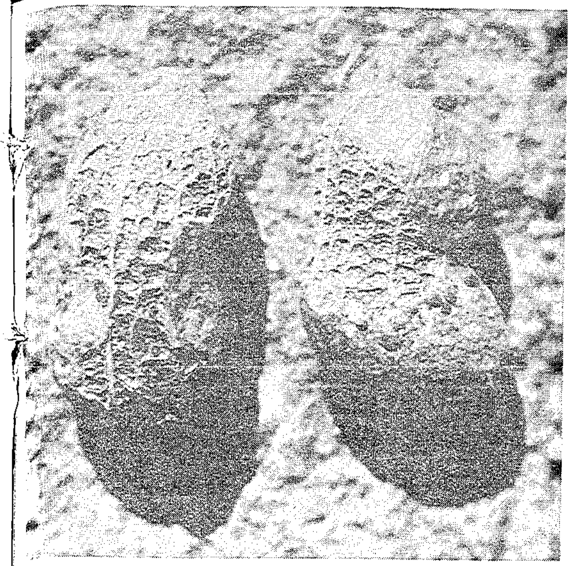


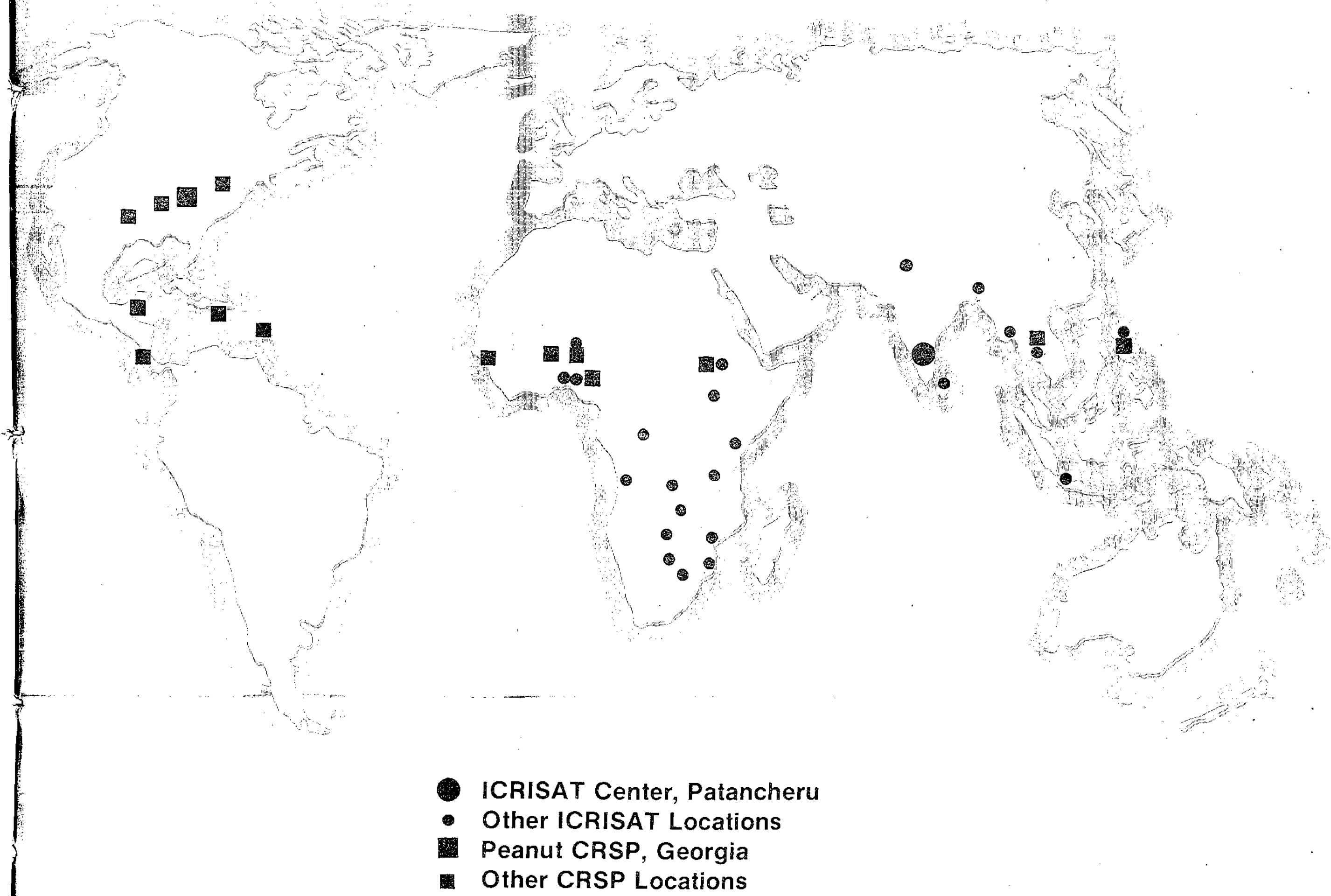
International Arachis Newsletter

Prepared by

LEGUMES PROGRAM, ICRISAT

Patancheru, Andhra Pradesh 502 324, India

?o. 6. November 1989



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Publishing Objectives

The International Arachis Newsletter is issued twice a year (in May and November) by the Legumes Program, ICRISAT, in cooperation with, the Peanut Collaborative Research Support Program, USA (Supported by USAID Grant No. DAN-4048-G-SS-2065-00). It is intended as a communication link for workers throughout the world who are interested in the research and development of groundnut, *Arachis hypogaea,* or peanut, and its wild relatives. The Newsletter is therefore a vehicle for the publication of brief statements of advances in scientific research that have current-awareness value to peer scientists, particularly those working in developing countries. Contributions to the Newsletter are selected for their news interest as well as their scientific content, in the expectation that the work reported may be further developed and formally published later in refereed journals. It is thus assumed that Newsletter contributions will not be cited unless no alternative reference is available.

Style and Form for Contributions

We will carefully consider all submitted contributions and will include in the Newsletter those that are of acceptable scientific standard and conform to the requirements given below.

The language for the Newsletter is English, but we will do our best to translate articles submitted in other languages. Authors should closely follow the style of reports in this issue. Contributions that deviate markedly from this style will be returned for revision. Submission of a contribution that does not meet these requirements can result in missing the publication date. Contributions received by 1 February or 1 August will normally be included in the next issue.

If necessary, we will edit communications so as to preserve a uniform style throughout the Newsletter. This editing may shorten some contributions, but particular care will be taken to ensure that the editing will not change the meaning and scientific content of the article. Wherever we consider that substantial editing is required, we will send a draft copy of the edited version to the contributor for approval before printing.

A communication should not exceed 600 words, and may include a maximum of two relevant and well-prepared tables, *or* figures, *or* diagrams, *or* photographs. Tables must not exceed 85 characters in width. All photographs should be good quality black-and-white prints on matt (nonglossy) surface paper in 85 mm or 180 mm width; send with negatives if possible. Color transparencies or color prints will not be accepted. Do not fold the photo or write on it, but identify each photo on the back with author's name and figure number. Type captions or legends on separate sheets, also clearly identified. Electron micrographs or photo micrographs should indicate the magnification in the caption. Each communication should normally be confined to a single subject and should be of primary interest to *Arachis* workers. The references cited should be directly relevant and necessary to supplement the article's content. All contributions should be typed in double spacing and two copies submitted.

SI units should be used. Yield should be reported in kg ha^{-1}. A "Guide for Authors" is available from the Editor.

Address all communications, and requests for inclusion in the mailing list, to:

The Editor
International Arachis Newsletter
Legumes Program
ICRISAT, Patancheru
Andhra Pradesh 502 324
INDIA

Cover illustration: Groundnut pods scarified by termites, predisposing the pods to aflatoxin contamination.

CONTENTS

News and Views

Editorial

This is the last issue of International Arachis Newsletter that J.P. Moss shall edit, as pressure of work and his other duties have forced him to resign from the editorship.

He would like to thank all those who have helped to make the newsletter a viable proposition, especially T. Nakayama and D. Cummins of Peanut CRSP, not only for their financial support, but also for their enthusiasm, which has given a great morale boost for all of us involved in IAN. He would also like to thank his colleagues at ICRISAT, both the groundnut scientists, and the production staff and technical editors, who helped so much to get the newsletters started. He also thanks all those who sent papers for publishing, and is pleased to say that we now receive a healthy number of papers for each issue. He also thanks those who review the papers, as it is their efforts that ensure the quality of the newsletter.

He finally thanks L.J. Reddy, who has been a great help since joining as the editor for IAN 3, and extends all his best wishes to L.J. Reddy and the new editor, P. Subrahmanyam, and assures them his full support for the future issues of IAN.

J.P. Moss
L.J. Reddy

Letter to the Editor

Dear Editor:

The report on 'Groundnut Yield Maximization Trials in India' by P.W. Amin, appearing in the November 88 issue of IAN, should be of great interest to groundnut scientists. May I offer a few suggestions?

1. A column giving the approximate cost of cultivation of each method would greatly help in understanding how labor/cost intensive each method is.
2. Normally, states are expected to formulate cultivation methods for crops after careful consideration. The data presented in the paper indicates substantially wide differences between the yields obtained by the ICRISAT method and the state method. If it is possible for the author to indicate where exactly the state recommendations went wrong and what alterations/additions are needed, it would be of immense utility to groundnut farmers.

My other comments pertain to the paper on 'Weed Management in Groundnut' by Ramakrishna and Ong appearing in the same issue.

1. One of the basic requirements of papers on weed control/management is a statement on which of the prominent weeds were controlled and which were not by the herbicides tested, or the treatments applied, and in the light of that an explanation of the differences in weed mass and yield (though yield is a function of individual as well as interacting factors, of which weed control is one).
2. A column indicating the cost involved in each treatment would be of importance because this factor, by far, determines the method one would like to adopt.
3. In view of the great role herbicides can play in Indian agriculture, such papers should clearly identify herbicides/treatments that are as efficient as the weed-free control, but at a lesser cost, because millions of farmers follow manual methods for weed control.

These comments, I hope, are found useful, and are not meant to be a criticism of the papers referred to.

Sincerely,

M.V. Rao
Retired Scientist
Central Rice Research Institute
Cuttack 753 006
India

ICRISAT LEGOFTEN Scientist Replies:

We have not mentioned the cost of cultivation because these trials were meant to demonstrate high-yield potential. Subsequent modifications to incorporate key factors for obtaining high yields have resulted in substantial reduction in cost of cultivation. The data from farmers' fields who have adopted this technology indicate that the cost of cultivation ranges from Rs 5000 to Rs 7000 ha^{-1}. Further reduction in cost of cultivation has become possible when a bullock-drawn implement has been developed by farmers to form raised beds and furrows and simultaneously to apply fertilizers and seeding in one operation. Substantial yield increases obtained by using this technology has resulted in higher net profits. The technology is now being widely adopted.

