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ANNUAL REPORT

on

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

Contract No. AID/ta-c-1384

March 1, 1977 - February 28, 1978

Prepared by

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

Submitted to

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

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PERSONNEL

Department of Plant Sciences
Texas Agricultural Experiment Station
College Station, Texas 77843

R. A. Frederiksen

James Foster	Technician
Loral Castor	Graduate Student
Dennis Franklin	Graduate Student
Robert Miller	Graduate Student
Marcial Pastor	Graduate Student
Salumu Shabani	Graduate Student

Texas Agricultural Experiment Station
Lubbock, Texas 79401

D. T. Rosenow

Charles Woodfin	Research Associate
Lawrence Minssen	Technician

J. W. Johnson

J. M. Phillips	Research Associate
Douglas Porter	Technician
Virginia Riggs	Technician

Department of Entomology
Texas Agricultural Experiment Station
College Station, Texas 77843

G. L. Teetes

Allen Wuensche	Graduate Student
Frank Davis	Graduate Student
Warlarde Chantrasorn	Graduate Student
David Hall	Graduate Student
Fred Baxendale	Graduate Student

Department of Soil and Crop Sciences
Texas Agricultural Experiment Station
College Station, Texas 77843

F. R. Miller

Victor Eder	Technician
John Thompson	Technician
Keith Lahr	Research Associate
John Scheuring	Graduate Student
German Perez	Graduate Student
Dan Meckenstock	Graduate Student
Alberto Betancourt	Graduate Student
Geoffory Thomas	Graduate Student

L. W. Rooney

J. A. Glueck	Research Associate
Lisa Glover Blakley	Graduate Student
J. O. Akingbala	Graduate Student
Choalin Chou	Graduate Student
C. Des Rosiers	Graduate Student
M. N. Khan	Research Scientist

K. F. Schertz

Dale Schafer	Computer Systems Analyst
Brian Mustain	Graduate Student
Ross Peters	Graduate Student

Co-workers:

L. E. Clark, Plant Breeder
Texas Agricultural Experiment Station, Vernon, Texas.

J. Craig, Plant Pathologist, USDA, Department of Plant Sciences,
Texas Agricultural Experiment Station, College Station, Texas.

P. W. Morgan, Plant Physiologist, Department of Plant Sciences
Texas Agricultural Experiment Station, College Station, Texas.

R. G. Pratt, Plant Pathologist
Texas Agricultural Experiment Station, Corpus Christi, Texas.

L. Reyes, Agronomist
Texas Agricultural Experiment Station, Corpus Christi, Texas.

R. W. Toler, Virologist, Department of Plant Sciences
Texas Agricultural Experiment Station, College Station, Texas.

C. W. Wendt, Soil Physiologist
Texas Agricultural Experiment Station, Lubbock, Texas.

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-1384

2. Key Investigators:

Richard A. Frederiksen
Department of Plant Sciences
Texas Agricultural Experiment Station
College Station, Texas 77843

Darrell T. Rosenow
Texas Agricultural Experiment Station
Lubbock, Texas 79401

3. Contract Period: March 1, 1977 - February 28, 1979
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5. Total AID funding of contract to date: $237,675
6. Total expenditures and obligations through previous contract year: $279,946
7. Total expenditures and obligations for current year: $237,675* Estimated: $290,000
8. Estimated expenditures for next contract year: $362,325

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*Does not include encumbrances.

B. Narrative Summary of Accomplishments and Utilization

During 1977, 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.

Elite sources of germplasm generated in Texas programs from introduced, converted and partially converted exotic sorghums were distributed to sorghum workers throughout the world. 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 and hybrids possessing tropical adaptation were grown in Africa and South America. The potential for these types of sorghums is excellent.

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

ANNUAL RESEARCH REPORT

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 agricultural 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 phaseolina*); 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 urgent 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 catalog sources of disease and insect resistance
2. To develop high yielding agronomically desirable sorghum varieties and lines;
3. To develop elite breeding populations of sorghum with high levels of resistance to disease and insects;
4. To develop efficient resistance screening techniques;
5. To evaluate populations or plant pathogens for their range or changes in virulence;

6. To identify characteristics useful in seed production such as cytoplasmic sterility factors, apomixis and crossing traits.

