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9. ABSTRACT
A PROJECT: To convert exotic lines of sorghum onto disease and insect resistant lines for use in temperate climates. Sorghum, one of the principal food and feed commodities of the world, has long been subject to such diseases as head smut, downy mildew, maize dwarf mosaic, anthracnose, charcoal rot, Fusarium stalk rot, and several common foliage diseases, and to insect losses from the sorghum midge, greenbug, banks grass mite, white grubs, sugarcane aphid. The Texas Agricultural Experiment Station initiated the research.
DURATION: February 1974 - February 1977
DEVELOPMENTS: This report describes activities conducted in this A.I.D. supported program during 1976-1977. Sources of new germplasm were supplied from converted and partially converted exotic sorghums. Disease and insect resistant dwarf height photoperiod insensitive sorghums were combined in random mating populations for easy distribution to sorghum improvement programs in LDCs and as research tools for improvement of grain sorghum in temperate regions. Breakthroughs have been achieved in development of greenbug resistant hybrids, high levels of midge resistance, and possible resistance to spider mites. Some of the disease and insect resistant sorghums have extraordinary general adaptivity. During the past year, several lines possessing tropical adaptation were identified and distributed for testing in a tropical nursery. A data management system was developed to permit more rapid summarization and distribution of cooperative international research findings.

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ANNUAL REPORT

on

Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance

Contract No. AID/ta-c-1092

February 15, 1976 - February 28, 1977

Prepared by

Texas Agricultural Experiment Station
Department of Plant Sciences
Department of Entomology
College Station
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Texas Agricultural Experiment Station
Lubbock

Submitted to

Agency for International Development
Department of State
Washington, D. C.

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REPORT SUMMARY

A. 1. Project Title and Contract Number: Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance: Contract Number AID/ta-c-1092

2. Key Investigators:

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3. Contract Period: February 15, 1974 - February 28, 1977
4. Period covered by report: February 15, 1976 - February 28, 1977
5. Total AID funding of contract to date: $279,946
6. Total expenditures and obligations through previous contract year: $274,117.71
7. Total expenditures and obligations for current year: $124,171.71*
   Estimated: $130,000
8. Estimated expenditures for next contract year: $290,000

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*Does not include encumbrances.

B. Narrative Summary of Accomplishments and Utilization

During 1976, research toward the development of disease and insect resistant sorghums was expanded and advanced one generation.

Pests and diseases reduce yields and lower quality of tremendous quantities of grain sorghum throughout the world each year. Sources of resistance to most of the major sorghum diseases, insect, and arthropod pests are identified through national and international testing programs. These include head smut, downy mildew, maize dwarf mosaic, anthracnose, root and stalk rots, grain mold or seed weathering, several foliar diseases, sorghum midge, greenbug, corn leaf aphid, and grass mites.

Sources of new germplasm were supplied from converted and partially converted exotic sorghums. Disease and insect resistant, dwarf height, photoperiod insensitive sorghums were combined in random mating populations both for easy distribution to sorghum improvement programs in LDC's and as research tools for improvement of grain sorghum in temperate regions. Development of greenbug resistant hybrids, the discovery of high levels of midge resistance, and possible resistance to spider mites are new major breakthroughs in sorghum improvement. Some of these disease and insect resistant sorghums have extraordinary general adaptation. During the past year several lines possessing tropical adaptation were identified and have been distributed for testing in a tropical adaptation nursery.

A data management system for more rapid summarization and distribution of internationally cooperative research was prepared.

ANNUAL RESEARCH REPORT

A. General Background

Sorghum (*Sorghum bicolor* (L.) Moench) is one of the principal food and feed commodities of the world. Sorghum is considered by many authorities as the third most important food grain, exceeded in utilization for food only by wheat and rice. Furthermore, sorghum is well adapted to cultivation under wide extremes in environmental conditions including arid, semi-arid, and sub-tropical areas of the world where other food commodities are often less well adapted.

In southwestern USA, where sorghums are a principal argicultural commodity, serious disease and insect problems have occurred repeatedly. During the past few years, there have been grave losses caused by head smut (*Sphacelotheca reiliana*); downy mildew (*Sclerospora sorghi*); maize dwarf mosaic (MDMV); anthracnose (*Colletotrichum graminicola*); charcoal rot (*Macrophomina phaseoli*); Fusarium stalk rot (*Fusarium moniliforme*); and a number of common foliage diseases.

Insects causing significant yield losses in grain sorghum annually are the sorghum midge (*Contarinia sorghicola*) and greenbug (*Schizaphis graminum*). Banks grass mite (*Oligonychus pratensis*) is a severe problem in the great plains region. Economically injurious insects that appear to be increasing in severity and distribution are white grubs (*Phyllophaga crinita*), sugarcane rootstalk weevil (*Anacentrinus deplanatus*), corn leaf aphid (*Rhopalosiphum maidis*), and yellow sugarcane aphid (*Sipha flava*). Consequently, the need for superior sources of disease and insect resistance in sorghums is urgently needed in Texas as well as

throughout the world.

In 1963, the Texas Agricultural Experiment Station and the United States Department of Agriculture initiated a program whereby exotic sorghums from the World Sorghum Collection were converted from tall, late maturing, photoperiod-sensitive types to shorter, earlier maturing, less photoperiod-sensitive lines. Conversion is accomplished by a crossing and backcrossing program using the short winter days of Puerto Rico for crossing and growing F_1's, with selection for short, early plants within segregating populations during the long summer days in Texas. Many exotic lines have been reported to be resistant to a number of diseases and insects, but until converted or partially converted, most of these lines are not available for use in temperate areas of the world. During the conversion process, we have been able to evaluate resistance from some partially converted exotic sorghums to diseases prevalent in the United States and to some insects. Some of these sorghums possess extraordinarily high levels of disease and insect resistance.

B. Statement of Project Objectives

1. To identify and define potential sources of multiple disease resistance and insect resistance in partially converted and converted exotic sorghums.
2. To develop agronomically elite populations of sorghum with high levels of multiple disease resistance and insect resistance.
3. To experimentally evaluate effectiveness and types of disease

resistance from lines obtained through primary screening and from artificially synthesized populations.

4. To develop uniform methods of determining insect and disease resistance and to study, where appropriate, mechanisms of resistance.

C. Continued Relevance of Objectives

Clearly, the objectives are part of an on-going program which has been actively developing at the Texas Agricultural Experiment Station for the past 12 years. These objectives complement a broad-ranged, interdisciplinary research program which recognizes the importance of developing agronomically adapted, disease and insect resistant sorghum cultivars. Until very recently, the limited germplasm resources have restricted sorghum improvement; however, the recent development of converted and partially converted exotic sorghums at the Texas Agricultural Experiment Station is opening tremendous opportunities for sorghum improvement.

These objectives are a sound and vital component of sorghum improvement for agriculture. They represent areas that need research and the findings and progress of this research will have application throughout the world.

D. Accomplishments to Date

Disease data were collected from the major screening nurseries throughout Texas. These included downy mildew, head smut and foliar

diseases on most of the 4,000 entries in the Berclair Head Smut Nursery and the nearly 7,000 entries at Beeville. Duplicate "race 4" head smut nurseries of 2,400 entries were evaluated at Edna and Halfway, Texas. Because of the extremely wet late summer, extensive grain mold developed providing an excellent opportunity to evaluate a number of selections for resistance from this disease-environment complex.

Essentially all of the early generation, advanced generation, partially converted and pedigree breeding materials were grown in one of the five major disease nursery sites in 1976. The head smut evaluations and seed molding, germination in the head, and weathering were among the most useful evaluations made during this growing season. Lists of converted and old lines with resistance to race 4 of Sphacelotheca reiliana and excellent comparisons of the performance of grain mold resistant hybrids with susceptible counterparts were possible.

At Lubbock, large nurseries were specifically planted for lodging and MDM evaluation. Also, other nurseries of regular breeding material were evaluated for disease and insect resistance, yield, adaptation, grain quality, and standability.

Three duplicate midge screening nurseries containing 3,000 plots each were grown at Beeville, Corpus Christi and Lubbock, Texas. Observations were made for midge resistance, disease resistance, general adaptation and yield potential. Fifteen hundred selections were made that had high levels of midge resistance and that were improved agronomically over their midge resistant parent. Selections with high levels of midge resistance were made from the random mated population TP8. These

S_1's will be evaluated and recombined in 1977.

Insect screening nurseries were also grown at Corpus Christi, Beeville, and College Station, Texas and Tifton, Georgia in 1976. One hundred converted exotic lines were screened for sorghum midge and sorghum webworm resistance. Based on damage ratings, previously identified midge-resistant lines continued to show good resistance levels. Several additional resistant lines were identified and will be reevaluated in 1977. Evaluations for sorghum webworm resistance in the 100 lines were based on infestation levels. A positive relationship was shown to exist between webworm numbers and sorghum headtightness. The relationship appeared to be sigmoidal.

The concept and identification of tropical adaptation (TA) in temperate zone sorghums has added to the realization that sorghum is a strongly adaptive species. The use of alien germplasm in combination with temperate types and a strong selection program in tropical, semi-tropical, and temperate regions, has benefited the overall adaptability of sorghum in Texas. The Texas Agricultural Experiment Station released three tropically adapted temperate zone female lines in 1977. Hybrids with these females have substantially increased yields in test plots in Puerto Rico, Guatemala, Mexico, and South Texas, while producing above average yields in Central and North Texas, and Nebraska. The overall grain quality of these sorghums is good and leaf disease resistance is excellent. These females have sweet stems and large leaves making them useful as forage parents also. They possess resistance to sorghum downy mildew and head smut (except *Sphacelotheca reiliana* race 4).

Tropical adaptation is being transferred to many other lines and vigorously selected for among partially or fully converted sorghums out of the SC program. Tests of TA materials have been made at approximately 15 locations in the U.S. and five locations in Central and Latin America. This ability to grow and select progenies in diverse environments has broadened the utility of sorghum as a higher yielding grain crop.