News from ICRISAT Center

Asian Grain Legume On-farm Research Planning Meeting, 20-24 Nov 1989, ICRISAT Center:

This meeting is being organized to bring together scientists, administrators, and extension specialists from Asian countries to meet with the representatives of ICRISAT, and other regional and international research and donor organizations in Asia to:

- assess a country's needs for increasing legumes production, and determine the constraints,
- identify the technology available to meet these constraints,
- review existing crop production strategies, via on-farm testing and transfer of technology,
- identify areas of assistance to be given by ICRISAT for transfer of technology (plant material, research methodology, agronomic manipulations, information and training), and
- develop time-bound plans for adaptive research and transfer of technology.

Invitations have been sent to Bangladesh, Indonesia, Myanmar, Nepal, Sri Lanka, and Vietnam to send three representatives - a senior research administrator, a senior legume research scientist, and a senior extension specialist to attend the meeting. Representatives (one each) from China, India, Pakistan, Philippines, and Thailand have also been invited to serve as consultants to the meeting, along with representatives from Australian Centre for International Agricultural Research (ACIAR); Regional Coordination Centre for Research Development of Coarse Grains, Pulses, Roots and Tuber Crops in the Humid Tropics of Asia and Pacific (CGPRT); International Rice Research Institute (IRRI); and Food and Agriculture Organization of the United Nations (FAO).

Groundnut Bacterial Wilt Research Coordination Meeting

Under the ecological conditions of East and southeast Asia, some strains of *Pseudomonas solanacearam* have evolved that are capable of attacking cultivated groundnut. In several countries of the region, serious bacterial wilt epidemics caused by these strains either currently occur or appear to be emerging. The disease is already important in the People's Republic of China and in Indonesia, and it is being recognized with increasing frequency in the Philippines, Thailand, and Malaysia. The disease has recently been reported for the first time in Sri Lanka. Bacterial wilt is also a problem in other Asian countries, and in some areas of Africa and the Americas.

In November 1988, a meeting of groundnut scientists from the Asian region was held in Malang, Indonesia. At this meeting the groundnut improvement project in Indonesia, which is supported by the Australian Centre for International Agricultural Research (ACIAR), was charged with coordinating research efforts directed towards control of this disease. A meeting of involved scientists has been proposed in conjunction with the 3rd International Conference on Plant Protection in the Tropics, in Malaysia, in March 1990. A meeting to evolve a regional coordinated approach to solve the problem of groundnut bacterial wilt will probably be held 18-19 March, just prior to the 3rd International Conference. The Australian International Development Assistance Bureau (AIDAB) has provided funds to ACIAR and ICRISAT to cover the costs of bringing a few key speakers to the meeting, local operating costs, and the costs of publications of the proceedings.

We invite involved scientists, who may be traveling to the 3rd International Conference, to consider participating in the groundnut bacterial wilt meeting. Those scientists who wish to attend should contact:

The Coordinator, AGLN
Legumes Program
International Crops Research Institute
for the Semi-Arid Tropics (ICRISAT)
Patancheru
Andhra Pradesh 502 324
India

and provide information on their areas of research involvement with the disease.

News About ICRISAT Groundnut Scientists

Dr K.R. Bock Retires

Dr K.R. Bock joined the SADCC/ICRISAT Regional Groundnut Program in December 1983 as team leader, and retires in December 1989.

His long and rich experience in the Southern African region helped him to establish quickly an effective network among the groundnut scientists of the region.

His major scientific achievements include elucidation of rosette virus infection patterns, perfection of an effective screening method for resistance to rosette virus, identification of the causal agent of groundnut streak necrosis disease (GSND), and quantification of yield losses due to GSND.

He will always be remembered by his colleagues for his practical approach to problems, and his willingness, always, to listen to, and to assist, his colleagues and subordinate staff.

We wish him well in his retirement, and great joy in the pursuit of one of his other great loves --nature and conservation.

Dr Bock (*third from right*) in conversation with participants of the 3rd Regional Groundnut Workshop for Southern Africa at Chitedze held in March 1988.

Dr S.N. Nigam Proceeds on Sabbatic Leave

Dr S.N. Nigam, Principal Groundnut Breeder, proceeded on his 1-year sabbatic leave, with his family, to North Carolina State University, Raleigh, USA, on 9 Jun 1989. While on his sabbatic, Dr Nigam would be working with the internationally reputed groundnut team headed by Prof. J. C. Wynne.

News from Peanut CRSP

The Peanut Collaborative Research Support Program (CRSP), held its annual planning meetings at Winston-Salem, North Carolina, USA, 10-14 July, in conjunction with the American Peanut Research and Education Society's (APRES) annual meeting. The focus this year was on an intensive and extensive program evaluation and the preparation of a proposal for a 5-year extension, 1990-95. Overseas collaborators in attendance were: Dr Brian Cooper, Caribbean Agricultural Research and Development Institute (CARDI), Antigua; Mr Jocelyn Grant, CARDI, Jamaica; Ms Margaret Hinds, University of West Indies, Trinidad; Dr Alfred Traore and Dr Philippe Sankara, University of Ouagadougou, Burkina Faso; Mr Ahmadou Bachir Sarr, Institute of Food Technology, Senegal; and Mr Surapong Charoenrath, Department of Agriculture (DOA), Thailand. Some 14 CRSP related research papers were presented at APRES, including presentations by Dr Cooper, Mr Sarr, and Mr Charoenrath.

Peanut CRSP scientists from the University of Georgia and Alabama A&M University participated in the Institute of Food Technologists annual meeting in Chicago in June 1989. Overseas collaborators with the University of Georgia project, Dr Vichai Haruthaithanasan, Kasetsart University, Bangkok, and Dr Rey Mabesa, University of the Philippines, Los Baños, attended and presented papers.

Dr Bharat Singh, Alabama A&M University, participated in a Consultants' Meeting at ICRISAT Center on Uses of Grain Legumes, 27-30 Mar 1989, and presented a paper entitled "Cereal Based Foods Using Groundnut and Other Legumes."

Dr James Demski, University of Georgia, participated in a Peanut Stripe Virus Research Coordinators' Meeting at ICRISAT Center, 1-4 Aug 1989. Dr Sopone Wongkaew, collaborator from Khon Kaen University, Thailand, and Dr Marina Natural, collaborator from the University of the Philippines, Los Baños, both participated. Dr Natural also participated in a 2-week groundnut and chickpea virus identification workshop prior to the meeting.

Dr Cedric Kuhn traveled to Zaria, Nigeria, in April to discuss and plan 1989 dissertation research with Ms P.E. Olorunju at Institute for Agricultural Research (IAR). Her research is related to breeding peanut for resistance to rosette virus.

Dr Louis Boyd, University of Georgia, (representative on the CRSP Board of Directors), visited research sites and collaborators in Senegal, 18-23 Feb 1989.

Dr Greg Parker, Research Associate, Texas A&M University, and on the Texas/West Africa breeding project, taught a 2-week, CRSP supported, SAS computer program for scientists at the University of Ouagadougou, Burkina Faso, in July-August 1989.

Drs Johnny W. Pendleton, Adjunct Professor, University of Illinois; John P. Cherry, Director, USDA/ARS Eastern Regional Research Laboratory; Allan J. Norden, Emeritus Professor of Agronomy, University of Florida; and Ray O. Hammons, retired, USDA/ARS peanut geneticist, Tifton, Georgia, make up the External Evaluation Panel of Peanut CRSP. They have visited the CRSP research sites in host countries and U.S. universities during 1989. Their report will be a basis for the grant extension proposal to be completed later this year. Dr Robert Pettit, Texas A&M, accompanied the Panel to Senegal and Dr David Cummins, Program Director, University of Georgia, accompanied the Panel to other sites.

Dr W.V. Campbell, North Carolina State University, traveled to Philippines and Thailand in March and April 1989 for work on the collaborative entomology project.

Dr Majeet Chinnan and Mr Tal Oz-Ari, University of Georgia postharvest project, traveled to Belize, Trinidad, and Barbados in March 1989 for planning and conducting collaborative postharvest research.

Dr R. W. Gibbons, Director, ICRISAT Sahelian Center, and member of Peanut CRSP Board of Directors, participated in the CRSP meetings at Winston-Salem, North Carolina, in July 1989.

News about USDA Groundnut Scientists

Dr D. Morris Porter, Research Leader and Plant Pathologist, was recently named a Fellow of the American Peanut Research and Education Society. Dr Porter is recognized nationally and internationally for his research on the etiology, epidemiology, and control of both foliar and soilborne diseases of groundnut. He has served the Society in many capacities, including its Presidency.

New Groundnut Varieties Released in India

The Government of India Central Subcommittee on Crop Standards, Notification, and Release of Varieties, at its 14th Meeting, held 1 Sep 1989, released and notified the groundnut variety, ICGS 76 (ICGV 87141).

The ICRISAT groundnut variety, ICGV 87141, is a virginia bunch variety suitable for rainfed cultivation in Zone V (Southern Maharashtra, Andhra Pradesh, excluding north-coastal districts, Tamil Nadu, Karnataka, and Kerala). It has given pod-yields 36% higher than Kadiri 3 (national control), 16% higher than C 198 (minikit control), 45% higher than Kadiri 2, and 34% higher than TMV 10. According to Dr El Ahmadi, Groundnut Breeder, Sudan, this variety has performed very well in Sudan also.

ICGS 76 has two-seeded medium-sized pods with tan seeds, and has good recovery for pod yield from midseason drought.

Reports

Report on the Second PStV-Coordinators' Meeting

D.V.R. Reddy (ICRISAT)

Thirty-nine scientists from Australia, Canada, France, India, Indonesia, Japan, the People's Republic of China, the Philippines, Thailand, the United Kingdom, and the United States have participated in the second Peanut Stripe Virus Coordinators' meeting held at the ICRISAT Center, 1-4 Aug 1989. The meeting was funded by ICRISAT, the Australian Centre for International Agricultural Research (ACIAR), Peanut Collaborative Research Support Program (Peanut-CRSP) and the Food and Agriculture Organization. Three keynote addresses were given by A.J. Gibbs from Australia, on "Database and its potential for plant virologists in developing countries", R.I. Hamilton from Canada, on "Seedborne legume viruses: importance, detection, and management", and A.A. Brunt, on "tropical legume viruses and their control". Seven country papers and three special papers were presented. Participants were taken on a field and laboratory trip to be shown current research on groundnut viruses at the ICRISAT Center.

PStV is currently regarded as one of the important virus diseases in Southeast Asia. Since the first meeting of PStV Coordinators, held at Malang in June 1987, the virus has been detected in several Southeast Asian countries. Reports from Indonesia and China show that the virus has potential to cause severe losses to yield of groundnut.

Aspects discussed at this meeting include the identification of isolates of PStV, the production of specific antibodies for identifying PStV isolates, the screening of germplasm for resistance/tolerance and nonseed transmission, and further refinements to the estimation of yield losses due to PStV. Screening of germplasm, currently being carried out at Indonesia with financial assistance from ACIAR and ICRISAT, will be continued.

