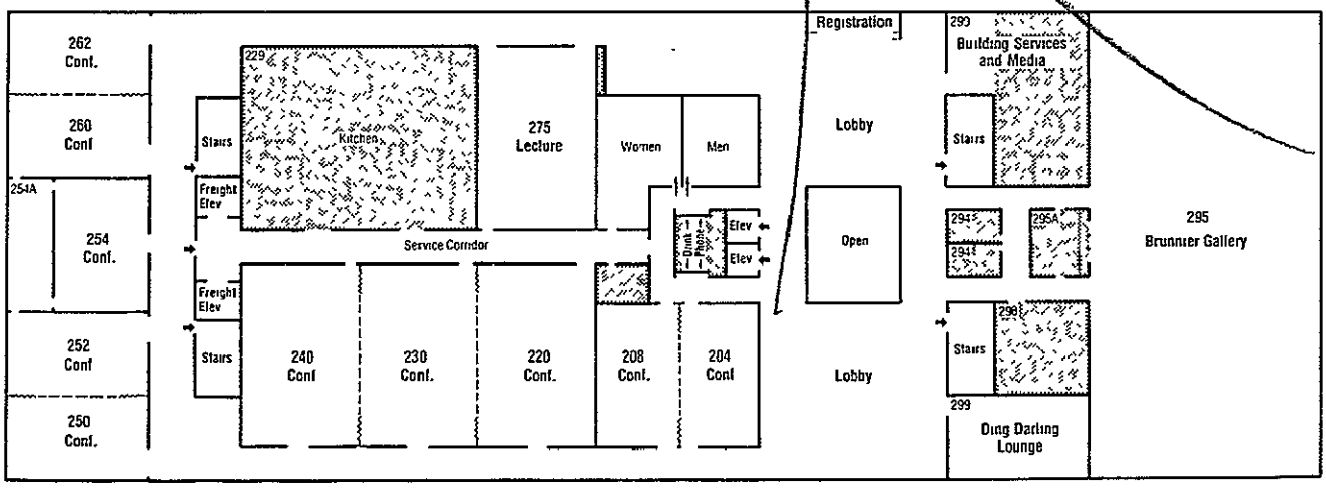




Ground Floor



First Floor



Second Floor