The IDIN, a 30-entry test composed primarily of the best multi-disease and insect resistant sorghums with appropriate elite sorghum for standard controls and disease differentials (Table 1) was mailed to cooperators at 16 locations in 12 regions. Data to date were received from two locations in two countries: Senegal and Egypt.

Some nursery results will be received later because of timing of growing seasons with seed distribution but others unfortunately were lost.

Several Texas lines were entered in the 1976 International Sorghum Downy Mildew Nursery (ISDMN) assembled and distributed by ICRISAT. Two lines, QL-3 and SC 120-14, remained completely free of systemic downy mildew at three sites in India, the only ones reported to date.

Other Texas entries	Mean % incidence
SC 170-12	1.47
SC 239-14	2.13
SC 110-14	3.84
TAM 428	4.18
SC 108-14	4.28
SC 414-12	5.60
SC 120-6-8-8	6.71
SC 170-6-17	7.21
SC 175-14	7.92
NSA 440-12	8.32
TAM 2566	8.45
SC 599-6-3	10.14
SC 423-14	11.92
QL 3	0
120-14	0

TAM 428 and SC 110-14 were entered in ICRISAT's 1976 International Sorghum Leaf Disease Nursery. Data from four locations in India and West Africa indicated that TAM 428 was resistant to leaf blight, zonate leaf spot, rust, and rough leaf spot, and SC 110-14 was resistant to leaf blight, zonate leaf spot and rough leaf spot.

Disease reactions for entries in the IDIN for the past three years are summarized in the Third Annual Progress Report on the Development of High Yielding Sorghums with Disease and Insect Resistance.

Table 1. International disease and insect nursery (IDIN), 1976

Entry no.	Designation	IS no.	Variety, kind, or group
1	SC 56-14	12568	Cau-Nig
2	SC 103-12	2403	Caudatum
3	SC 108-14	12608	Zerazera
4	TAM 428 (110-9)	12610	Zerazera
5	SC 110-14	12610	Zerazera
6	SC 112-14 (uc)	12612	Zerazera
7	SC 120-14-1	2816	Zerazera
8	SC 170-6-8-8 (4252)	12661	Zerazera
9	SC 170-6-17 (4267)	12661	Zerazera
10	SC 173-12-6	12664	Zerazera
11	TAM 2566 (175-9)	12666	Zerazera
12	SC 175-14	12666	Zerazera
13	SC 237-14	3071	Dobbs
14	SC 239-14	3574	Zerazera
15	SC 326-6	3758	Nigricans
16	SC 414-12E-P1	2508	Cau-Kaf
17	SC 423-14 (2680)	2579	Zerazera
18	SC 599-6-3 (9247)	--	Rio
19	SC 599-6-10 (9188)	--	Rio
20	SC 748-5-3	3552	Cau-Guin
21	NSA 440-12	--	Kafir der.
22	(B 3197 x SC 170-6)(1753)	--	Kafir-Zera der.
23	(SC 599-6 x SC 134-6)(1880)	--	Rio-Dur Doc der.
24	QL 3 selection	--	C. Kaf der.
25	TAM 2567	--	Tx 2536 der.
26	B Tx 378	413	Redlan
27	B Tx 398	412	Martin
28	Tx 7078	415	Combine 7078
29	Tx 2536	10542	Y. E. Fet. der.
30	Sweet Sudan	721	Sw. Sudangrass

1976 International Disease and Insect Nursery Locations

Location (number)	Cooperator
* Bolivia (1)	Charles Ward La Paz
Brazil (2)	M. A. Faris Recife
	R. E. Shaffert Sete Lagoas
Egypt (1)	S. I. Salama Giza
El Salvador (1)	Tom Burton San Salvador
* Guatemala (1)	A. N. Plant Guatemala City
Mexico (6)	Shree P. Singh CIMMYT Mexico 6, D.F.
	Hugo Macias Matamoros
* Puerto Rico (2)	A. Sotomayor-Rios Mayaguez
	Paul Powell Mayaguez
Senegal (1)	J. C. Girard Bambey
Taiwan (Rep. of China) (1)	Paul M. H. Sun Taipei
Thailand (1)	Aran Patanothai Khon-Kaen
Venezuela (1)	Mauricio Riccelli Valencia
Yemen (1)	Yahya Shuga USAID - SANA
	E. M. Stickney, Jr. USAID - SANA

* In an ADIN

Location of the 1976 All Disease and Insect Nurseries

Location	Principal Diseases
Beeville, Texas	Head smut, downy mildew
Berclair, Texas (2)	Head smut, downy mildew, seed weathering (mold), zonate, foliage diseases
Chillicothe, Texas	Drought tolerance
College Station, Texas (4)	Maize dwarf mosaic, Helminthosporium blight, sugarcane aphid, adaptation
Corpus Christi, Texas	Head smut, downy mildew, seed weathering, foliage diseases, adaptation
Edna, Texas	Head smut, downy mildew
Halfway, Texas	Charcoal rot
Lubbock, Texas (4)	Rust, seed weathering, charcoal rot, lodging, Fusarium head blight, corn leaf aphid, MDM
Pecos, Texas	Mites
Temple, Texas	
Uvalde, Texas	
Weslaco, Texas	Foliage diseases, adaptation
El Centro, California	Late summer disease complex
Experiment, Georgia	Anthracnose
Manhattan, Kansas (2)	MDM
Meridian Mississippi	Anthracnose
State College, Mississippi	Anthracnose
Guatemala	Anthracnose, tropical adaptation
Tampico, Mexico (2)	Leaf blight, rust
Ajuntas, Puerto Rico	Leaf blight
Isabela, Puerto Rico	Anthracnose, rust, zonate, leaf spot

Thirty-five all disease and insect nurseries were grown at 22 locations in 1976. Data from many of these tests are summarized in the Third Annual Progress Report on Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance, ta-c-1092. Exceptionally good data were obtained on leaf blight, head smut, grain mold or seed weathering, and the usual foliar diseases in South Texas and Puerto Rico. Artificial inoculation of ADIN entries with MDMV permitted comparisons between natural and artificial disease reactions. Certain lines which develop little diseases under natural conditions, but are very sensitive when inoculated, led to the description of field resistance to MDM as well as new sources of resistance.

Several sorghum lines included in the IDIN and ADIN were released or are in the process of being released. (Note seed distribution in Section E.)

Combination of artificial inoculation and near ideal weather conditions permitted some of the better evaluations for stalk rot and lodging that have been made during the past five years. Clear cut differences among lines were evident at both Lubbock and Halfway.

Artificial inoculation under field conditions were made for leaf blight, charcoal rot, grain mold, head smut and anthracnose. Parental lines, F_1 rows and F_3 rows from F_2 plants were all inoculated for their reaction to leaf blight. Data from the 1976 nurseries suggested a complex inheritance with some cytoplasmic factors involved. Inoculations with the charcoal rot pathogen provided breeders with uniform pathogen effects when evaluating host reaction to the disease. Data from Lubbock and Halfway, particularly from the lodging resistant

experimental hybrid test support the contention that progress has been made toward the identification of charcoal rot resistant hybrids. Anthracnose resistance evaluations made in Georgia and Texas were artificially inoculated whereas those from Puerto Rico were natural.

Several sorghum lines from the conversion program with resistance to field grain deterioration (FGD) have been identified. Four of these lines produce grain without a testa that have white, red or lemon yellow pericarps and are low in tannins. The test weight, density and viability of grain from all sorghum lines decreases with prolonged exposure to inclement weather; but, the reduction was less for lines with resistance to FGD. The conductivity of seed leachates and the rate of water uptake by seed appear to be potentially useful indices of resistance to FGD. The lines with resistance to weathering have the least conductivity in the leachates.

Applications of benomyl, maneb Bravo, Duter and Difolatan were made for control of foliage diseases in sorghum. Benomyl gave the best control of zonate leaf spot. Control of grain mold was not evident in these trials.

Sorghum entries from Kansas, Oklahoma, Mississippi, Nebraska, Arkansas, Iowa, California and the Regional yield tests were all included in at least one of the major disease nurseries in South Texas.

Texas Populations:

Population development included the random mating in either Texas or Puerto Rico of TP1 (greenbug resistant), TP5RB (broad base), $TP9R_1$ (lodging-Pythium root rot), $TP9R_4$ (lodging-puncture rated), TP10RB (MDM resistant), TP12 (high lysine-Ethiopian source), TP13B (B-line waxy), TP14R (R-line waxy), TP16 (high lysine-P721), TP18 (low head smut-

S_1 tested), and TP 19 (high head smut-S_1 tested). Two populations, TP13B, and TP14R, received their third random mating and release is planned. They contain waxy endosperm in a broad background of elite U.S. and exotic germplasm containing disease, insect and lodging resistance as well as improved weathering resistance. To develop TP18 and 19, a group of 350 S_1's were grown in the smut nurseries at Berclair, Edna and Halfway. Thirty-four lines with low or no smut infection were random mated in Puerto Rico during the winter and the new population along with half sib selections will be evaluated in 1977.

The regional sorghum midge test was planted at Corpus Christi, College Station and Lubbock, Texas; Stillwater, Oklahoma; and Tifton, Georgia. Uniform rating systems based on percentage damaged seed on late planted sorghum were used to evaluate the entries. Some modification of the rating schemes was found necessary and the revised system will be employed in 1977. Results from the regional tests compared favorably, but in general, damage ratings were somewhat higher from Oklahoma and Georgia than Texas. Most midge resistant lines identified to date are Caudatums and those with the highest level of resistance have a testa and small glumes. Sorghums with high resistance are TAM 2566, AF 28, IS 2501C (SC 52), IS 2549C (SC 228), IS 3071C (SC 237), IS 2579C (SC 423), IS 2508C (SC 414), and IS 12612C (SC 112).