The meeting also put forward several recommendations, which include:

- procedures for investigating epidemiology,
- procedures to follow for maintenance and distribution of germplasm free from seedborne groundnut viruses,
- publication of an information bulletin on PStV,
- extensive screening of wild Arachis species and interspecific derivatives for locating resistance, and
- intensification of efforts to identify genotypes with nonseed transmission of PStV.

The group's activities have been expanded to include other economically important groundnut viruses in the region. Considerable progress has been made on the recommendations proposed by the group at the first PStV Coordinators' meeting. Efforts made by this group are expected to result in a reduction in losses of yield due to PStV, and the prevention of further spread of PStV through germplasm exchange.

Training Course on the Detection and Identification of Legume Viruses

D.V.R. Reddy (ICRISAT)

A training course on the "Detection and Identification of Legume Viruses" was held at the ICRISAT Center, 10-29 Jul 1989, with nine participants from Bangladesh, India, Nepal, the Philippines, Thailand, and Uganda. The course covered theoretical aspects of "Methods for Plant Virus Diagnosis", and "Management of Plant Virus Diseases". Over 75% of the time was devoted to laboratory activities. Participants were given 'hands on' experience in the mechanical inoculation of groundnut viruses; various forms of enzyme-linked immunosorbent assay, the comparison of pencillinase, alkaline phosphatase, and horseradish peroxidase systems; dot immunobinding assay, the purification of peanut mottle virus; and in addition, polyacrylamide gel electrophoresis for analyzing viral polypeptides; the extraction of single and double-stranded RNA and their analysis in polyacrylamide and agarose gels; and the negative staining of virus particles for electron microscopy.

Participants, given a test prior to the course, had substantially improved their performance, when repeating the test after the completion of the course. The course was rated favorably by all the participants, who requested that a similar course should be organized at regular intervals.

Bangladesh In-country Training Course on Legumes

As a part of its activities, the Asian Grain Legumes Network (AGLN) of ICRISAT, and the Bangladesh Agricultural Research Institute (BARI), organized an In-country Training Course on Legumes, at Joydebpur, Bangladesh, 9-18 Sep 1989. The Thailand Regional Outreach Program of the Asian Vegetable Research and Development Center (AVRDC), Taiwan, and the International Center for Agricultural Research in the Dry Areas (ICARDA), Syria, also collaborated in conducting the course. In addition to the ICRISAT mandate legumes (chickpea, pigeonpea, and groundnut), the course also included mung bean and black gram (with help from AVRDC and India), and lentils (with help from ICARDA).

This was the second In-country Training Course organized by AGLN, the first one being held in Nepal, during March 1988. AGLN organizes these in-country training courses, to enable: (a) a greater number of a country's research/extension staff to attend these courses, since they are held within the country; (b) the local senior scientists also to act as resource faculty to the training course; and (c) to provide an opportunity for interaction among scientists from the country and international institutes.

The resource persons to the training course included 14 scientists from Bangladesh, 5 from ICRISAT, and 1 each from AVRDC, ICARDA, and the Indian program. There were 30 participant-trainees from the headquarters, the Regional Research Stations, and the Agricultural Research Stations of BARI.

The course was inaugurated by M. Motlubur Rahman, Executive Vice-Chairman, Bangladesh Agricultural Research Council (BARC), and M.H. Mondal, Director General, BARI, chaired the inaugural session.

The program consisted of lectures/presentations, followed by discussions. The presentations covered agronomy, breeding, physiology, pathology, entomology, soils, nutrition, and postharvest handling.

A field trip to groundnut-growing areas around Joydebpur was organized. Participants were able to learn identification of the symptoms caused by various groundnut diseases and insect pests.

The trainees evaluated the course as being very good and useful, and were able to improve their knowledge and understanding of the crops, and other related aspects.

A New Growth Habit Variant of Taxonomical Importance in Groundnut

M.V.C. Gowda, H.L. Nadaf, and **K. Giriraj** (All India Coordinated Research Project on Oilseeds, University of Agricultural Sciences, Dharwad, Karnataka 580 005, India)

Arachis hypogaea L. has been classified into two subspecies, *hypogaea* and *fastigiata* (Gibbons et al. 1972). The subspecies *hypogaea* is characterized by alternate branching, spreading/semispreading habit, absence of flowers on main axis, long duration (120-160 days) and presence of seed dormancy. Sequential branching, erect habit, presence of flower on main axis, short duration (85-130 days), and lack of seed dormancy characterize the subspecies *fastigiata*. However, there are exceptional variations with overlapping features that make classification difficult (Ramanatha Rao 1988).

One such variant with combined characters of both the subspecies was observed in the segregating material of a cross (Dh 3-20 x CGC 1) at Main Research Station, University of Agricultural Sciences, Dharwad during the 1983 rainy season. It has features of subsp *hypogaea*, such as long trailing n+1 branches (90-110 cm), short main axis (15-20 cm), and 50-60 day seed dormancy, coupled with characters of subsp *fastigiata*, such as sequential branching, absence of n+2 and n+3 branches, flowers on main axis, light-green leaves and short duration (Table 1 and Fig 1). Regeneration of the variant over four seasons confirmed its stability with respect to the characters mentioned. This has been designated as "Dharwad Early Runner" (DER). This kind of intermediary form may arise due to introgression in nature or hybridization between intraspecific groups.

The DER could be useful as a donor parent to introduce seed dormancy in spanish bunch-valencia groups and earliness and high shelling percentage in the virginia group.

Table 1. Description of the variant, Dharwad Early Runner.

Descriptor	Descriptor state
Growth habit	Procumbent
Number of n+1 branches	4
Number of n+2 branches	Nil
Number of n+3 branches	Nil
Length of main axis (n)	15-20 cm
Length of n+1 branches	90-110 cm
Branching pattern	Sequential
Flowers on main axis	Present
Type of inflorescence	Simple
Leaf color	Light green
Pubescence on stem	Profuse
100-seed mass	20-25
Shelling percentage	75-80
Days to maturity	95-100
Seed dormancy	50-60 days

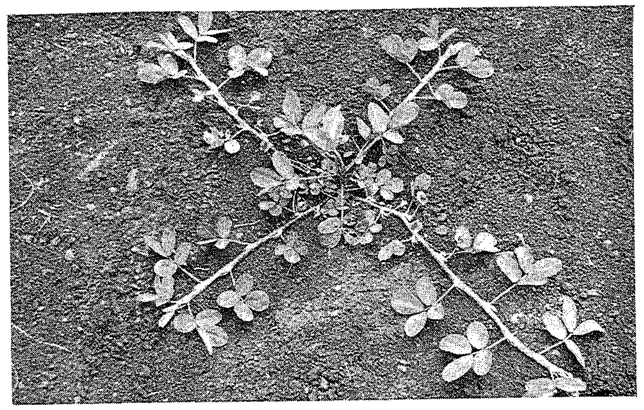

Figure 1. The growth habit of the Dharwad Early Runner.

References

Gibbons, R.W., Bunting, A.H., and **Smartt, J.** 1972. The classification of varieties of groundnut (*Arachis hypogaea* L.). Euphytica 21:78-85.

Ramanatha Rao, V. 1988. Botany of *Arachis hypogaea* L. Pages 35-38 *in* Groundnut (Reddy P.S., ed.). New Delhi, India: Indian Council of Agricultural Research.

Genetics of Inflorescence Types in Groundnut

P. Vindhiya Varman and **T.S. Raveendran** (Agricultural Research Station, Aliyarnagar, Tamil Nadu 642 101, India)

In groundnut, there exist two types of inflorescence, compound and simple. The inflorescence in spanish types (subsp *fastigiata* var *vulgaris*) is compound; whereas it is simple in valencia (subsp *fastigiata* var *fastigiata*) and virginia (subsp *hypogaea* var *hypogaea*)

Figure 1. (a) Compound inflorescence (spanish); (b) simple inflorescence with rudimentary reproductive axis (virginia); and (c) simple inflorescence with elongated reproductive axis (valencia).

Table 1. Chi square test for 9:7 and 13:3 dihybrid ratios.

Crosses	Filial generation	Simple inflore-scence	Compound inflore-scence	Ratio	X^2 value	'P' value
Valencia x virginia						
NC Ac 17090 x ALR 1	F_1	17	-	-	-	-
	F_2	586	474	9:7	0.40	0.75-0.50
NC Ac 17090 x Kadiri 3	F_1	23	-	-	-	-
	F_2	735	560	9:7	0.13	0.75-0.50
NC Ac 17135 x ALR 1	F_1	16	-	-	-	-
	F_2	514	436	9:7	1.77	0.50-0.30
NC Ac 17135 x Kadiri 3	F_1	29	-	-	-	-
	F_2	776	584	9:7	0.36	0.75-0.50
		Value for heterogeneity 2.68				
Valencia x spanish						
NC Ac 17090 x Co 2	F_1	-	31	-	-	-
	F_2	255	1170	13:3	0.68	0.75-0.50
NC Ac 17090 x JL 24	F_1	-	24	-	-	-
	F_2	235	981	13:3	0.27	0.75-0.50
NC Ac 17135 x Co 2	F_1	-	19	-	-	-
	F_2	172	797	13:3	0.64	0.75-0.50
NC Ac 17135 x JL 24	F_1	-	21	-	-	-
	F_2	190	860	13:3	0.30	0.75-0.50
		Value for heterogeneity 1.21				

types. The length of reproductive axis in valencia is longer whereas it is rudimentary in virginia (Fig. 1). Vindhiya Varman et al. (1986) were of the opinion that the character is expressed under wider spacing, and that the character failed to develop in close planting.

The inheritance of types of inflorescence was studied in eight inter- and intrasubspecific crosses involving valencia x virginia and valencia x spanish types. In F_1 generation, the hybrids of valencia x virginia crosses expressed simple inflorescence; whereas valencia x spanish crosses exhibited compound inflorescence (Table 1). Simple and compound inflorescences in F_2 generations were observed in a ratio of 9:7 in the four crosses between valencia and virginia, indicating the involvement of two genes possessing a complementary effect.

However, the segregation ratio was 13:3 for compound and simple inflorescence in the four crosses between valencia and spanish, suggesting the control of two genes with inhibitory effects. The genes present in the spanish form should have inhibited the expression of simple inflorescence.

Reference

Vindhiya Varman, P., Rathinaswamy, R., Sethupathi Ramalingam, R., and **Vaman Bhat, M.** 1986. Inheritance of inflorescence type in groundnut. Madras Agricultural Journal 73:719-720.