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 13 years. These activities involve an integrated interdisciplinary approach toward the development of sorghums for cultivation in temperate and tropical regions. The work plan stresses ecologically sound host plant resistance as a means of combating diseases and pests. 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 to crop improvement throughout the world.

D. Accomplishments to Date

Disease data were collected from the major screening nurseries in Texas, Mississippi and Georgia. These included downy mildew, head smut and

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 3,000 entries were evaluated at Edna and Kress, Texas with an additional 1200 entries at Kress. Generally, disease development under natural conditions was relatively poor compared with previous years. Artificial inoculation of head smut, downy mildew and foliar pathogens was more useful.

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 1977. Converted and old lines with resistance to race 4 of Sphacelotheca reiliana were evaluated in both South and North Texas in 1977.

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.

The 30-entry International Disease and Insect Nursery (IDIN) was grown in 22 locations in 1977 (Tables 1 and 2). Excellent disease data were obtained from several African and Latin American countries and are reported in detail in the Fourth Annual Progress Report (ta-c-1384). In general, the IDIN entries in West Africa had similar adaptation ratings (note the trip reports of Senegal, Niger and Upper Volta).

Table 1. INTERNATIONAL DISEASE AND INSECT NURSERY (IDIN) - 1977-78

Entry no.	Designation	IS No.	Variety, kind or group	Plot numbers Rep I	Plot numbers Rep II
1	SC 56-14	12568	Cau-Nig	11	34
2	SC 103-12	2403	Caudatum	25	48
3	SC 108-14	12608	Zerazera	3	55
4	TAM 428 (SC110-9)	12610	Zerazera	9	32
5	SC 110-14	12610	Zerazera	18	41
6	SC 112-14 (uc)	12612	Zerazera	23	46
7	SC 170-6-17(4267)	12661	Zerazera	5	39
8	SC 170-14	12661	Zerazera	10	53
9	SC 173-12-6	12664	Zerazera	17	51
10	TAM 2566(SC175-9)	12666	Zerazera	2	57
11	SC 175-14	12666	Zerazera	21	31
12	SC 237-14	3071	Dobbs	14	59
13	SC 279-14	7419	Conspicuum	30	40
14	SC 326-6	3758	Nigricans	27	47
15	SC 414-12E-P1	2508	Cau-Kaf	7	45
16	Sc 599-6-3(9247)	17459	Rio	16	36
17	SC 599-11E	17459	Rio	28	50
18	SC 748-5-3	3552	Cau-Guin	13	33
19	Tx 430	-	(Tx2536 X SC170)der.	4	42
20	B Tx 624	-	(B3197 X SC170)der.	20	54
21	GPR 148	-	-	6	38
22	(SC56 X SC33) sel 1778	-	Cau-Nig-Dur der.	24	38
23	(B3197 X SC170) sel 1750	-	Kafir-Zera der.(R line)	22	35
24	(IS2930 X IS3922)	-	Y. End.	29	44
25	QL 3 selection	-	C. Kaf. der.	15	58
26	TAM 2567	-	Tx 2536 der.	8	60
27	B Tx 378	413	Redlan	26	49
28	B Tx 398	412	Martin	1	37
29	Tx 7078	415	Combine 7078	12	43
30	Tx 2536	10542	Y. E. Fet. der.	19	52

Table 2. 1977 International Disease and Insect Nursery (IDIN) Locations*

Location (Number)	Cooperator
Bolivia (2)	Charles Ward Santa Cruz
Botswana (1)	D. E. Gollifer Gabarone
Brazil (1)	M. Lira Recife
Egypt (1)	S. I. Salama Giza
Ethiopia (1)	Brhane Gebrekidan Nazareth
Guatemala (1)	A. Plant Guatemala City
India (4)	N. V. Sundaram (3) New Delhi B. R. Barwale (1) Bombey
Mali (1)	S. A. Clarke Bamako
Mexico (2)	S. P. Singh (1) Poza Rica H. Macias (1) Matamoros
Mississippi (1)	N. Summo Meridian
Niger (2)	Clark Harvey Maradi
Nigeria (1)	M. M. El Rouby Zaria
Pakistan (1)	S. F. Hassan Islamabad

Table 2. Continued.