Midge resistant "B" lines were identified and backcrossed to both "A" and "B" lines in the midge screening nurseries. The identification of "B" lines with midge resistance is very important since midge resistance is not a completely dominant characteristic, thus both parents will need to be resistant if a hybrid is to have high levels of midge resistance.

C. J. Rossetto of Brazil has reported that sorghums received from these projects, SC 175-9, SC 239-14, SC 175-14 and SC 574-6, are midge resistant by the mechanism of antibiosis. Midge larva in these lines have a higher mortality and development time is increased.

Greenbug resistant hybrids developed in this program continue to perform in an excellent manner. Experimental greenbug resistant hybrids out-produced all other hybrids in the TAES Statewide Performance Tests which were grown at nine locations. Greenbug resistant hybrids produced 7800 kilograms more grain per hectare than greenbug susceptible hybrids when the insects were not controlled with an insecticide. Greenbug resistant hybrids reduced the insect population by approximately 75 percent.

Greenbug resistance from five new sources have been transferred, by backcrossing, from their grassy parent lines into grain types. Agronomically desirable disease resistant, greenbug resistant S_1 rows from TP1R were identified, recombined and random mated.

Techniques were developed for determining resistance mechanisms of sorghum midge resistant sorghums. Procedures for measuring resistance levels were based on comparisons of grain development from midge infested and midge free sorghum heads. By this technique, comparisons could be made of resistance levels of a specific line or among genotypes. Preference for adult visitation was determined by capturing adults in plastic bags at predetermined time intervals. Heat killed the adults and accumulated moisture entrapped the adults in the bags away from the head and allowed for easy counting. Antibiosis evaluations were made by caging adult midge on developing

spikelets followed by close examination, recording subsequent egg deposition, larval development and adult emergence.

Mite evaluation tests and nurseries were grown, but the absence of sufficient mite populations prevented evaluation for resistance to this pest.

Interpretation of Data and Supporting Evidence:

The Third and final Annual Report for ta-c-1092 presents essentially the complete body of data which should be referred to for more specific details of progress made during the past year. Some of the more significant findings included the confirmation of sources of superior resistance to seed mold (field grain deterioration). Seed mold ranks as one of the major deterrents to the utilization of dwarf early maturing varieties and hybrids in LDCs. In Senegal, Nigeria and at ICRISAT, selection for mold resistant sorghums represents one of their major research efforts. We believe that our program complements theirs. One of our weathering resistant lines is already in the International Disease and Insect Nursery and SC 279 was included in 1976. The differentiation of races of pathogens between sorghum growing regions of the world dramatically underlines the need for cooperative international testing and continuous constructive evaluation of host plant resistance under multiple environments. For example, anthracnose developed on TAM 428 in Africa, to a lesser degree in South America and during 1976 in Puerto Rico. Races of Colletotrichum graminicola have been suspected but these new data represent the first evidence for different races attacking sorghum.

The progress toward developing lodging and stalk rot resistant sorghums will benefit the more arid sorghum growing regions where high temperatures and low moisture conditions promote these conditions. The greenbug resistant sorghums were grown on two million hectare in North America during 1976--which means a $20,000,000 savings from costs to control greenbugs chemically as well as eliminating other undesirable effects of pesticide use.

Commercially acceptable midge and mite resistant sorghums, in time, are being developed.

The use of disease and insect resistant sorghums means the difference between success and failure in crop production in LDC's as well as developed countries. The outstanding value of the research on sorghum improvement in Texas has been the ability to coordinate agronomic characters with host resistance. This is because multi-million hectare field laboratories (Texas farms) annually challenge the high yielding sorghum under some of the most severe environments in the world. At the same time, examples of some of the finest grain sorghum cultivation exists in Texas. The broad based state-wide program is continuing in its program to coordinate research activities and programs in Africa, India, and South America. Staff from ta-c-1092 represented our programs at consultant meetings at ICRISAT, India, and have visited Brazil, Senegal, Nigeria, Thailand, Venezuela and CIMMYT regarding sorghum improvement research. Dr. H. Doggett visited Texas A&M University in March 1976 and Rob Williams was here in April.

Research Design:

Subtle changes in design are needed, in part, to facilitate data processing summarization and handling. Currently, we are cooperatively developing a sorghum and millet data processing network with USDA-ARS Data Systems Application Division and with the Information Sciences/ Genetic Resources Program, Boulder, Colorado.

To obtain a more thorough appreciation of the response of the dwarf and photoinsensitive U.S. sorghum cultivars in LDC's, during the past season we initiated a general adaptation test. These sorghum lines and hybrids are being evaluated under the direct control of our program, and in other instances, they will be coordinated through the outreach programs of ICRISAT.

Persons requesting and receiving seed of disease and insect resistant sorghum lines or germplasm in 1976

International:

H. O. Arriaga
ARGENTINA

E. A. Pujals
ARGENTINA

H. J. Pacagnini
ARGENTINA

R. A. Parodi
ARGENTINA

R. G. Henzell
AUSTRALIA

C. W. Ward
BOLIVIA

John Clark
BOTSWANA

C. J. Rossetto
BRAZIL

R. E. Schaffert
BRAZIL

Tom Burton
EL SALVADOR

National Expt. Station
EL SALVADOR

H. A. El Shafey
EGYPT

A. N. Plant
GUATEMALA

S. T. Broikar
INDIA

N. G. P. Rao
INDIA

K. V. S. Reddy
INDIA

S. Blum
ISRAEL

S. P. Singh
MEXICO

L. E. Wallace
NIGERIA

A. Sotomayor-Rios
PUERTO RICO

K. Samphantharak
THAILAND

U.S. - Private Breeders:

A. J. Allison
Taylor Evans Seed Co.

F. G. Alston
George Watner Seed Co.

Gayland Anderson
Hunt Seed Co.

C. P. Berry
P-A-G Seeds

J. D. Carroll
Delta & Pine Lane Co.

L. C. Coffey
Coffey Seed Co.

Dick Crill
Pacific Oilseeds, Inc.

E. B. Ellis
Conlee Seed Co.

R. L. Ellsworth
Excel Hybrid Seed Co.

J. L. Ervin, Jr.
Holden Foundation Seeds

D. F. Gross
Pfizer Genetics

L. G. Hoegemyer
Hoegemyer Hybrids, Inc.

Art Johnson
Browning Seed Co.

R. R. Kalton
Land O'Lakes Research Farm

H. J. Kidd
Pioneer Hi-Bred International

Noble Koepp
Grower's Seed Association

N. W. Kramer
ACCO Seed

M. G. Lacy
R. C. Young Seed Co.

L. R. Langford
Coker's Pedigree Seed Co.

R. C. Mitchell
R. C. Mitchell Seed

A. B. Maunder
DeKalb Ag Research

B. R. McGehee
McNair Seed

J. M. Osborne
NC+ Hybrids

Peyton Ramey
WAC Seed, Inc.

Paul Revier
Funk Seeds International

Wayne Richardson
Richardson Seed Farms

C. O. Sandlin
Funk Seeds International

Raymond Sidwell
Northrup, King & Co.

K. L. Skalberg
Weather Master Seeds, Inc.

J. E. Stroike
Rohm & Haas Co.

Blake Williams
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University of Florida

Greg Hinze
Colorado St. Expt. Sta.-Akron, Colorado

P. T. Nordquist
University of Nebraska

J. A. Osana
University of Missouri

W. R. Ross
University of Nebraska

J. J. Starks
Oklahoma State University

R. Voight
University of Arizona

D. E. Weible
Oklahoma State University

B. R. Wiseman
ARS-Tifton, Georgia

Biographical List and Short Abstracts of Research Reports for 1976 Representing Efforts to Disseminate the Results of the Research Project.

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2. Frederiksen, R. A. 1976. Current status of the downy mildew of maize in the Americas. Kasetsart J. Vol. 10. In press.

3. Frederiksen, R. A. and B. L. Renfro. 1976. Global status of maize downy mildew. Ann. Rev. Phytopathol. In press.

4. Frederiksen, R. A., G. L. Teetes and D. T. Rosenow. 1976. Utilizing disease and insect resistance in North American crop plants. In 100 Years of Agricultural and Food Chemistry. AVI Publishing Co., Westport, CT. In press.

5. Frederiksen, R. A., D. T. Rosenow, G. L. Teetes, and J. W. Johnson. 1976. Disease and insect rating schemes for sorghum. Sorghum Newsletter. 19:119-123.

6. Frederiksen, R. A. and F. R. Miller. 1976. Reaction of selected A & B lines to several common sorghum diseases. Sorghum Newsletter. 19:127.

7. Foster, D. G., G. L. Teetes, J. W. Johnson, D. T. Rosenow and C. R. Ward. 1977. Field evaluation of resistance in sorghums to Banks grass mite. Crop Science. In press.

8. Foster, D. G., G. L. Teetes, J. W. Johnson and C. R. Ward. Resistance in sorghums to the Banks grass mite; laboratory determination of resistance mechanism. J. Econo. Entomol. In press.

9. Johnson, J.W., G. L. Teetes, D. T. Rosenow and J. M. Phillips. 1976. Evaluation of selected sorghums for mite resistance. Sorghum Newsletter. 19:130.

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14. Rosenow, D.T., J. W. Johnson, Dennis Pietsch and H. J. Walker. 1976. Grain sorghum hybrid performance. Tex. Agric. Expt. Sta. P.R. 3426-9.

15. Rossetto, C. J., J. Overman, J. W. Johnson, G. L. Teetes and V. Nagai. 1976. Evaluation of sorghums for midge resistance. Ann. Plant Resistance to Insects Newsletter. 2:39.

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17. Teetes, G. L. and W. L. Sterling. 1976. A sequential sampling plan for a white grub in grain sorghum. The Southwestern Entomol. 1:118-120.