Evaluation of Broadbeds and Furrows (BBF) for Irrigated Groundnut on Medium Black Soils of Konkan, India

B.P. Patil (Central Experiment Station, Wakawali, Ratnagiri district, Maharashtra 415 711, India)

Irrigated groundnut, as a cash crop, is being increasingly promoted in the command areas of minor and medium projects in Konkan, in view of the diversification of its cropping pattern. At present, double cropping with rice is posing problems of tillage and plant protection, besides being expensive in water and labor use. Therefore, the introduction of arable crops, especially of groundnut, is being explored. In the Konkan area there are two types of soils: medium black soils (Vertisols) of north Konkan, with a low infiltration rate (Dongale 1987), and the lateritic soils (Alfisols) (Dongale et al. 1987). Both of these soils have low infiltration rates, and get waterlogged in the rainy season. Recently, the BBF technology has been found useful both for rainfed and for irrigated groundnut (Amin et al. 1987). We report here the improved water management technology of BBF in comparison to the control basin method.

Broadbeds, 1.2 x 5 m, with a 30 cm furrow in between two beds, and a control basin, 5 x 5 m, were prepared side by side in medium black soil. Soil analysis showed that organic carbon was 0.75%, pH 6.5, and available nutrients were 15 kg of P_2O_5 ha^{-1} and 250 kg of K_2O ha^{-1}. Bulk density of soil was 1.4 g cm^{-3}, and the initial infiltration rate was 1.35 cm h^{-1}. Field capacity was 32% and wilting point was 20%. A common dose of 25 kg N + 50 kg P in a urea and single superphosphate mixture was placed below seed rows and covered completely. Groundnut (SB XI) was sown on 10 Feb 1988, after treatment with captan, at the rate of 4 g kg^{-1} of seed at 30 x 15 cm intervals, on both BBF and control basins. In case of BBF, gypsum at the rate of 500 kg ha^{-1} was applied at peg formation near the crop rows. Usual interculture, weeding, irrigation, and plant protection practices were followed for both the plots. Harvesting was done on 21 Mar 1988. The yield and yield-contributing characters are presented in Table 1.

Table 1. Effect of BBF on yield contributory characters and yield of groundnut, Konkan, India, postrainy season 1988.

Character	Control basin	BBF
Number of effective pegs $hill^{-1}$	22.3	41.1
Mass of dry pods $hill^{-1}$ (g)	12.9	23.8
Dry matter $hill^{-1}$ (g)	40.0	73.7
Dry pod yield (kg ha^{-1})	2190	4050
Haulm yield (kg ha^{-1})	5070	8610

It is evident from the data (Table 1) that the total and effective number of pegs was almost doubled in BBF treated with 500 kg of gypsum ha^{-1}. A consistent trend was also evident with the dry mass of pods and dry matter per hill, which eventually resulted in doubling the dry-pod yield of groundnut. This clearly indicated the possibility of doubling the yield level of groundnut with BBF on the medium black soils of Konkan.

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Influence of Soil Moisture Content on Pod Zone Temperatures in Groundnut

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Soil temperatures markedly influence groundnut yields (Ong 1986). Surface soil temperatures in particular are influenced by soil moisture content. Many earlier studies on drought-stress effects, particularly in the tropics, have not considered the effects of soil moisture content on soil temperature. In a study on the effects of the frequency of irrigation on groundnut productivity, soil temperatures at the pod zone were recorded in relation to soil moisture content (Table 1).

The study was conducted in the wetland farm of Sri Venkateswara Agricultural College, Tirupati, Andhra Pradesh, India, located at 13°N, 79°E during the postrainy season of 1987/88. A valencia bunch variety JL 24 was utilized for the study. Soils of the experimental field were typical red sandy-clay loams. The crop was sown on 13 Jan 1988 and harvested on 19 Apr 1988. The following treatments were used: (T_1) High frequency irrigation, with 5 cm of water at 5-day intervals; (T_2) Normal irrigation, with 5 cm of water at 10-day intervals. Equal amounts of water were let into each treatment. The temperature-moisture relationships of the pod zone recorded in one 10-day cycle, from the 60th to the 70th day after sowing, are presented here.

When the soil-moisture content in the pod zone

Table 1. Pod zone soil temperatures of groundnut as influenced by soil moisture content, 60 to 70 days after sowing, Tirupati, postrainy season 1987/88.

	T_1 High frequency irrigation (at 5-day intervals)			T_2 Normal irrigation (at 10-day intervals)			T_3 Barren land and no irrigation	
	Soil moisture (%)	Soil temperature °C		Soil moisture (%)	Soil temperature °C		Soil temperature (at 5 cm depth) °C	
Days after irrigation		Min	Max		Min	Max	Min	Max
0	12.1	24.1	26.7	12.1	26.8	26.3	28.5	40.0
	±0.74[1]	±0.66	±0.67	±0.74	±0.2	±0.17	±0.28	±0.58
2	11.4	25.2	28.3	10.9	25.7	28.0	29.0	41.0
	±0.66	±0.92	±0.33	±0.66	±0.12	±0.17	±0.28	±0.46
4	9.1	24.2	28.8	8.1	27.1	29.3	29.0	39.0
	±0.50	±0.58	±0.33	±0.46	±0.19	±0.17	±0.40	±0.29
6	12.30	26.3	27.2	5.5	27.31	32.5	28.0	43.0
	±0.46	±0.44	±0.33	±0.14	±0.12	±0.35	±0.40	±0.29
8	10.94	25.0	28.5	3.3	29.0	34.9	30.0	42.5
	±0.14	±0.76	±0.50	±0.33	±0.27	±0.51	±0.28	±0.40
10	9.91	25.7	29.7	3.1	29.4	34.7	30.0	43.0
	±0.22	±0.66	±0.4	±0.23	±0.19	±0.49	±0.46	±0.23

1± SEm values are mean of six replicates.

decreased there was an increase in soil temperature. Within 4 days after irrigation, the soil-moisture content decreased by 3-4% with 2-3°C rise in temperature in the pod zone. Further reduction in soil-moisture content 10 days after irrigation resulted in a greater increase in both minimum and maximum pod-zone soil temperatures by 4-5°C in T_2, as compared to T_1. The mean temperature rose from 26.2°C to 29.2°C, which is substantial enough to cause yield reductions.

The dry-pod yields from treatment T_1 were 2880 kg ha^{-1} compared to 2180 kg ha^{-1} from T_2, a decrease by 24%. The increase in soil temperatures during the pod-filling period by 4-5°C can partly explain the decrease in pod yields, apart from the effect of moisture stress. Temperatures equal to 35°C or more are known to reduce groundnut yields when they occur during critical phenophases, such as seed filling (Ketring 1986). Di-nitrogen fixation by root nodules may also get adversely affected, as observed by Nambiar and Dart (1980), who reported decrease in nitrogenase activity of nodulated roots of groundnut cv Kadiri 71-1 with increase in temperatures of assay bottles. The soil temperatures in an nonirrigated barren area adjacent to the experimental field were much higher (Table 1), emphasizing the importance of irrigation and crop cover. In conclusion, it can be said that a good crop cover and maintenance of soil-moisture content can appreciably reduce soil temperatures, and make it possible to maintain them around 30°C.

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Groundnut Drought-simulation Studies at ICRISAT Sahelian Center

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Although it has been shown that there is a greater probability of drought at the beginning and at the end of the rainy season in the Sahel, potentially damaging drought spells often occur at any time during the cropping season. Variability in the rainfall pattern may well be at least as important a factor as total moisture shortage. Under these conditions, recovery and return to active growth and development, after exposure to varying periods of drought, may be more important than drought avoidance or drought tolerance.

We ran two deficit irrigation trials at ICRISAT Sahelian Center (ISC) during the 1987/88 dry season. Both these trials tested the performance of many groundnut lines irrigated every 1, 2, or 3 weeks, with each irrigation giving 20 mm or 40 mm of water. In the first trial, during Sep-Dec 1987, we found no difference in the yields of the four groundnut lines. Reducing the frequency and amount of irrigation reduced the yields of both haulms and pods as expected (Table 1). We observed that growth almost ceased under the cold temperatures in December and there seemed to be hardly any visual signs of foliar drought stress at this time, even in the treatments which received little water. We, therefore, consider that it is not desirable to screen for drought tolerance late in the year at ISC.

We repeated the trial during Feb-Jun 1988, during the much hotter weather, using the same irrigation treatments and nine groundnut lines. In this trial, the treatments with irrigation every 3 weeks effectively gave no pods for any of the groundnut lines, so we ignored these treatments in the further analysis of the data. Genotypes ICGV 87123 and 55-437 gave the highest pod yields over all irrigation treatments, but at the same time gave very low haulm yields. It seems that under drought-stress conditions at ISC the plants may be able to produce reasonable haulm yields or reasonable pod yields, but not both. There were no significant interactions between genotype and irrigation treatment for pod or haulm yield. We found that one of the genotypes in this trial gave somewhat anomalous results and we removed its data from further analyses. ICG 1697 is a leafy valencia line that has been identified as drought tolerant at ICRISAT Center. It produces high haulm yields but few pods at ICRISAT Sahelian Center (Table 2), and as such may not be successful in these transitional regions of West Africa. We made weekly determinations of soil-moisture content with neutron probes, and took daily measurements of crop canopy - air temperature differences with infra-red thermometers on all plots in the trial. There were large differences in mean soil-moisture content in the 0-210 cm horizon between irrigation treatments (Table 2) with lower soil-moisture content where less water was applied, as would be expected. However, we found no differences in soil-moisture content between genotypes. We found considerable differences between genotypes in crop canopy - air temperature difference. This value is related to leaf water potential and it is considered that drought-tolerant genotypes should have a high leaf water potential or a more negative value of the crop canopy - air temperature difference. A strong negative correlation ($r = -0.822$, $P = 0.012$) was found between midseason crop canopy - air temperature difference and pod yield under intermediate stress conditions (20 mm of water each week), whereas no correlation was found when there was not much drought stress (40 mm of water each week), or when there was extreme stress (20 mm of water every 2 weeks). It would appear that under intermediate drought-stress conditions the genotypes that maintain a higher leaf water potential are able to support higher pod yields. We consider that measurements of crop canopy - air temperature differences at times when the rainfed crop is showing some drought stress could give us a useful indication of potential drought tolerance, and we plan to test further the effectiveness of this method as a screening technique in future trials.

Table 1. Effect of different drought periods on four groundnut genotypes, Sadoré, Niger, postrainy season 1987.

Period between irriga-tions	Irriga-tion dose	Genotype	Yield ($t\ ha^{-1}$) Haulm	Yield ($t\ ha^{-1}$) Pods	Shelling %	Late season plant - air temp. diff.	Mean soil moisture total (mm)
1 week			1.60	1.64	72	-1.66	54.8
2 weeks			1.32	1.05	69	0.62	48.4
3 weeks			1.33	0.70	66	1.46	44.9
SE			±0.09	±0.16	±2	±0.54	±1.1
	40 mm		1.59	1.45	69	-0.85	51.4
	20 mm		1.24	0.80	68	1.13	47.3
SE			±0.07	±0.13	±2	±0.44	±0.9
		55-437	1.11	1.10	72	0.19	48.6
		47-16	1.74	1.14	67	0.34	48.5
		ICGS(E) 13	1.19	1.20	70	0.30	49.8
		ICGS(E) 22	1.63	1.08	67	-0.27	50.7
SE			±0.06	±0.08	±1	±0.20	±0.5

Table 2. Effect of frequency and rate of irrigation on nine groundnut genotypes, Sadoré, Niger, dry season 1988.