18. Teetes, G. L., L. J. Wade, R. C. McIntyre and C. A. Schaefer. 1976. Distribution and seasonal biology of Phyllophaga crinita in the Texas high plains. J. Econ. Entomol. 69:59-63.

19. Teetes, G. L. 1976. Damage assessment and control of wireworms in grain sorghum. Tex. Agric. Expt. Sta. B-1167:4 p.

20. Teetes, G. L., E. G. Lopez and C. A. Schaefer. 1976. Seasonal abundance of the greenbug and its natural enemies in grain sorghum in the Texas high plains. Tex. Agric. Expt. Stn. B-1162:4 p.

21. Teetes, G. L., J. W. Johnson and D. T. Rosenow. 1976. Screening for corn leaf aphid resistant sorghums. Sorghum Newsletter, 19:128.

22. Teetes, G. L., J. W. Johnson and D. T, Rosenow. 1976. Damage assessment of greenbug resistant sorghum hybrids. Sorghum Newsletter. 19:128.

23. Teetes, G. L. 1975. Insect resistance and breeding strategies in sorghum. Proc. Ann. Corn and Sorghum. Res. Conf. 13:32-48.

24. Young, W. R. and G. L. Teetes. 1977. Sorghum entomology. Ann. Rev. Entomol. 22:193-218.

CHARACTERISTICS OF NONSENESCENCE IN SORGHUM BICOLOR (L.) MOENCH

R. R. Duncan, A. J. Bockholt, and F. R. Miller

ABSTRACT

Three sorghum lines which exhibit a 'nonsenescing' tendency were compared with four senescing sorghum lines. These nonsenescing lines have been observed to remain green and vigorous in the field at grain harvest time when 'normal' sorghum types have senesced and apparently ceased functioning physiologically. Leaf blade chlorophyll content, some growth parameters, and yield components were studied. Averaged over the 1974 growing season, leaf blade chlorophyll content was 16% higher in the nonsenescing lines than in the senescing lines. Leaf area duration was 26% higher in the nonsenescing lines. The senescing lines produced 23% higher yields per hectare.

1976. Agron. Abs. p. 71

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

CURRENT STATUS OF THE DOWNY MILDEW OF MAIZE IN THE AMERICAS

R. A. Frederiksen

ABSTRACT

In the past fifteen years sorghum downy mildew, Sclerospora sorghi, has appeared in the United States, Mexico, Argentina, Brazil, Venequela and observed in Bolivia, Guatemala, Honduras, El Salvador and Uruguay. The disease is present probably in Peru, Colombia and other Central American countries, but official reports or sightings are lacking.

The evidence suggests that sorghum species are a significant collateral host of this disease. Consequently, it will be imperative that downy mildew first be controlled in sorghum.

1976. Kasetsart J. Vol. 10. In press.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GLOBAL STATUS OF MAIZE DOWNY MILDEW

R. A. Frederiksen and B. L. Renfro

ABSTRACT

This article reviews the history, species, major problem areas and control techniques of downy mildew of Gramineae worldwide.

1976. Ann. Rev. Phytopathol. In press.

UTILIZING DISEASE AND INSECT RESISTANCE IN NORTH AMERICAN CROP PLANTS

R. A. Frederiksen, G. L. Teetes and D. T. Rosenow

ABSTRACT

The importance of American agriculture, as one of the few food exporting nations of the world has international humanitarian and vast political implications. Excluding agribusiness and forestry, agriculture during the past 5 years has been valued at over 50 billion dollars annually, principally from the production of corn, wheat, soybeans, and grain sorghum. Consequently, protecting these commodities is a vital concern to the nation's economic welfare.

1976. In 100 Years of Agricultural and Food Chemistry. AVI Publishing Co., Westport, CT. In press.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

DISEASE AND INSECT RATING SCHEMES FOR SORGHUM

R. A. Frederiksen, D. T. Rosenow, G. L. Teetes, and J. W. Johnson

ABSTRACT

It is extremely important that uniform disease and insect note taking systems be established. A guide was prepared by the authors as an attempt to establish such a system for taking disease and insect notes in sorghum.

1976. Sorghum Newsletter. 19:119-123.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

REACTION OF SELECTED A & B LINES TO SEVERAL COMMON SORGHUM DISEASES

R. A. Frederiksen and F. R. Miller

ABSTRACT

Several major disease occurrences related to genetic uniformity have appeared in grain sorghum in Texas during the past 2 decades. These have included head smut (1958, 1968, 1974), anthracnose (1966), downy mildew (1967), maize dwarf mosaic (1967), Phythium root rot (1971), and Fusarium head blight (1972).

In 1975 we grew 17 A and B pairs of Sorghum bicolor lines at Berclair and Victoria to test their reaction to downy mildew, head smut and other diseases. About half of the heads of both sterile and fertile plants were bagged in each row to provide additional comparison between plants with normal seed set and barren plants. Two fully randomized replicates were grown at each location. There appeared to be no difference in disease reaction between A and B lines for any of the foliar diseases. However, at Berclair, B Tx 3197 had significantly more head smut than A Tx 3197. The incidence was not as high at Victoria, but there B Tx 3197 had more smut than the A-line. Downy mildew damage was greater on A Tx 407 than on B Tx 407 at Berclair. All other A- and B-lines did not differ in incidence of head smut although there appeared to be a slightly lower level of downy mildew on B-lines than on A-lines at both locations. Bagging of heads on either fertile or sterile plants did not influence reaction to any of the diseases evaluated.

1976. Sorghum Newsletter. 19:127.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

FIELD EVALUATION OF RESISTANCE IN SORGHUMS TO BANKS GRASS MITE

D. G. Foster, G. L. Teetes, J. W. Johnson, D. T. Rosenow and C. R. Ward

ABSTRACT

The Banks grass mite, Oligonychus pratensis (Banks), is a serious pest of sorghum, (Sorghum bicolor (L.) Moench. Because of the unreliability of chemical control, mite resistant sorghums would be extremely valuable in controlling this pest. To determine levels of resistance in 19 sorghum lines and hybrids, field tests with natural mite infestations were conducted near Pecos, Texas. Evaluations were based on mite numbers, population density ratings and damage ratings.

Field evaluation of selected sorghum lines and F_1 hybrids indicated the presence of resistance to Banks grass mite. Grain type sorghums of similar maturity did not differ significantly in mite infestations, but some were damaged less than others; those with less damage were relatively high in sugar and were "non-senescing" types. The two sorghums that were least infested were late maturing (SC 56-14) or both late maturing and high in tillering ('Sweet Sudan'). B Tx 618 was more resistant to damage than B Tx 378, and this resistance was reflected in hybrids between these lines and SC 599. Sorghums identified in this study should be useful in the development of mite resistant sorghum hybrids.

1977. Crop Science: In Press

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

RESISTANCE IN SORGHUMS TO THE BANKS GRASS MITE; LABORATORY DETERMINATION OF RESISTANCE MECHANISM

D. G. Foster, G. L. Teetes, J. W. Johnson and C. R. Ward

ABSTRACT

Oligonychus pratensis (Banks) exhibited no differential preference response for SC 599-6, a previously identified mite resistant sorghum line, when given a choice of that sorghum or a susceptible grain type (TX 7000), a grassy sorghum (KS 30) or a sweet sorghum ('Honey'). However, a greater preferential response was recorded for any sorghum line at plant growth stages 2-6 versus stage 1, 7 and 8. Life span duration did not significantly differ when the mite was reared on SC 599-6, SC 56-6, TX 7000, BTZ 378, KS 30, Sweet Sudan or High Sugar Honey sorghums. Mites reared on isolated sorghum leaflets at growth stages 1-6 had a longer life span (25.7 days) and ovipositional period (11.6 days) than mites reared on sorghum leaf discs at growth stages 6-8 (19.1 and 8.9 days, respectively). However, fewer eggs (4.3) were deposited daily by females on sorghums at growth stages 1-6 than on sorghums at growth stages 6-8 (11.1).

Tolerance appeared to be the major resistance mechanism of 599-6 sorghum as test results indicated less damage occurred to that line even when infested with mite populations equal to that on TX 7000 or High Sugar Honey sorghum.

1977. Journal of Economic Entomology: In Press

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

EVALUATION OF SELECTED SORGHUMS FOR MITE RESISTANCE

J. W. Johnson, G. L. Teetes, D. T. Rosenow and J. M. Phillips

ABSTRACT

Nine sorghum lines and nine hybrids were evaluated for their reaction to a natural infestation of Banks grass mites at the Texas Agricultural Experiment Station at Pecos, Texas, in 1975. Leaf and stalk death ratings and low percent reduction in seed size indicate that two SC 599 (partially converted "Rio") selections, TAM 2568 and TAM 618 have mite resistance. Data on the hybrids A Tx 378 x SC 599 (9188) and A Tx 378 x SC 599 (9247) suggests that resistance of the pollinators is recessive.

1976. Sorghum Newsletter. 19:130.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GREENHOUSE AND FIELD TECHNIQUES FOR EVALUATING RESISTANCE OF SORGHUM CULTIVARS TO THE GREENBUG

J. W. Johnson, G. L. Teetes and C. A. Schaefer

ABSTRACT

Sorghum, Sorghum bicolor (L.) Moench, cultivars were grown in flats in the greenhouse and infested with greenbugs, Schizaphis graminum (Rondani), 7 days after emergence. In seedling trials plants retaining 50% live leaf tissue when susceptible checks were dead were considered to be resistant. Resistance of mature plants was determined in field plantings by attaching two 2.54 cm^3 plastic cages containing 5 adult greenbugs per cage to the leaves of plants in the boot stage or older. In field trials plants were considered to be resistant that had 50% or less of leaf area killed by greenbugs under the cage when susceptible checks had 90% or more leaf death under the cage. Using these techniques for evaluation of resistance in breeding lines and their progeny, resistance has been transferred to numerous improved agronomic breeding stocks. These breeding stocks have been released by the Texas Agricultural Experiment Station.

1976. The Southwestern Entomologist. 3:150-154.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

REPORT ON THE INTERNATIONAL SORGHUM ANTHRACNOSE VIRULENCE NURSERY

S. B. King and R. A. Frederiksen

ABSTRACT

An International Sorghum Anthracnose Virulence Nursery (ISAVN) was initiated in 1975 to obtain information on the virulence of Colletotrichum graminicola (Ces.) G. W. Wils. on sorghum. Data from 9 of the 19 locations interested in growing this nursery (15 of which lie in the western hemisphere) show evidence for physiologic specialization of C. graminicola on sorghum. This is especially apparent in reaction differences between Nigeria and locations in the western hemisphere, and to a lesser degree between Venezuela and other locations.

It is intended that the ISAVN be continued. The objective, procedures, and number of entries will remain the same, although 5 new entries will likely replace 5 of the entries used in 1975.

1976. Sorghum Newsletter. 19:105-106.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

SELECTED PREDATORS OF APHIDS IN GRAIN SORGHUM AND THEIR RELATION TO COTTON

E. G. Lopez and G. L. Teetes

ABSTRACT

There was a seasonal relationship in abundance of greenbug, Schizaphis graminum (Rondani), and corn leaf aphid, Rhopalosiphum maidis (Fitch), and several selected predators on field planted sorghum wheat, and volunteer johnsongrass. As aphid numbers increased on any host, predators also increased. As parasitism decreased aphid population levels in grain sorghum, predator density decreased in that crop. Predator population levels in cotton began to increase at about the same time that predator density began to decrease in sorghum. Based on the relative similarity of the two habitats in terms of species composition, the two different plant communities became more intimately related as the growing season progressed. Of ca. 500,000 predators captured, marked and released in grain sorghum, 51 or 0.01% were recaptured in nearby cotton.

1976. J. Econ. Entomol. 69:198-204.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

THE RESPONSE OF SELECTED DIVERSE SORGHUMS TO LATITUDINAL ENVIRONMENT VARIATIONS IN TEXAS

Hector Armando Mena

ABSTRACT

A study was conducted at six locations in Texas to determine the extent of climactic variations on plant characteristics, and to determine the possible climactic factors causing differences of yield of grain sorghum.

Twenty-five entries were planted in a randomized block design with three replications at six locations representative of geographical areas of Texas: Halfway, Dallas, College Station, Uvalde, Corpus Christi and Weslaco. The agronomic practices during the crop season were those normally used at each respective location.

The observations taken on the crop were: yield, height, days to 50% flower, exsertion, head-length, grain weight and number of seed per head. The meterological data included: maximum, minimum and mean temperatures, radiation which reached the earth surface during the crop season and daylength. These data were taken per stage of growth. Analysis of variance, simple regressions and simple correlations were computed.

The data revealed that days to flower and weight of kernels are important plant characteristics in determining yield performance at these locations studied.

The radiation levels were considered not to be a limiting factor for yield of grain sorghum in Texas.

Daylength was important in determining yield and may reenforce the temperature effect at those locations at higher latitudes. It was suggested that daylength is important in determining both days to flower and weight of kernels.

According to the relationships found, temperature was considered the most variable and important factor in causing differences in performance of grain sorghum at these locations. Diurnal temperatures were more important than night temperatures in determining days to flower and weight of kernels. A negative correlation between minimum temperature and yield was not detected, but an overlapping of diurnal temperatures on this relationship was suggested. It was considered that a factor accounting for the low yield at those locations at lower latitudes should be high night temperatures.

1976. M.S. Thesis. Texas A&M University, College Station, Texas

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Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GRAIN SORGHUM HYBRID PERFORMANCE

D. T. Rosenow, J. W. Johnson, Dennis Pietsch and J. H. Walker

ABSTRACT

Grain sorghum hybrids are evaluated annually for field performance at several locations in Texas representative of the major grain sorghum producing acres. In addition, grain samples are taken for investigations in feed and food utilization.

1976. Tex. Agric. Exp. Sta. P.R. 3426-9.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

EVALUATION OF SORGHUMS FOR MIDGE RESISTANCE

C. J. Rossetto, J. Overman, J. W. Johnson, G. L. Teetes, and V. Nagai

ABSTRACT

Comparative evaluation of the damage done by the sorghum midge, *Contarinia sorghicola*, in selected sorghum germplasm, in Campinas, State of Sao Paulo, Brazil, was carried out in 1975. The damage was graded with a visual scale from 0 to 10. The average damage grades for the germplasms are given in the parenthesis:

AF-28 (1,1)	SC 423-14 (4,5)	Sgirl-MR-1 (5,9)	BT x 399 (9,3)
SC 414-14 (2,5)	SC 239-14 (4,5)	SC 108-14 (6,0)	SART (9,4)
SC 175-14 (2,6)	SC 228-14 (5,0)	SC 120 (6,0)	BT x 4042 (9,4)
SC 175-9 (3,1)	Grandor (5,1)	TAM 428 (6,2)	Spreader (9,4)
SC 424-14 (3,4)	SC 112-14 (5,2)	BY x 378 (8,3)	SC 265-14 (9,6)
SC 237-14 (3,5)	SC 322-14 (5,2)	BT x 3197 (8,3)	B. Leoti (9,9)
SC 574-6 (3,5)	SC 52-14 (5,4)	T x 2536 (8,9)	T x 700 (9,9)
SC 268 (3,7)	AF 112 (5,5)	T x 7078 (9,1)	

1976. Annual Plant Resistance to Insects Newsletter. 2:39.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

RELEASE OF PARASITOIDS TO CONTROL GREENBUGS ON SORGHUM

K. J. Starks, R. L. Burton, G. L. Teetes, and E. A. Wood, Jr.

ABSTRACT

As an alternative to insecticides for greenbug control on grain sorghum, Lysiphlebus testaceipes (Cresson), a native parasitoid, was reared on plants infested with greenbugs, Schizaphis graminum (Rondani), in greenhouses at Stillwater, Oklahoma; acclimatized on plant material at 5° C for storage; and shipped by air as mummies to Lubbock, Texas, for release in sorghum fields when greenbug populations were below 12 per plant. Emergence of adults was better than predicted, but release points should have been closer together. In plots where 14,000 and 28,000 parasitoids were released per acre, greenbugs did not increase to damaging populations as rapidly as they did in releases of 7,000 parasitoids per acre and in control plots. Counts of L. testaceipes mummies indicated higher numbers in plots where parasitoids were released. Parasitoid releases at 14,000 and 28,000 per acre along with insecticide applications resulted in grain yields significantly higher than produced in control plots. Aphelinus asychis, an imported parasitoid of aphids, and native predators were not effective in preventing greenbug damage. Corn leaf aphids, another host of L. testaceipes, did not help in the establishment of L. testaceipes.

1976. U. S. Department of Agriculture ARS-S-91:12 p.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

A SEQUENTIAL SAMPLING PLAN FOR A WHITE GRUB IN GRAIN SORGHUM

G. L. Teetes and W. L. Sterling

ABSTRACT

Sampling data were subjected to several frequency distribution models to determine spatial dispersion patterns of the white grub, Phyllophaga crinita (Burmeister). The negative binomial distribution fitted the data well and was used to devise a sequential sampling plan for preplanting surveys to assist in making pest management decisions. The plan is based on infested and uninfested samples, and counts of the total number of larvae per smaple are not required.

1976. The Southwestern Entomol. 1:118-120.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

DISTRIBUTION AND SEASONAL BIOLOGY OF PHYLLOPHAGA CRINITA IN THE TEXAS HIGH PLAINS

G. L. Teetes, L. J. Wade, R. C. McIntyre, and C. A. Schaefer

ABSTRACT

Damaging population levels of a white grub, Phyllophaga crinita (Burmeister), annually infest ca. 40,000 acreas of grain sorghum and wheat in a 7 county area in the Texas Southern High Plains.

Based on weekly sampling, larvae were present in the field throughout the year and was the only stage present during all months except May, June, and July. Pupae were most abundant in mid-June and the subsequent adults were most prevalent in early July. The egg stage was most abundant ca. 1-2 wk following peak adult abundance.

Adult activity was recorded by light trap collections and was greatest during late June and July which corresponded to the peak abundance of adults collected in the field.

1976. J. Econ. Entomol. 69:59-63.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

DAMAGE ASSESSMENT AND CONTROL OF WIREWORMS IN GRAIN SORGHUM

G. L. Teetes

ABSTRACT

Populations of the true wireworm, Aeolus mellillus (Say), were determined with baited traps of sorghum seed. Trap catches were highest 1 or 2 weeks after trap establishment. The number of wireworms found in traps was twice the number present in one linear row foot. A population level of one wireworm per linear foot of row usually damaged approximately 10 percent of the planted seed, which caused a reduction in plant stand but not in grain yield.

Several insecticide seed treatments reduced wireworm numbers and damaged seed, and some resulted in increased plant stands but not yields. Lindane appeared to affect seed germination. Carbofuran and Dasanit^{R} (O, O-diethyl O-P-((methylsulfinyl-phenyl) phosphorothioate) appear to hold promise as replacement seed treatments for the standard chlorinated hydrocarbon insecticides.