Period between irrigations	Irrigation dose	Genotype	Haulm yield (t ha^{-1})	Pod yield (t ha^{-1})	Seed yield (t ha^{-1})	Shelling %	Early season plant-air temp. diff.	Mid season plant-air temp. diff.	Late season plant-air temp. diff.
1 week			1.75	0.61	0.35	55	-4.92	-3.83	1.39
2 weeks			1.70	0.22	0.11	34	-3.26	-1.30	3.48
SE			±0.07	±0.08	±0.05	±3	±0.06	±0.30	±0.52
	40 mm		1.84	0.57	0.31	51	-4.24	-4.13	1.65
	20 mm		1.61	0.26	0.15	38	-3.94	-1.00	3.23
SE			±0.07	±0.08	±0.05	±3	±0.06	±0.30	±0.52
1 week	40 mm		1.91	0.76	0.44	56	-5.17	-5.26	0.89
1 week	20 mm		1.60	0.47	0.26	53	-4.67	-2.40	1.89
2 weeks	40 mm		1.78	0.39	0.19	46	-3.31	-3.00	2.40
2 weeks	20 mm		1.61	0.05	0.03	22	-3.22	0.41	4.57
SE			±0.10	±0.11	±0.07	±4	±0.09	±0.43	±0.74
		55-437	1.28	0.57	0.34	57	-3.45	-2.77	2.43
		47-16	1.64	0.30	0.17	39	-3.17	-1.14	3.29
		ICG 1697	1.93	0.24	0.11	31	-4.76	-2.30	2.28
		TS 32-1	1.97	0.27	0.15	41	-4.15	-1.84	2.65
		J 11	1.60	0.45	0.28	48	-3.63	-2.62	2.12
		ICGV 87123	1.46	0.58	0.34	55	-4.41	-3.32	2.49
		ICGV 87141	1.37	0.47	0.27	49	-4.52	-3.73	2.15
		ICGV 86529	2.26	0.41	0.19	39	-4.24	-2.69	2.03
		ICGMS 64	2.01	0.45	0.21	38	-4.50	-1.97	2.49
SE			±0.19	±0.06	±0.04	±4	±0.22	±0.21	±0.10

Foliar Application of Urea Boosts Irrigated Groundnut Yield

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Groundnut is an important oilseed crop in India. Methods to improve the productivity of this crop are of great importance. Experimental work conducted at the Regional Agricultural Research Station, Tirupati, India, has resulted in the development of technologies that could have a great impact on boosting irrigated groundnut yields. Nitrogen is a major nutrient useful in increasing the productivity of groundnut. Research work carried out at this center for several seasons has established that 30 kg ha^{-1} of nitrogen is optimum, out of which 20 kg is to be applied as basal dressing and the remaining 10 kg as top dressing by placement, around 30-35 days after sowing to improve pod yield significantly.

Top dressing by broadcasting and mixing of 10 kg N ha^{-1} with soil gave an increase in pod yield of 145 kg ha^{-1} over that achieved when only 20 kg N ha^{-1} was applied as basal dressing. Pod yield was further increased by 227 kg ha^{-1} when the dressing was placed at 5 cm depth. The same quantity of nitrogen given as foliar application of 2% urea further increased the pod yield by 363 kg ha^{-1}. The yield data and economics are given in Tables 1 and 2.

An increase of 17% in pod yield was obtained by foliar application of 2% urea, as compared to placement, which itself gave 11% increase in pod yield over broadcasting.

Groundnut crops during the postrainy season are infested by several insect pests and foliar diseases. Most of the pesticides and fungicides can be mixed with 2% urea. The additional yield due to mixing urea with pesticides and fungicides was 636 kg ha^{-1} (23.7%), as compared to application of only urea.

Foliar application of 2% urea was found to be very profitable if need-based pesticides, such as monocrotophos (Nuvacron®) and mancozeb (Dithane M-45®), were mixed and sprayed 30-35 days after sowing.

Table 1. Yield and yield attributes of irrigated groundnut as influenced by different treatments, Tirupati, postrainy seasons 1986 and 1987.

Treatment	Number of filled pods $plant^{-1}$		100-pod mass (g)		100-seed mass (g)		Shelling %		Pod yield (kg ha^{-1})		
	1986	1987	1986	1987	1986	1987	1986	1987	1986	1987	Mean
T_1 20 kg N as basal application (control)	6.1	5.9	98.0	83.0	38.7	40.0	76.2	61.7	1955	2222	2088
T_2 20 kg N as basal application + 10 kg N as top dressing by broadcasting and mixing	6.8	6.8	100.5	89.3	41.0	41.7	78.5	64.0	2080	2387	2233
T_3 As in T_2 but by placement at 5 cm depth	7.4	7.2	101.2	93.3	41.7	42.3	79.0	67.0	2158	2762	2460
T_4 20 kg N as basal placement + 10 kg N as 2% urea foliar spray	7.7	8.1	102.7	102.0	42.7	45.3	79.5	72.0	2320	3327	2823
T_5 T_4 + mixed with need based pesticides and fungicides (Nuvacron® + Dithane M-45®) as foliar spray	8.2	9.5	104.2	108.0	45.0	53.3	80.2	74.3	2423	4216	3319
SE	±0.3	±0.4	±1.1	+3.5	±0.8	±2.4	±0.8	±1.5	±52	±164	
CV (%)	9.4	8.5	2.2	6.1	3.9	8.8	2.0	3.6	4.4	8.7	

Table 2. Economics of different nitrogen treatment in groundnut, Tirupati, postrainy seasons 1986 and 1987.

Treatment	% increase of pod yield over control	Additional net return over control (Rs ha^{-1})	Benefit: cost ratio
T_1	-	-	-
T_2	6.9	462	1.74
T_3	17.8	1456	1.95
T_4	35.2	2992	2.24
T_5	59.0	5121	2.58

A 1000 L ha^{-1} of spray solution, using a high-volume sprayer, gave satisfactory coverage. These results obtained may be location specific and there is need for verification at many other sites.

A Check List of Groundnut Diseases Recorded in Zambia

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Groundnut is an important food and cash crop in Zambia. Diseases are a major constraint on its production. The following is the list of fungal, viral, and bacterial diseases, and a parasitic weed, recorded on groundnut in Zambia:

A. Fungal Diseases
1. Early leaf spot - *Cercospora arachidicola* Hori
2. Late leaf spot - *Phaeoisariopsis personata* (Berk. & Curt.) v. Arx
3. Rust - *Puccinia arachidis* Speg.
4. Aflaroot/ aflatoxins - *Aspergillus flavus* Link ex Fr.
5. Web blotch - *Didymella arachidicola* (Chock) Taber, Pettit & Philley
6. Crown rot/pod rot - *Aspergillus niger* van Tiegh
7. Root rot/pod rot - *Sclerotium rolfsii* Sacc.
8. Leaf scorch - *Leptosphaerulina crassiasca* (Sechet) Jackson & Bell
9. Phyllosticta leaf spots - *Phyllosticta* sp
10. Leaf blight - *Phomopsis* sp
11. Wilt - *Fusarium oxysporum* Schlecht emend Snyd. & Hans.

B. Viral Diseases
1. Groundnut rosette - Groundnut rosette viruses
2. Peanut mottle - Peanut mottle virus
3. Streak necrosis - Sunflower yellow blotch virus
4. Mild mottle - Cowpea mild mottle virus

C. Bacterial Disease
1. Wilt - *Pseudomonas solanacearum* E.F. Smith

D. Parasitic Weed
1. Alectra root parasite - *Alectra* sp

Many of the groundnut diseases listed in this paper were reported earlier. Only rust, web blotch, leaf scorch, leaf blight, peanut mottle, streak necrosis, and mild mottle diseases were detected in recent years. Early leaf spot, late leaf spot, aflaroot/aflatoxin, groundnut rosette, streak necrosis, and peanut mottle are economically important diseases and research is being carried out on all these diseases by the Food Legume Research Team in Zambia. Early leaf spot, which appears on 3-4 week old plants, causes severe damage in every season in all the major groundnut-growing areas. Late leaf spots appear on 2-3 month old plants and cause moderate infection. In most seasons, both the leaf spots account for nearly 50% yield losses. Rust, aflaroot/aflatoxin, groundnut rosette, and streak necrosis are potentially important and occur in every season at low to moderate severity. They cause epidemics only in certain favorable seasons, resulting in considerable yield loss.

Rust was first reported in Zambia in the 1974/75 season (Raemaekers and Preston 1977). A severe outbreak of rust was recorded in 1974/75 and the 1983/84 seasons. Moderate levels of aflaroot and aflatoxin are present in every season (Kannaiyan et al. 1989). Groundnut rosette was severe in the 1982/83 crop season. Web blotch was particularly severe in the high rainfall, cooler areas, such as at Solwezi, Northern Western Province. Fusarium wilt is commonly noticed in sandy-loam soils and drought-prone areas. Peanut mottle was widely prevalent in the 1982/83 and the 1986/87 seasons in the major crop-growing areas in the country, and caused considerable loss in yield in highly susceptible varieties. In recent years, the increased incidence of streak necrosis disease is being recorded both at the research station and in farmers' fields. The incidence/severity of other diseases is low at present.

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Further Studies on Fungicidal Control of Groundnut Leaf Spots in Zambia

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Early leaf spot (*Cercospora arachidicola* Hori) and late leaf spot (*Phaeoisariopsis personata*) [Berk. & Curt.] v. Arx) are commonly present in the major groundnut-growing areas in Zambia and together they causes about 50% yield loss in most seasons. Recently Kannaiyan and Haciwa (1989) reported the efficacy and economic benefits of four fungicides in controlling the leaf spots and rust (*Puccunia arachidis* Speg) diseases in Zambia. Labilite® (20% thiophanate methyl + 50% maneb), a new formulation, was found to be most economical and also effective in minimizing the severity of foliar diseases. Benlate® was very effective in controlling the leaf spots (but not rust), and not economical when compared with Labilite®. Dithane M45® was as economical as Labilite®,

Table 1. Effect of fungicides and number of sprays on leaf spots and seed yield of three groundnut varieties, Msekera Regional Research Station, Chipata, Zambia[1].