1976. Tex. Agric. Exp. Stn. B-1167:4 p.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

SEASONAL ABUNDANCE OF THE GREENBUG AND ITS NATURAL ENEMIES IN GRAIN SORGHUM IN THE TEXAS HIGH PLAINS

G. L. Teetes, E. G. Lopez and C. A. Schaefer

ABSTRACT

Based on population studies during 1971, 1972, and 1973, biotype C greenbug, Schizaphis graminum (Rondani), tended toward highest seasonal abundance in grain sorghum during mid- to late July. Predators showed a similar trend, but peak populations occurred shortly after greenbug populations began to decline. The proportion of the greenbug population parasitized increased to a peak in early August as the total greenbug population was declining rapidly. Lysiphlebus testaceipes (Cresson) was the most abundant primary parasite of the greenbug. Other primary parasites reared from mummies were Diaeretiella rapae (M' Intosh) and Aphelinum nigritus (Howard). Hyperparasites (parasites of parasites) reared from mummies were Charips sp., Pachyneuron siphonophorae (Ashmead), Asaphes lucens (Provancher), and Aphidencyrtus aphidivorus (Mayr). Charips sp., and P. siphonophorae were the most abundant hyperparasites affecting the primary parasite L. testaceipes. Hippodamia spp. were the most abundant predators.

1976. Tex. Agric. Exp. Stn. B-1162:4 p.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

SCREENING FOR CORN LEAF APHID RESISTANT SORGHUMS

G. L. Teetes, J. W. Johnson and D. T. Rosenow

ABSTRACT

In 1975 sorghum nurseries containing sources of diverse germplasm were screened for resistance to the corn leaf aphid, Rhopalosiphum maidis Fitch. Based on damage ratings on these sorghums, it was apparent that some of the commonly used sorghum parental lines were highly susceptible to corn leaf aphid damage. For example, B "Redlan" was recorded to be extremely susceptible.

Also, in these screening trials several Zera Zera sorghums, especially TAM 428, were found highly resistant to corn leaf aphid damage. The resistance to TAM 428 is affected by the other parental line used in hybrid combination. Sources for resistance to the corn leaf aphid do exist, even in some agronomically improved lines.

1976. Sorghum Newsletter. 19:128.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

DAMAGE ASSESSMENT OF GREENBUG RESISTANT SORGHUM HYBRIDS

G. L. Teetes, J. W. Johnson and D. T. Rosenow

ABSTRACT

As a result of both public and private breeding programs, greenbug resistant sorghum hybrids of good agronomic quality have been developed. Acceptance by producers of these resistant hybrids will probably be good; however, there will be concern expressed because of the levels at which these hybrids are infested.

Greenbug numbers (4767/plant), and damaged leaves, (4.7) were greater and yield/acre (3317) less on the susceptible sorghum under natural infestation than the resistant sorghums either naturally infested or caged. Natural greenbug infestation on resistant sorghum reached only 700/plant and caused no significant leaf or yield loss. Under cages, the greenbug population on resistant sorghum reached ca. 2500/plant and caused significant leaf and yield loss. Greenbug numbers below this level did not reduce yields. Yield and seed size was decreased at the 2500 greenbug/plant level because at this density 3.3 leaves/plant had been killed. Based on these and prior data, leaf loss of 3.3 per plant on susceptible sorghum resulted in yield loss. It would appear that the damage tolerance level for resistant or susceptible sorghums is approximately the same. However, greenbug numbers have not occurred naturally on resistant sorghums at a level sufficient to cause significant damage to result in yield loss.

No benefit was shown in treating the naturally infested resistant sorghums. Data would indicate that the economic threshold, based on damage only and not greenbug numbers would be the same for resistant and susceptible sorghums.

1976. Sorghum Newsletter. 19:128.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

INSECT RESISTANCE AND BREEDING STRATEGIES IN SORGHUM

G. L. Teetes

ABSTRACT

Host plant resistance as a means of managing insect pests of sorghum is discussed. The advantages are stressed of plant resistance in dealing with insecticide resistant pest populations or minimizing their development. A review is given, summarizing the current status of sorghums resistant to greenbug, sorghum midge and Banks grass mites.

1975. Proc. Ann. Corn and Sorghum Res. Conf. 13:32-48.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

SORGHUM ENTOMOLOGY

W. R. Young and G. L. Teetes

ABSTRACT

A review of sorghum entomology worldwide. Includes one table listing sorghum insect and mite pests including pests' scientific name, geographic distribution, pest status, nature of damage, and economic threshold and a key to pertinent literature. The current situation regarding sorghum pests and approaches to their control is covered. Pest management, in contrast to unilateral pesticide use, is emphasized, and the interrelationships of sorghum pests with appropriate components for their management are described. Selected references include 177 citations.

1977. Ann. Rev. Entomol. 22:193-218.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1092 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

Papers presented at 10th Biennial Grain Sorghum Research and Utilization Conference. March 2-4, 1976. Wichita, Kansas.

"Status of Breeding for Midge Resistance," J. W. Johnson

"Host Plant Resistance Terminology," G. L. Teetes

"Value of International Involvement Among U.S. Sorghum Programs," R. A. Frederiksen

"A Decade of Research on Viruses in Sorghum," R. W. Toler

"Properties of Sorghum with Resistance to Weathering," J. A. Glueck

"Discussion on Standardization of Terms and Rating Systems for Grain Quality Parameters," L. W. Rooney

"Discussion on Data Handling and Standardization of Parameters," K. F. Schertz

"Response of Grain Sorghum to Cultural and Management Practices in the Rolling Plains," L. E. Clark

International Trips Made Representing Efforts to Disseminate Results of the Research Project

INDIA

From September 3 to September 14, 1976, Drs. Jerry W. Johnson and George L. Teetes travelled in the sorghum growing regions and visited several research centers in India and Thailand. The purpose of the trip was to observe the insect-pest situation in sorghum, review current research programs, and to coordinate research cooperation between the Texas Agricultural Experiment Station and the visited countries.

Indian Agricultural Research Institute, New Delhi: The tour of this research institute was coordinated by Dr. M. G. Jotwani, Entomology Research Project Leader of the All India program. Dr. Jotwani and his associates reviewed their research activities which included a field trip to their research plots.

Their research program appeared to be a well coordinated effort directed toward developing systems for managing sorghum insect pests. Major emphasis was being placed on the shoot fly and the sorghum stem borer. These are "key" sorghum pests in India and rightfully deserve the attention they are receiving.

The research effort included several management tactics for these pests including cultural control (planting date manipulation), host plant resistance, biological control (to a limited extent) and chemical controls based on economic threshold levels.

Opportunities for cooperative research were discussed and should lead to an increased exchange of genetic material and information. Presently, neither the shoot fly nor the sorghum stem borer occur in

North America. Our continued cooperation with the entomologists at IARI would seem imperative and would definitely be mutually beneficial.

International Crops Research Institute for the Semi-Arid Tropics, Hyderabad: The tour of this research institute was coordinated by Dr. R. C. McGinnis, Associate Director of ICRISAT. The visitation program consisted of field tours of several major research areas including: farming systems, pearl millet, entomology, and sorghum. The farming systems tour was directed by B. Diwakar who, with his associates, reviewed production factor research in agroclimatology, hydrology, soil physics, soil fertility and chemistry, farm machinery, land and water management, and agronomy.

The pearl millet field tour was directed by D. J. Andrews and his associates J. V. Majmudar, R. P. Jain, K. Anand Kumar, S. C. Gupta, R. J. Williams, S. D. Singh, R. P. Thakur and A. H. Kassam. The pearl millet breeding program was being directed toward stability of yield, and disease resistance, especially to downy mildew. Insect pests of pearl millet appeared to be of minor consideration in production of that crop.

The tour of the entomology program was directed by Dr. K.V.S. Reddy. Dr. J. C. Davies was out of the country at the time of our visit. Major emphasis in sorghum entomology was being placed on screening and evaluation of sorghums resistant to the sorghum shoot fly and the sorghum stem borer. Sources of resistance to each of these pests have been identified. The close working relationship between the entomologists and the plant breeders was very apparent. The development of plant resistance in combination with planting date manipulations seemed the

logical approach to dealing with these serious sorghum pests. The complimentary research on pest biology, ecology, and host-pest relationships strengthens the entomology program into a well-rounded, sound activity.

Drs. H. Doggett and R. Jambunthan directed the field tour of the sorghum breeding program. Other associates involved in the tour included K. V. Ramaiah, P. K. Lawrence, B. T. S. Gowda, and D. J. Andrews. The extensive sorghum breeding program involved cereal physiology in relation to genetic improvement, improved grain quality, pest resistance breeding, development of early and mold free grain sorghum, breeding for short and photoinsensitive sorghums, high altitude sorghums, Striga resistance, development and testing of hybrids, source populations, and introgression, grain-grass sorghums, tetraploid grain sorghum and international testing.

The overall research program of ICRISAT was extremely impressive. The program is goal-oriented, directed by specific objectives which consider the socioeconomic conditions of the country. The atmosphere of continued and even greater cooperation between ICRISAT and TAES was expressed in a brief meeting with Dr. R. W. Cummings, Director.

SENEGAL

From September 22-October 2, 1976, R. A. Frederiksen travelled in the millet and sorghum growing regions of Senegal. Principal visits were to the research stations at Bambey, Nioro du Rip, Sefa, Darou and Sinthior Maleme and the extension demonstration for Sine-Saloum, Unites Experimentale de Koumbia.

In-depth interviews were held with Dr. J. C. Girard, Dr. J. Denis, and Dr. A. Sarr. Brief visits were held with Director L. A. Sauger and Dr. Mauboussin.

Disease situations: Pearl millet.

Without doubt, downy mildew (Sclerospora graminicola) is the most serious and damaging disease of cultivated pearl millet in Senegal. Land race varieties with up to 50% of the plants affected are common in the Region De Diourbel. Other diseases likely to cause damage particularly in the earlier maturing varieties include ergot and kernel smut. Rust, Pyricularia leaf spot and other leaf spotting diseases do not appear to cause significant losses.

In grain sorghum the most prevalent disease was sooty stripe caused by Ramulispora sorghi. Other diseases observed included bacterial streak (red stripe ?), Xanthomonas sorgicola or (Xanthomonas rubrilieans), anthracnose, Colletotrichum graminicola; leaf blight, Exserohilum turcicum; grey leaf spot, Cercospora sp.; zonate leaf spot, Gleocercospora sorghi; mosaic and other virus-like diseases. Seed molds, known to be a major problem, were not evident at the stages of plant development during late September 1976.