Variety	Treatment (rate ha^{-1})	No. of sprays	Leaf spots severity (1-9) 1986/87	Leaf spots severity (1-9) 1987/88	Leaf spots severity (1-9) Mean	Seed yield (kg ha^{-1}) 1986/87	Seed yield (kg ha^{-1}) 1987/88	Seed yield (kg ha^{-1}) Mean	% increase over control
Chalimbana	Control		8.3	8.4	8.4	822	321	571	-
	Labilite® 2 kg	1	5.7	7.0	6.4	1271	426	849	49
		2	5.3	5.3	5.3	1170	574	872	53
		3	3.0	4.0	3.5	1190	870	1030	80
	Benlate® 250 g + Dithane M45® 1.5 kg	1	6.7	6.7	6.7	1289	444	867	52
		2	5.3	5.7	5.5	1243	611	927	62
		3	4.3	4.7	4.5	1232	704	968	70
MGS 2	Control		8.6	8.4	8.4	1175	492	834	-
	Labilite® 2 kg	1	6.0	7.0	6.5	1681	685	1183	42
		2	4.7	4.7	4.7	1621	815	1218	46
		3	3.3	4.0	3.7	1665	833	1249	50
	Benlate® 250 g + Dithane M45® 1.5 kg	1	6.0	7.0	6.5	1487	618	1053	26
		2	4.7	5.3	5.0	1431	778	1105	33
		3	3.7	5.3	4.5	1429	981	1205	44
MGS 3	Control		7.9	8.5	8.2	1008	648	829	-
	Labilite® 2 kg	1	5.0	8.0	6.5	1491	870	1181	43
		2	5.0	5.3	5.2	1407	963	1185	43
		3	2.7	4.3	3.5	1469	1129	1299	57
	Benlate® 250 g + Dithane M45® 1.5 kg	1	6.0	7.7	6.9	1362	889	1126	36
		2	4.7	5.7	5.2	1341	963	1152	39
		3	2.7	5.0	3.9	1389	1055	1222	47
SE			±0.1	±0.1	NA	±36	±25	NA	
CV (%)			11	7	NA	15	19	NA	

1. Mean of three replications in each season, 1986/87 and 1987/88.
NA - Not analyzed.

controlled rust, but was not effective against leaf spots.

Labilite® is not readily available in the country due to foreign-exchange problems. In order to find out an alternative fungicide formulation, two field trials were conducted in the 1986/87 and 1987/88 crop seasons at Msekera Regional Research Station, Chipata, Eastern Province, the major groundnut-growing area in the country. A spray combination of Benlate® (250 g ha^{-1}) and Dithane M45® (1.5 kg ha^{-1}) was compared with Labilite® (2 kg ha^{-1}) on three groundnut varieties: Chalimbana, MGS 2, and MGS 3. The fungicides were sprayed once, at 80 days after sowing (DAS), or twice, at 80 and and 100 DAS, or three times, at 60, 80, and 100 DAS. Citowett® (100% alkylanyl polyglycol ether), a spreading and sticking formulation, was added to the spray liquid at the rate of 0.25 mL L^{-1}. Fungicides were applied as water-based sprays using a knapsack sprayer. The control plots were sprayed with water and Citowett® in the same way. A 3 x 3 x 3 factorial design with three replications was used. Natal Common, a cultivar highly susceptible to leaf spots, was planted 2 weeks earlier between plots and around the trial as spreader rows.

Disease severity (1-9 scale) and defoliation (%) were scored before each spray. The final observations were recorded 15 days before harvest. Yield components, pod number $plant^{-1}$, pod yield, seed yield, shelling percentage and 100 seed mass (g) and seed appearance were also recorded. The summarized results of leaf spots severity and seed yield are presented in Table 1.

Spreader rows of Natal Common provided a uniform disease pressure in all the plots. In both seasons there was a severe epidemic of early leaf spot, but damage by late leaf spot was moderate. The leaf spots caused severe damage to nonprotected control plots of all three varieties (8.2 to 8.4 on a 1-9 scale).

Both the fungicide treatments reduced the leaf spots severity significantly over the control in all the varieties. The overall reduction in disease severity was in proportion to the number of sprays of the fungicide. A similar trend was observed with defoliation. The interaction between fungicides used and the number of sprays was significant for leaf spots severity and the extent of defoliation.

In 1986/87, significant differences in seed yield were found depending on the fungicides and the varieties used, but not on the number of sprays used, perhaps due to the 2-week dry period that occurred during the pod-filling stage in mid-March. In 1987/88, the trial was planted in late December because of a dry spell in early December. This late planting resulted in a relatively low seed yield over that of the first season trial. However, a significant increase in seed yield was recorded between varieties, fungicides, and the number of sprays used. Yields were not significantly different only among some of the spray regimes in MGS 2. In overall performance, Chalimbana, a local variety susceptible to leaf spots, gave the maximum increase in seed yield after fungicide treatments, and was followed by MGS 3 and MGS 2. Subrahmanyam et al. (1984) reported such differences while testing groundnut varieties in a fungicidal screening trial.

All the fungicide treatments performed equally well in controlling the leaf spots and in increasing the seed yield over that of the control. Benlate® + Dithane M45® was as effective as Labilite® in reducing the leaf spots and in increasing seed yield. Since Labilite® is not readily available in the market, this combination spray can be a good alternative, and is being evaluated in both on-farm and on-station trials before being recommended to farmers in Zambia.

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Control of Early Leaf Spot in Groundnut by Treatment with a Select Group of Chemicals

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Much information has been now accumulated to show that many compounds other than conventional plant protection chemicals may provide good protection to plants against a variety of pathogens. Wain and Carter (1972) and Sinha (1984) have reviewed many such cases involving metal salts, amino acids, plant-growth regulators, and other compounds. Previous studies in this laboratory have shown that wet-seed treatment with dilute concentrations of some phytoalexin-inducing compounds and related chemicals can provide rice plants substantial protection from brown spot (Giri and Sinha 1983a,b; Sinha and Hait 1982) and blast diseases. In that context, the aim of the present study was to investigate the effect of seed treatment with some of these chemicals, in pot-grown groundnut plants, against early leaf spot caused by *Cercospora arachidicola* Hori. This is one of the major diseases affecting groundnut crops.

Seeds of a susceptible groundnut cultivar, J 11, were sown in 20 cm earthen pots filled with garden soil mixed with well-decomposed farmyard manure (3:1). Seeds were given presowing treatments by soaking for 24 h in a dilute solution of five chemicals at room temperature. For the control treatment, seeds were soaked in water for the same period. There were four pots per treatment, each with 7-10 plants. None of the treatments had any adverse effect on seed germination or seedling growth. To test the effect of these treatments on natural infection, pots with 2-week-old plants were placed at random between the rows of groundnut plants in a field already infected with early leaf spot. The disease intensity on each leaf was visually scored on a 0-5 scale (0 = no infection, and 5 = leaf totally affected or dead), 60 days after sowing, and expressed in terms of a disease index per leaf.

In the first experiment, plants in all five treatments recorded significantly lower (57-71%) severities (P = 0.01), as compared to those in the control treatment (Table 1). The best effect was recorded with cycloheximide, and the least with 2,4-dichlorophenoxyacetic acid (2,4-D), the difference between their effects being significant. The other three chemicals, 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), indole-3-acetic acid (IAA), and cycocel ([2-chloroethyl] trimethyl ammonium chloride) had intermediate effects, not significantly different from that of either cycloheximide or 2,4-D.

In the second experiment, run on similar lines, the first four chemicals were used with a range of three concentrations each, and cycocel with two concentrations only, with a view to determine their optimum concentration and also to reexamine the earlier observations. Disease severity was significantly reduced (P = 0.01) in all the treatments (46-67%) (Table 2). Results in general confirmed the earlier observations. No graded concentration effect was apparent for any of the five chemicals tested. Stronger effects were mostly recorded with the middle concentration, i.e., 10^{-6}M for cycloheximide, 2,4,5-T, and 2,4-D, and 10^{-4}M for IAA. For cycocel, a stronger effect was achieved with the lower (500 ppm) of the two concentrations tested.

It appears that the wet-seed treatment with the five compounds, not normally used for plant protection and also having no or little fungitoxicity at the concentrations employed, can considerably limit early leaf spot development in groundnut. There is little direct relationship between the concentrations of these chemicals and their protective effects. These observations coupled with the fact that test compounds show a fairly strong effect at rather dilute concentrations imply that in controlling early leaf spot these chemicals may have acted by conditioning susceptible groundnut plants for a more vigorous and dynamic defence response to the pathogen. Such conditioning of the host may have been based on the activation of its latent defence potential that normally remains suppressed in a compatible host-pathogen interaction, and this would mean induction of resistance. This appears to be a new approach for disease control in groundnut that merits further exploration.

Table 1. Effect of seed treatment with five chemicals on early leaf spot development in pot-grown groundnut plants (cv J 11) exposed to natural inoculum, Kalyani.

Treatment	Concentration	Mean disease index $leaf^{-1}$
Water (control)		2.1
Cycloheximide	10^{-6} M	0.6 (-71.4)[2]
2,4,5- trichlorophenoxyacetic acid	10^{-6} M	0.8 (-61.9)
2,4-dichlorophenoxyacetic acid	10^{-6} M	0.9 (-57.1)
Indole-3- acetic acid	10^{-4} M	0.8 (-61.9)
Cycocel	500 ppm	0.7 (-66.7)
CD (P = 0.05)		0.26
CD (P = 0.01)		0.36

1. Symptoms were assessed 60 days after sowing; results are based on 30-35 plants in four pots.
2. Values in parentheses indicate percentage reductions in terms of control.

Table 2. Effect of seed treatment with chemicals on early leaf spot development in pot-grown groundnut plants (cv J 11) exposed to natural inoculum, Kalyani.

Treatment	Concentration	Mean disease index leaf^{-1}
Water (control)		2.4
Cycloheximide	10-5M	1.0 (-58.3)[2]
	10-6M	0.8 (-66.7)
	10-7M	1.1 (-54.2)
2,4,5-trichlorophenoxyacetic acid	10-5M	1.3 (-45.8)
	10-6M	0.9 (-62.5)
	10-7M	1.0 (-58.3)
2,4-dichlorophenoxyacetic acid	10-5M	1.1 (-54.2)
	10-6M	0.8 (-66.7)
	10-7M	1.0 (-58.3)
Indole-3-acetic acid	10-3M	1.1 (-54.2)
	10-4M	0.9 (-62.5)
	10-5M	1.2 (-50.0)
Cycocel	500 ppm	0.9 (-62.5)
	1000 ppm	1.1 (-54.2)
CD (P = 0.05)		0.13
CD (P = 0.01)		0.18

1. Symptoms were assessed 60 days after sowing; results are based on 32-35 plants in four pots.
2. Values in parentheses indicate percentage reductions in terms of control.

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Screening Groundnut Genotypes for Seed Transmission of Peanut Stripe Virus

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Peanut Stripe Virus (PStV), formerly reported as peanut mild mottle virus, is one of the most economically important groundnut viruses in the People's Republic of China. Groundnut plants infected by seed transmission appear to provide the primary inoculum source. Over 700 groundnut germplasm lines were screened for seed transmission of PStV in 1987 and 1988, in the Oil Crops Research Institute, Wuhan. PStV-infected genotypes were obtained from epidemic areas. Over 60 seeds of each genotype were tested by growing out tests in a greenhouse. They were infected by PStV 8 and 9 weeks after sowing. Genotypes which failed to show any external PStV symptoms in the growing out tests were later tested by a simple indirect enzyme-linked immunosorbent assay (ELISA) and direct antigen coating (DAC) procedure (Hobbs et al. 1987). Small portions of cotyledons were dissected from each seed for ELISA-DAC tests. Preliminary results showed complete correlation between ELISA-DAC and growing out tests.

The average rate of PStV seed transmission in 229 groundnut lines tested was 4.7% in initial screening in 1987. Most genotypes showed seed transmission ranging from 2% to 10%. Nevertheless seed transmission as high as 23.3% was noticed. Thirty-four genotypes, which showed less than 5% seed transmission, were screened again. Only three genotypes showed less than 1% seed transmission. Interestingly two of these genotypes showed no seed transmission to peanut mottle virus (D.V.R. Reddy, personal communication, 1989). The average rate of PStV seed transmission in 500 groundnut genotypes was 8.6% in the initial screening in 1988. The majority of genotypes showed seed transmission ranging from 5% to 20%. Over 100 genotypes were further screened by the ELISA-DAC test, and nine genotypes which showed less than 1% of PStV seed transmission were identified (Table 1). The genotype F 87-358 (148-7-4-3-12-8 x NC Ac 17090, a PMV-nonseed transmission line from ICRISAT) continued to show low seed transmission (2/342, or 0.58%) in tests conducted in 1988. We are currently retesting all the promising genotypes which showed less than 1% seed transmission.

Table 1. Groundnut genotypes showing less than 1% of PStV seed transmission in the People's Republic of China, 1988.

	Rates of PStV seed transmission	
Field no. of the line	No.of seeds tested	Groundnut seed infection (%)
F 87-358	185	0.54
F 87-357	111	0.9
F 87-225	111	0.9
F 88-158	215	0.0
F 88-313	129	0.0
F 88-456	393	0.25
F 88-448	259	0.39
F 88-082	213	0.47
F 88-166	306	0.66
F 88-037	150	0.67
F 88-222	147	0.68
F 88-442	132	0.76

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Recent Entomological Studies on Groundnut in Zambia

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In Zambia, many insects have been known to infest groundnut, but very little information exists on their economic importance and on the scope for minimizing the damage they cause. Entomological studies on groundnut, undertaken during the 1987/88 season by the Food Legume Research Team in Zambia, are briefly discussed in this report.

Samples of insects found infesting groundnut at Msekera, Eastern Province, were periodically collected and sent to the Commonwealth Agriculture Bureau International Institute of Entomology (CABIIE), London, for identification. New records were established for three genera each of grasshoppers and leafhoppers. The grasshoppers were identified (by J.P. Grunshaw), ODNRI, London) as *Zonocerus elegans* (Thunberg), and *Acanthacris* sp, besides an undetermined genus of Canatopinae. The three genera of leafhoppers (identified by W.R. Wilson, CABIIE, London) were *Exitianus* sp, *Signoretia* sp, and *Broctomorphus* sp, which are known to be mostly associated with grasses or forest plants (W.R. Wilson, personal communication). The leafhopper genus *Empoasca* is known to occur on groundnut in Zambia, Zaire, Zimbabwe, and Malawi. (Sithanantham et al. 1989).

It needs to be ascertained whether the three genera now recorded are regular pests, or only transient feeders on groundnut in the absence of their preferred hosts.

A roving survey of the severity of damage by different pests on groundnut was undertaken during the crop maturity stage in April 1988, in the Eastern Province, which is the major crop growing area in the country. In seven districts 32 farmers' fields were inspected. In each field, the severity of damage by sucking pests, defoliators, and soil pests was visually scored on a 1-9 scale, in four plots of 1 m^2 each. The damage by sucking pests (mainly by leafhoppers, and to a lesser extent by whiteflies and thrips) ranged from 3 to 7. Their severity appeared to be more (scores of 5 and above) in Chipata South, Katete, Lundazi, and Mambwe districts. Soil pests (mostly termites and to a lesser extent whitegrubs, wireworms, and millipedes) appeared to be next in importance, with a severity rating of 1-4. Their damage seemed to be somewhat higher in Katete and Petauke districts. Defoliating pests appeared to be the least important, the range in their damage rating being 1-3. Within this group, however, grasshoppers were the most common, followed by beetles, while caterpillar damage was very limited.

On-station replicated trials conducted at Msekera (plateau system) and at Masumba (valley system) yielded estimates of avoidable losses due to the pest groups. The improved variety MGS 2 performed better than the local varieties, Chalimbana at Msekera, and Makulu Red at Masumba (Table 1). More details of these studies on soil pests are described elsewhere (Sithanantham 1988).

Some of the available groundnut genotypes (30), received earlier from ICRISAT as being resistant/tolerant to individual pests, were grown in single row replicated trials along with local controls and infestor rows both at Msekera and Masumba. The severity of sucking pest (mostly leafhopper) damage on a 1-9 scale ranged from 2.0 to 6.5 at Msekera, and from 1.0 to 6.0 at Masumba. Two entries, ICG 485 and ICG 5044, had distinctly low ratings for this pest group at both the sites. Similar low ratings against defoliating pests (mostly grasshoppers) were recorded by ICG 485, ICG 5043, and ICG 2537. The severity of soil pest damage was not adequate (rating range 1.0 to 2.5) to distinguish the susceptibility levels. Efforts will be made to augment soil pest infestation in future trials.

Similar trials conducted at Msekera with 16 high yield/quality selections, each of short and long duration, revealed that ICG 4790, ICGMS 11, HYQ (CG) S-10, Tifspan, and Robut 33-1 were promising against sucking-pest damage, while relatively low damage by soil pests was also observed in ICG 4790, HYQ (CG) S-10, in ICGM 289, and Swallow. Robut 33-1 appeared to suffer more pod scarification (by termites), which needs verification, since this may lead to a greater aflatoxin problem.

In addition to these trials, visual ratings were made for sucking pest (mostly leafhopper) damage in the germplasm at Msekera. Out of 562 alternate branching, 11 were distinctly less damaged, and out of 413 sequential branching accessions, 19 were less damaged. Similar ratings at Msekera and Masumba in breeder's advanced/SADCC variety trials, totalling 130 entries, and in the foliar-disease screening nursery, showed 21 entries to be promising against sucking pests, 17 against pod scarification (by termites), and 12 against pod damage by other soil pests.

An on-station trial at Msekera, in which four insecticides were applied to the soil at sowing (at 2 kg a.i. ha^{-1}), showed that carbofuran application resulted in a significant overall increase in seed yield of 75%, and chlorpyriphos application resulted in an 55% increase. However, the economic returns per Kwacha invested were distinctly more for the latter. Efforts are being made to determine the residue levels in seed at harvest, so as to decide the safety of such insecticide use to consumers.

Fifteen on-farm trials, three each in five districts of Eastern Province, were conducted to compare the soil-insect incidence in nonprotected plots with that in plots receiving a basal application of dieldrin (2 kg a.i. ha^{-1}). The overall extent of termite incidence in protected plots was about 70% less than in nonprotected plots. However, the overall avoidable loss was only less by 10%, perhaps due to other secondary adverse effects of the insecticide on the plant.

Table 1. Estimation of avoidable yield losses due to pests in on-station trials at Msekera and Masumba, Zambia, 1987/88.

Location	Cultivar	Yield losses (%)	Value in Zambian Kwachas ha^{-1}	Equivalent to U.S.$ ha^{-1}	Pests
Msekera	Chalimbana	12	1120	112	Foliage pests
		14	1170	117	Soil pests
	MGS 2	6	560	56	Foliage pests
		11	1090	109	Soil pests
Masumba	Makulu Red	16-30	860-2000	86-200	Soil pests
	MGS 2	11-16	880-1370	88-137	Soil pests

Acknowledgments

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An Inert Dust Protects Stored Groundnut from Insect Pests

S. Mittal and **J.A. Wightman** (ICRISAT Center)

It is anticipated that as ICRISAT and other organizations help to improve and stabilize groundnut production there will be a greater need to protect the seed and pods from storage pests. Insecticides and fumigants can be hazardous, expensive, and nonavailable, and may need sophisticated equipment to apply them. We have demonstrated how a cheap and inert clay dust, "attapulgite-based clay dust" (ABCD), supplied by M.K.H. Siddiqui of the Central Research Laboratory, Hyderabad, India, protected pods and seeds from three species of storage pests.

Table 1. The mean number of larvae ± pupae ± adult *Corcyra cephalonica, Tribolium castaneum,* and *Caryedon serratus* after 40, 80, and 120 days on groundnut seed or pods treated with attapulgite-based clay dust, ICRISAT Center, summer 1988.

Storage pest	Mean no. of larvae ± pupae ± adults observed per tube: Days after setting the trials — 40 days T	40 days C	80 days T	80 days C	120 days T	120 days C
Corcyra cephalonica	0.2 ±0.9	10.0 ±0.9	0±0	116 ±21.1	0±0	TSD
Tribolium castaneum	0.05 ±0.05	4.5 ±0.8	0±0	6.3 ± 1.9	0±0	12.7±4.3
Caryedon serratus	4.1 ±0.6	11.4 ±0.8	8.8±0.8	45.4 ± 2.5	6.5±3.5	90.3±5.7

T = treated; C = control.
TSD = Total seed damage.

Ten grams of ABCD were thoroughly mixed with 2 kg of groundnut seed (cv TMV 2). This mixture was placed in plastic containers measuring 8 x 5 cm (dia) in 40 g aliquots. A duplicate (control) set of containers was prepared in which nondusted seed had been placed. Fifty eggs, less than 24 h old, of either *Tribolium castaneum* or *Corcyra cephalonica*, were placed in the containers. Each treatment was replicated 20 times.

Pods colonized by *Caryedon serratus* were obtained by placing 500 g of TMV 2 pods in a glass jar with 50 beetles. After 48 h, 400 pods with eggs were separated and divided into two batches of equal size. One batch was treated with ABCD dust (0.5% w/w), and the other was left nontreated. Treated and control batches were divided into lots of 20, and placed into 8 x 5 cm tubes. The number of insects in all tubes were counted after 40, 80, and 120 days.

The results (Table 1) show clearly that the dust had a marked effect on the ability of the insects to survive and reproduce. All the *C. cephalonica* and *T. castaneum* were dead by 80 days where the seed had been treated. *C. serratus* had some capacity to survive the treatment, presumably because the larvae develop within the pods and are therefore protected. However, the data show that the exponential population growth rate that was evident in the control vials had been prevented by the clay dust.

We recommend to scientists in the national agricultural research systems of countries where groundnut is grown and stored on the farm or in centralized warehouses to evaluate these data in the context of the current and potential need for a cheap and effective method of protecting the product from pests. These data indicated that the implicit methodology is worth evaluating on a larger scale.

Mulching Effects on Termite Scarification of Drying Groundnut Pods

C.S. Gold, J.A. Wightman, and **M. Pimbert** (ICRISAT Center)

Termites are important pests of groundnut in Africa and Asia. Plant mortality and/or reduced yields result(s) from tunneling in tap roots and stems, defoliation, attack of pegs, scarification of pods--with associated increases in aflatoxin contamination; (see cover photo), and consumption of drying haulms.