In maize small amounts of southern corn leaf blight, Bipolaris maydis, northern leaf blight, Exserohilum turcicum, an unknown streak-like virus (particularly at Bambey) and stalk rot at Sinthiou Maleme.

The research activities of Dr. J. C. Girard have developed several major areas. His greatest effort has been toward a more thorough understanding of the epidemiology of downy mildew in millet including

variability in the pathogen and to develop disease screening programs with millet and sorghum breeders to improve levels of host resistance to downy mildew of millet, grain molds and leaf diseases in sorghum. Other activities involve routine disease identification of most field crops, frequently involving rice, sugar cane, maize and ground nuts. In addition, Dr. Girard has been asked to initiate a quarantine service and phytosanitary certification program.

Other commodities with significant disease problems requiring attention include sorghum, maize, rice and sugar cane. Similar research problems exist or potential will appear for the other crops. These include virus problems in maize and smut in sugar cane.

It was felt that the pathology program for ISRA is greatly over-extended. However, additional research and technical programs in plant pathology are needed for CNRA. These include all aspects of direct research on diseases, cooperative research with other discipline areas and applied plant pathology, for such items as diagnoses and control recommendations and phytosanitary certification. At least two additional full-time pathologists are needed. Recommendation is that they both share in the applied and fundamental research program. Additional support is needed at the technical or non-professional level. Well trained agronomic engineers are not only needed in pathology but perhaps in most of the research groups at CNRA.

It was felt that a baccalaureate program in agriculture is needed. Such a program might be developed out of a training institute within a research station, such as CNRA.

The research staff with CNRA at Bambey and the Sorghum and Millet Improvement Staff within the Texas Agricultural Experiment Station compliment each others' programs. This rapport should be maintained by joint planning and cooperative testing.

THAILAND

Drs. Johnson's and Teetes' travel to Thailand provided an opportunity to observe sorghum production and the insect pest situation. This was coordinated by Dr. W. R. Young, Foundation Representative, Rockefeller Foundation. A review of the Thai sorghum program was presented by Dr. Krisda Samphantharak and Mr. Sommuk Wongtong of Kasetsart University and Dr. Jinda Jan-orn, and Mr. Boonsoom Meksongsee, Thai Department of Agriculture.

A tour was made of the facilities at Bangkhen followed by a visit with Dr. Tanongchit Wongsiri, Director of Entomology of the Department of Agriculture. A tour was made of the National Corn and Sorghum Research Center at Farm Suwanwjokasikit near Pakchong, Nakhon Ratchasima. The research program at Farm Suwan is directed to support the National Corn and Sorghum Improvement Program. Scientists from the university, Department of Agriculture and the Rockefeller Foundation are concentrating on the development of higher yielding, disease and insect resistant and fertilizer responsive varieties.

From October 4-7, 1976, R. A. Frederiksen attended the Conference on Research Needs and Strategy to Control the Downy Mildew Diseases of Corn held in Bangkok, Thailand hosted by the Thai National Corn and Sorghum Program cooperative with the Rockefeller Foundation.

A tour of field experiments and research facilities at Farm Suwan, headquarters of the Thai National Corn and Sorghum Program. A field trip was made to a portion of the Thai corn belt.

A small but impressive acreage of sorghum is grown in Thailand. Disease problems observed included a variety of leaf spotting fungi including Phyllachora sorghi (tar spot). This disease appeared to cause insignificant damage but it represented a first observation for RAF of this desease. Downy mildew rarely, if ever, occurs on sorghum in Thailand. Consequently, the downy mildew of Thailand is known by some authors as a maize pathotype.

Listed below is a partial list of news releases and public media articles. Copies of other news media articles are given on the following pages as examples.

Only Pests Justify Milo Switch, Southwest Farm Press, January, 1977.

Companies Release Midge Tolerant Hybrids, Grain Sorghum News, February, 1977.

Scientists Examine Sorghum Diseases, Lubbock Avalanche-Journal, July 4, 1976.

Scientists Seek to Anticipate and Avoid Sorghum Problems, Southwest Farm Press, March 31, 1977.

The Scientists Tell Me...

Disease and Insect Resistance Worth Millions in Texas Sorghum

By Robert L. Haney
TAES Science Writer

Scientists are finding ways to add disease and insect resistance to Texas' No. 1 grain crop, sorghum. And these discoveries mean millions of dollars to consumer and producer alike.

The consumer benefits in several ways: First, chemical usage is cut way down so environmental pollution is reduced; second, crop losses are reduced which adds both quality and quantity to our total food supply; third, the producer saves cost of chemicals and the labor for applying them. This helps hold down cost of both feed grain and food while still giving the producer a reasonable return on investment.

Grain sorghum production and usage is big business in Texas. Last year, producers got more than $647,300,000 for their crop, which amounts to about half of the nation's total grain sorghum value.

And of course grain sorghum is the kingpin of our whole livestock industry, through corn is making a comeback.

A fantastic array of diseases and insect pests has developed over the years to plague our millions of acres of grain sorghum. But a team of scientists with the Texas Agricultural Experiment Station (TAES) are leaders in an international effort to solve these problems.

Sources of resistance to most of the major sorghum diseases, insects and mites have been identified (though not yet incorporated) through a national and international testing program.

These include head smut, downy mildew, maize dwarf mosaic, anthracnose, root and stalk rot, seed weathering, several foliar (leaf) diseases, sorghum midge, greenbug, corn leaf aphid, and spider mites.

Whew! With that many enemies it's a wonder we have any grain sorghum. But, the Experiment Station research team of entomologists, agronomists, virologists, cereal chemists and sorghum breeders is engaging these enemies with remarkable success.

Their success has been rewarded with a major grant from the Agency for International Development to offset the costs of coordinating their research with other scientists around the world, according to Dr. Richard Frederiksen, a plant pathologist at Texas A&M University.

This international interest in grain sorghum is readily understood when you realize that sorghum is one of the principal food and feed commodities of the world. Sorghum grain is used as livestock feed here but many authorities rate sorghum as the third most important food grain, exceeded in utilization for food only by wheat and rice.

Sorghum is well adapted to cultivation under wide extremes in environmental conditions including arid, semi-arid, and sub-tropical areas of the world where many other crops grow poorly or not at all.

Frederiksen says, "We are trying to anticipate what pathogens, pests and other problems in sorghum will be, before they cause grave losses.

"Host resistance ranks as the most important means, and for some as the only means, of controlling our major disease problems.

"It appears that host resistance can help reduce insect damage, as well.

"For example, to control greenbugs in sorghum, Texas producers are spending about $20 million each year on chemicals and application costs. Experiment Station entomologists believe resistant grain sorghums, when widely used, can cut that cost by 90 per cent (save $18 million per year, besides the ecological value)."

Last year, resistant sorghums were planted on 4.5 to 5 million acres and insecticide use was cut by half, according to Dr. George Teetes, Experiment Station entomologist. And on closely supervised fields, only 6.4 percent of resistant sorghums were treated with no loss in yields, compared to 99.4 percent of susceptible sorghums.

Frederiksen sums it up, "The whole purpose of the resistance program is to build a broad base of resistance to disease and insects. Since both insects and pathogens (disease) can mutate (change genetically) so rapidly, we must anticipate and be able to supply as needed new sources of genetic resistance in the sorghum plant."

Editor's Note — Any questions regarding this column should be addressed to Science Writer, Dept. of Agricultural Communications, Texas A&M University, College Station, Texas 77843.

Sorghum breeder lessens greenbug bite

Greenbugs took an expensive bite out of sorghum yields in 1968. But unfortunately for them, that same year a dedicated plant breeder named Jerry Johnson started a greenbug resistance program at Texas A&M's Lubbock Agricultural Experiment Station.

"The greenbug problem was becoming serious," Dr. Johnson explains. "We were running into an insecticide resistance problem. Initially these insects were easy to control, but in the '70's this changed dramatically, and put a sense of urgency into our greenbug resistance program."

By 1971, his work resulted in the release of improved agronomic types to commercial seed companies. Today, descendants of those releases are in farmers' fields, producing grain sorghum in spite of greenbugs. And research goes on in the search for improved varieties.

At the Lubbock Texas A&M University Agricultural Research and Extension Center, Johnson and his co-workers are close to the greenbug problem. "In Texas," he says, "we have a concept of research and extension together. Much of our research in West Texas, therefore, is applied research."

Although greenbugs have invaded 60-70% of sorghum acreage from Texas to South Dakota, Dr. Johnson feels the battle will be won. "Most seed companies," he says, "won't release new varieties for this area unless they have greenbug resistance."

And more than greenbugs challenge Johnson's plant breeding creativity. We're working on all the insect problems prevalent in Texas," he says. "Greenbugs, sorghum midge and mites are the main ones."

Dr. Johnson is intrigued by sorghum's overall potential. "I think you're going to see some big breakthroughs in yield and quality," he says. "And our ultimate goal is to improve sorghums as a feed and food ingredient."

This dedication to crop improvement for producer and consumer alike, is why Northrup King proudly salutes Dr. Jerry Johnson. His goal, like ours, is to help farmers produce more from every acre through creative seed research.

Dr. Jerry W. Johnson, Associate Professor, Texas Agricultural Experiment Station, Lubbock, Texas.

NORTHRUP KING SEEDS
NATIONAL HEADQUARTERS MINNEAPOLIS, MINNESOTA 55413

NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION / [illegible] Miller, Director / The Texas A&M University System
Agricultural Research and Extension Center / Lubbock / Telephone (AC 806) 746-6101

April 2, 1976

RESEARCH REPORT #104

GREENBUG RESISTANT SORGHUMS EXPECTED TO LIVE UP TO NAME

LUBBOCK -- Producers who use greenbug resistant sorghum hybrids this crop season can fully expect "good to excellent" yields even in the presence of greenbug infestations, provided production circumstances are normal.

This conclusion comes from evaluations last season of greenbug resistant sorghums tested on Deaf Smith and Hale County farms, and from four years of observations throughout the Great Plains from Texas to Nebraska.

Dr. Jerry W. Johnson, sorghum breeder for the Texas Agricultural Experiment Station, released the results this week, citing Texas High Plains sorghum producers for their contributions to research which led to the rapid development of the greenbug resistant hybrids.

With these hybrids on the market for the first time this year, he added, producers who use them can expect lower greenbug populations, sustained yields even with greenbug infestation, and agronomic characteristics at least equal to susceptible hybrids.

"Greenbug resistant hybrids will save Texas sorghum producers millions of dollars in insecticide costs and lower yields caused by the greenbug," Johnson said.

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"Greenbug resistance has now been incorporated into hybrids that are indistinguishable from susceptible hybrids in the absence of greenbugs," Johnson said, "but which can produce a 600 percent increase in grain yield when the greenbug population is large."

Johnson said breeding efforts to incorporate greenbug resistance into sorghum hybrids acceptable to producers was begun in 1969 by Experiment Station personnel and other public and private researchers. Since then, Experiment Station scientists have reared millions of greenbugs in the greenhouse and thousands of breeding lines have been evaluated for resistance in the greenhouse and in the field.

In the past four years, he added, greenbug resistant hybrids have been tested throughout the Great Plains from Texas to Nebraska. Observations during this time have caused cautious optimism among sorghum breeders about "hybrids that contain greenbug resistance derived from the three lines--Iuris Grass (PI 58108), IS809 and PI 264453."

Among these observations were the following:

•Greenbugs are present on greenbug resistant hybrids but at one-third to one-half the numbers found on susceptible hybrids.

•beneficial insects remove the greenbugs from resistant hybrids earlier in the season than from susceptible hybrids.

•Greenbug resistant sorghums can be damaged by greenbugs but it takes a large number of greenbugs feeding for a longer period of time on resistant sorghums to cause the same yield loss on susceptible sorghum hybrids.

•Greenbug resistance in sorghum has no adverse effects on grain yield, quality or other important agronomic characteristics of the hybrid.

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GREENBUG RESISTANT SORGHUMS: 3-3-3-3

In 1975 yield trials where greenbugs were controlled, resistant hybrids produced grain yield equal to standard commercial hybrids (over 7500 pounds per acre), Johnson reported. However, in Deaf Smith and Hale County tests where greenbugs were not controllable with insecticides, resistant hybrids produced seven times as much grain as susceptible hybrids (600 pounds per acre for non-resistant hybrids compared to 4500 pounds per acre for resistant hybrids) in Deaf Smith County, and over two times as much grain in Hale County (3700 pounds for the susceptible compared to 6100 pounds for the resistant hybrids.)

Breeding and evaluation studies conducted by Experiment Station personnel in greenbug resistance have been aided by a research grant from the Texas Grain Sorghum Producers Board.

"Most sorghum producers on the Texas High Plains can take pride in the fact that they have had a direct input into the availability of greenbug resistant hybrids when they participated in the check-off program," Johnson said. "These producers will receive a return on their investment many-fold."

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NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION / J. E. Miller, Director / The Texas A&M University System
Agricultural Research and Extension Center / Lubbock / Telephone (AC 806) 746-6101

June 2, 1976

RESEARCH REPORT #111 FOR IMMEDIATE RELEASE

TEXAS AGRICULTURAL EXPERIMENT STATION RELEASES
NEW GREENBUG RESISTANT SORGHUMS

LUBBOCK -- The Texas Agricultural Experiment Station has released 23 more new greenbug resistant sorghum lines to commercial seed companies and public agencies. Research scientists expect the new material to be incorporated into commercial hybrids and made available to producers by 1978.

Considered agronomically improved over previously released greenbug resistant lines by the Experiment Station, the new lines have a greater range in maturity and higher levels of disease resistance.

Designated as Tx 2734 through Tx 2752, the greenbug resistant lines were derived from "five elite sorghum varieties" that have proved useful in Texas sorghum production.

The source of greenbug resistance used in the 23 lines is from material first identified as greenbug resistant in 1969 by the Kansas, Oklahoma and Texas Experiment Stations.

Dr. Jerry Johnson, Lubbock-based Experiment Station sorghum breeder, says the new sorghums will be used by commercial companies to incorporate into their

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hybrids. The new hybrids should have higher yield potential and superior agronomic characteristics equal to or better than most greenbug resistant varieties currently being grown on the Texas High Plains, he says.

The greenbug, an aphid which attacks small grain and sorghum, has cost sorghum producers in excess of 10 million dollars annually since 1968, the year High Plains crops suffered the first serious greenbug infestation, Johnson adds. When greenbug resistance was found in Tunis grass derivative lines and other grassy, non-adapted sorghums from the World Sorghum Collection, Texas researchers set out to incorporate that characteristic into lines that could be used in hybrids for High Plains production.

Since then, Johnson says, thousands of breeding lines have been evaluated in the greenhouse and in the field.

In 1972, the Texas Agricultural Experiment Station released its first greenbug resistant material with the distribution of two greenbug bulks, TAM BK-41 and TAM BK-42.

In 1974, two other germplasm bulks, TAM BK-43 and TAM BK-44, were released as well as two greenbug resistant yellow endosperm pollinator lines, TAM 2567 and TAM 2568. Some of the greenbug resistant hybrids available this year have these yellow endosperm pollinators as the male parent.

Johnson says that some commercial companies obtained greenbug resistant material as it became available and incorporated it into their breeding lines. Some of the greenbug resistant hybrids marketed in 1976 were developed in this manner by commercial companies.

GREENBUG RESISTANT SORGHUMS: 3-3-3-3

With greenbug hybrids on the market for the first time this year, Johnson says, producers expect their sorghum crops to produce good yields even in the presence of heavy greenbug populations. Tests and observations from four years of plantings throughout the Great Plains from Texas to Nebraska indicate that hybrids containing greenbug resistance should perform well under heavy greenbug populations.

In 1975 yield trials, he says, yields of resistant hybrids equalled those of non-resistant or susceptible hybrids where greenbugs were controlled or absent, and under greenbug attack produced up to seven times as much grain as the susceptible varieties.

"Although there are indications that widespread use of greenbug resistant sorghums will alleviate the sorghum producer's greenbug problem," Johnson says, "Experiment Station scientists are continuing to search for new sources of resistance to the insect pest and to incorporate resistance into new and improved varieties."

Breeding and evaluation studies conducted by Experiment Station personnel in greenbug resistance have been aided by a research grant from the Texas Sorghum Producers Board.

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TAES

NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION / J. E. Miller, Director / The Texas A&M University System
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June 28, 1976

RESEARCH REPORT #114 FOR IMMEDIATE RELEASE

TAES SCREENING PROGRAM REDUCES SORGHUM LOSSES

LUBBOCK -- Not given to solving problems after crop damage has already been done, Texas Agricultural Experiment Station research scientists are using sorghum disease screening nurseries in Texas, Puerto Rico and five other states to detect new diseases or any changes in old ones before they become economically damaging on the High Plains.

Dr. Darrell Rosenow, sorghum breeder at Lubbock, and Dr. R. A. Frederiksen, College Station - based pathologist, are carrying out their research in more than 20 disease screening nurseries in Texas, Puerto Rico, Mississippi, Georgia, Kansas, Arizona and California.

The TAES disease nursery program, which began in 1958, is designed to prevent or reduce losses to new disease organisms or to more potent strains of old pathogens.

"By planting the same sorghum variety lines at several locations, new diseases or new races are often detected before they can become an economically important disease," says Rosenow. "Breeders already, then, either have or can be working on sources of resistance when the disease or race appears here on the Plains."

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SORGHUM DISEASES STUDIED 2-2-2-2

An example of the changeablility in sorghum diseases is head smut, a disease that has been around for a long time, but which has increased significantly the past few years. According to Rosenow, the smut organism has the ability to change rapidly to break down plant resistance, rendering the sorghums susceptible.

"New races of smut first developed in South Texas in the early 1960's, and since then evolved independently in West Texas," Rosenow says. To combat the versatile pathogen, large screening nurseries were located in key areas of the Coastal Plains where the newest races exist.

"These nurseries help identify germplasm sources with resistance. The germplasm material is then made available to all sorghum breeders for use in incorporating resistance into their hybrids."

In 1976, because of obvious rapid change in smut races in South Texas and unusually high incidence of head smut in some sorghum fields on the High Plains, a smut screening nursery under Rosenow's supervision was planted on the High Plains near Halfway, just west of Plainview.

The nursery contains over 2,400 entries and is a duplicate of nurseries planted near Edna and Beeville in South Texas.

Lines with resistance grown at all three locations will be used in breeding programs to devel p smut resistant hybrids, adds the scientist.

Rosenow and his co-workers are studying other disease problems, including charcoal rot, a stalk rot induced by moisture stress during grain development, and maize dwarf mosaic, caused by a virus transmitted by aphids. They're also scrutinizing Pythium root rot, Fusarium head

blight, downy mildew, and foliage diseases such as rust, bacterial stripe, and anthracnose. Also under study is field grain weathering, caused by various organisms present during periods of damp weather.

"Excellent sources of resistance to all these diseases have been identified," he says. "These sources are currently being used by commercial seed company breeders in an effort to reduce disease losses and to reduce the threat of losses in the future."

Assisting Rosenow and Frederiksen are Lucas Reyes and Dr. Bob Pratt of Corpus Christi, Dr. F. R. Miller and Dr. R. W. Toler of College Station, and Dr. J. W. Johnson of Lubbock.

The research study is supported in part by the Texas Grain Sorghum Producers Board and the United States Agency for International Development.

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