Termites are social insects with high reproductive rates. The location and destruction of subterranean nests is difficult while mortality to foraging termites may have little effect on colony size and provide only limited control. Therefore, termite control has relied heavily on prophylactic barriers through application of persistent chemical insecticides. Concern about harmful side effects to human beings and the environment has created an interest in alternative control measures.

This paper reports results from a preliminary trial using mulches to protect drying groundnut pods against scarification by *Odontotermes* spp and/or *Microtermes obesi*.

Five treatments (a bare ground control, and mulches of sunn hemp, *Celosia argentea*, neem cake, and *Ipomoea fistulosa*) were placed in a split-plot design with 20 replications. Three-hundred g of groundnut pods (cv Robut 33-1) were placed either on, or mixed in, mulches while pods were placed directly on the ground in control plots. Plot size was 2 x 0.5 m. Mulch depth was 2.5 cm for neem cake and 5.0 cm for the other treatments.

Presence or absence of termites in study plots was noted on three occasions (29, 36, and 49 days after mulching) (Fig. 1). Termites were present in 50 to 70% of control plots (presumably attracted by groundnut pods). Termites were rarely present in neem cake and uncommon in *Ipomoea* mulches. In contrast, both genera of termites fed on sunn hemp leaves and were encountered in all plots containing this mulch. Termites were common initially in *Celosia* plots but declined at later sampling dates. Termites did not appear to feed on Ipomoea or *Celosia*.

Scarification was observed soon after pods were placed in the field and, presumably, continued for the duration of the trial. Both *Odontotermes* and *Microtermes* were observed within sheeting of scarified groundnut pods suggesting that both genera are responsible for scarification. Pods were collected 49 days after mulching and scored 0 - 4 (where 0 = no damage, 1 = 1-25%, 2 = 26-50%, 3 = 51-75%, and 4 = 76-100% damage) for scarification levels. Analyses were conducted on percentage of pods with scarification and damage levels.

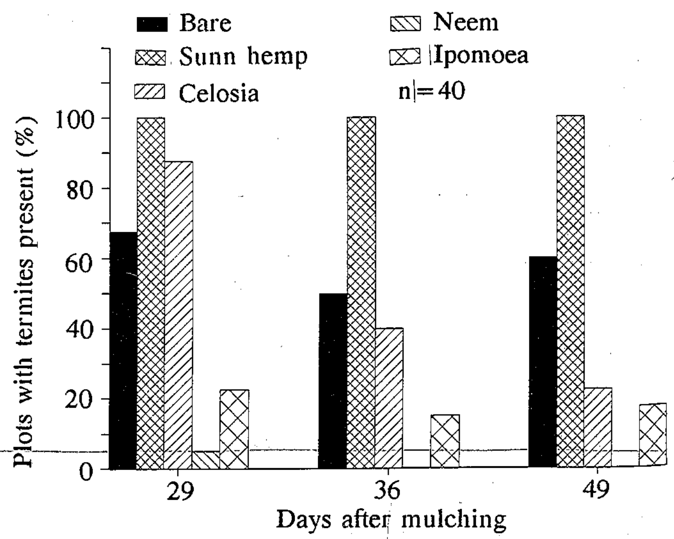

Figure 1. Termite incidence in control and mulched plots.

Damage to groundnut pods in the neem cake and *Ipomoea* treatments was negligible (Table 1). In contrast, 36% of the pods in the control plots were scarified with an average 22% of the surface area (for all pods) damaged. Sunn hemp mulches increased termite damage, relative to control plots, while damage in *Celosia* mulches was intermediate. Additionally, damage levels were lower for pods placed on top of, rather than mixed in, the mulches.

Low levels of termites in neem cake and *Ipomoea* mulches suggest these substances act as repellent barriers between the soil and groundnut pods. The absence of termites 49 days after mulching and negligible scarification levels in the same treatments further suggest that these effects may persist over many weeks. If so, this would be an important property since termites are primarily "end of season" pests. Mulches incorporated into the soil at planting might later protect groundnut pods from termite attack.

Studies are currently being conducted at ICRISAT Center to elucidate the mechanisms by which neem cake and *Ipomoea* may reduce termite damage and how these findings might be applied to farmers' fields.

Table 1. Termite damage of groundnut pods in different mulch treatments at ICRISAT Center, Jan to Mar 1989. (Split-plot design, n = 20).

Position of pods	Pods scarified (%)	Scarification rating[1]
On top of mulch	20 (.21)[2]	0.50
Mixed in mulch	28 (.31)	0.75
F value	27.34**	24.39**
SE	±(.01)	±0.04
CV (%)	50.8	58.2
Treatment		
Bare ground	36 (.37)	0.88
Sunn hemp	59 (.66)	1.69
Celosia	17 (.17)	0.38
Neem cake	2 (.02)	0.04
Ipomoea	7 (.07)	0.14
F value	156.35**	118.67**
SE	±(.02)	±0.06
CV(%)	(54.7)	63.1

1. Scored on a scale of 0 to 4, where 0 = no damage; 1 = 1-25%; 2 = 26-50%; 3 = 51-75%; 4 = 76-100% of shell scarified.
2. Numbers in parentheses: arcsine transformed values of radians.

Recent ICRISAT Publications

The publishing address for each publication is: ICRISAT, Patancheru, Andhra Pradesh 502 324, India.

ICRISAT. 1989. Summary and recommendations of the Asian Region Groundnut Scientists' Meeting, 14-17 Nov 1988. MARIF, Malang, Indonesia. Patancheru, A.P. 502 324, India: ICRISAT.

ICRISAT. 1989. Groundnut Variety ICGS 11 (ICGV 87123). Plant Material Description no.20 (ISBN 92-9066-151-8). (Supplied gratis.)

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ICRISAT. 1989. Linking grain legumes research in Asia: Summary Proceedings of the Regional Legumes Network Coordinators' Meeting, 15-17 Dec 1988, ICRISAT Center, India. Patancheru, A.P. 502 324, India: ICRISAT.

ICRISAT. 1989. Annual Report 1988. Patancheru, A.P. 502 324, India: ICRISAT.

Aflatoxin contamination of groundnut: proceedings of the International Workshop

Following the workshop in October 1987, and a recommendation made at the meeting, a short document containing an overview of the problem, summaries of all the papers, reports of working groups, and recommendations was published in English, French, and Spanish, and widely circulated.

The full 432-page proceedings is now available from ICRISAT Center. It contains a general overview of the problem of aflatoxin contamination of groundnut, and over 40 papers grouped to cover the following topics: importance of aflatoxins, aflatoxins and trade, monitoring and action at the national level, removal of aflatoxins, methods for aflatoxins analysis, general research on aflatoxin contamination, and genetic resistance.

Also included are group discussion reports on: evaluation and monitoring of contamination of groundnuts and groundnut products, analytical methods, research on on-farm control of aflatoxin contamination, and research on control with reference to storage, transit, and processing. Recommendations cover information and training, strategies for control, and future research needs. Overview, summaries, group discussion reports, and recommendations, are in English, French, and Spanish.

All workshop participants and authors will receive a copy of the full proceedings, as will any library that regularly receives copies of all ICRISAT publications. If any other readers would like to buy a copy, they are available from Information Services, ICRISAT, Patancheru, Andhra Pradesh 502 324, India. Price LDC, $21.60; HDC, $64.80; and India, Rs 331.00. If you would like to receive a copy of the Summary and Recommendations, a few are still available in all three languages from the same address.

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5. Professional Qualifications(Highest Degree/other) PhD [ ] MA/MS [ ] BA/BS [ ]
   High School/Diploma [ ] Other .....
6. Institute/Organization
7. Street Address
8. City
9. State/Province
10. Postal/Zip code
11. Country
12. Telex No.
13. Cable Address
14. Telephone Number (Office)
15. Telephone Number (Residence)
16. If you are a member of a Computer-Based Messaging System or
    Electronic-Mail System please give your CBMS address.
17. Nationality
18. First Language

Relationship with ICRISAT: If you have contacts with ICRISAT, please give name(s) of contact person(s)

19. Contact 1
20. Contact 2
21. Contact 3

and indicate if you are or were

22. ICRISAT Staff (give details and dates)
23. Collaborator with Legumes Program (give details and dates)
24. Collaborator with ICRISAT (give details and dates)
25. Consultant to ICRISAT (give details and dates)
26. Visitor (give details and dates)
27. Trainee (give details and dates)
28. Member of AGLN

Please indicate a maximum of three of the major interests listed overleaf (enter letters selected from A to I) [ ] [ ] [ ] and a maximum of five specific interests (enter numbers selected from 11 to 95). Your specific interests need not be confined to the major interest groups you have selected. [ ] [ ] [ ] [ ] [ ]

Which ICRISAT Publication do you find most useful?
Which ICRISAT Service do you find most useful?
What activity occupies most of your time?
Administration ( ) Research ( ) Teaching/Training ( ) Extension ( ) Other ....
What percentage of your time do you spend working with Arachis? ( )
List a maximum of three of your publications relevant to Arachis (You may send a complete list of your publications, if you wish).

A. *Breeding*

11. Confectionery breeding
12. Disease-resistance breeding
13. Pest-resistance breeding
14. Adaptation breeding
15. Nutrition and food quality
16. Genetic studies
17. Mutation breeding
18. Breeding methodology

B. *Cytogenetics*

21. Cytology
22. Haploids
23. Aneuploids
24. Wild species
25. Wide crosses
26. Tissue culture
27. Transformation
28. Protoplasts

C. *Physiology/Microbiology*

31. Water stress
32. Drought screening
33. Nitrogen fixation
34. Mineral nutrition
35. Photoperiod studies
36. Climate and environment
37. Temperature tolerance

D. *Pathology*

41. Fungal diseases
42. Aflatoxin
43. Bacterial diseases
44. Nematodes
45. Deficiency and toxicity diseases
46. Foliar diseases
47. Pod and soilborne diseases
48. Disease control
49. Surveys

E. *Virology*

51. Characterization
52. Identification
53. Detection
54. Classification
55. Transmission
56. Cultural control
57. Sources of resistance
58. Integrated management
59. Surveys

F. *Entomology*

61. Taxonomy
62. Bionomics
63. Ecology
64. Varietal resistance
65. Chemical control
66. Cultural control
67. Cropping systems
68. Integrated pest management
69. Insect vectors

G. *Genetic resources*

71. Collection and assembly
72. Evaluation
73. Maintenance and conservation
74. Documentation

H. *Agronomy*

81. Soil and crop management
82. Fertilizer response
83. Interculture
84. Plant population
85. Rotations
86. Harvesting, seed technology, postharvest management
87. Irrigation and water management
88. Tolerance of adverse soils
89. Machinery

I. *Other*

91. Training
92. Extension
93. Library science/Information technology
94. Sociology or Anthropology
95. Other

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