Location (Number)	Cooperator
Panama (1)	C. Goodrich Balboa
Papua New Guinea (1)	M. R. Wanjari Port Moresby
Senegal (1)	J. C. Girard Bambey
Sudan (2)	A. E. Kambal (1) Shabat M. A. Faris (1) Khartoum
Taiwan (1)	P. Sun
Tanzania (1)	S. Z. Mukuru/P. Duffield Dar es Salaam
Upper Volta (2)	C. M. Pattanayak (1) Ouagadougou J. A. Frowd (1) Kamboinse
Venezuela (2)	M. Riccelli (1) Valencia Gino Malaguti (1) Maracay
Yemen (1)	E. M. Stickney

* IDIN entries are also in the ADIN, see ADIN nursery locations.

Table 3. 1977 All Disease and Insect Nursery (ADIN) Locations*

Location (Number)	Characteristics Screened For:
Texas	
Berclair (2)	Head smut, downy mildew, zonate
Chillicothe (1)	Drought tolerance
College Station (3)	Maize dwarf mosaic (MDM), foliage diseases, adaptation
Corpus Christi (1)	Head smut, downy mildew, adaptation
Edna (1)	Head smut, downy mildew, seed weathering
Halfway (2)	Corn leaf aphid, adaptation
Kress (1)	Head smut, rust, Fusarium head blight, insecticide burn
Lubbock (5)	MDM, rust, seed weathering, lodging, corn leaf aphid, drought tolerance
Pecos (1)	Mites
San Angelo (1)	Drought tolerance
Uvalde (1)	Adaptation
Weslaco (1)	Midge, adaptation, foliage diseases
Georgia - Experiment (1)	Anthracnose
Kansas - Manhattan (1)	MDM
Mississippi - Meridian (1)	Anthracnose, foliage diseases
Egypt - Giza (S. I. Salama) (1)	Head smut
Guatemala - Guatemala City A. Plant (1)	Anthracnose, adaptation
Mexico - Tampico (1)	Leaf blight, rust, downy mildew
Puerto Rico - Isabela (1)	Anthracnose, leaf blight, rust

The lodging breeding and screening program in 1977 intensified efforts on evaluation of hybrids. Ten hybrid tests were planted, including one each in Kansas and Nebraska. Tests planted which contained only lines included ten Statewide Lodging Tests (SLT), six Advanced Lodging Tests (ALT), and four Preliminary Lodging Tests (PLT). The primary lodging test consisted of 21 lines and 61 hybrids called the SMLDS Test, standing for sugar, mite, lodging, drought, and senescence. It was designed to learn more about the relationship among these characteristics. Past experience had indicated that an unusually high number of lodging resistant, nonsenescent lines also exhibited mite resistance.

Ideal weather conditions contributed to excellent data on the charcoal-rot, moisture-stress type lodging, on differences in nonsenescence, and on response under drought. Unfortunately, no good mite data were obtained in 1977. Sugar analyses indicated that % sugar in the stem drops dramatically during grain development in all cultivars (but not to the same degree in all) and then again increases following physiologic maturity of the grain. Differences in sugar percentages exist among varieties and between dryland and irrigated plots. The relationship among sugar, the physiologic state of the plant, and the varietal response to various pest and environmental stresses is still not understood and will be investigated again in 1978.

Excellent correlation ($r = 0.70$) were obtained between nonsenescence ratings and both charcoal-rot and lodging percentage.

Therefore, ratings on the relative degree of plant senescence when plants are under moisture stress during the late grain development stage appears to be an excellent selection technique for lodging and charcoal rot resistance. Infra-red aerial photography ratings of the color differences among individual plots in a nursery under moisture stress were not correlated with lodging,charcoal rot, or senescence ratings.

and Fusarium. More varieties in the GWT were damaged by Fusarium than by Curvularia, although on susceptible varieties the damage by Curvularia was severe.

A field emergence test of inoculated seed was conducted at one location using five varieties. Fusarium reduced emergence compared with Curvularia and controls.

In addition to the non-brown sorghum lines previously reported as possessing resistance to preharvest grain deterioration (SC 748-5, SC 279-14, SC 566-14, 74PR759, and B Tx 398), an additional line, SC 630-11, has been identified with resistance to both microbial deterioration and preharvest sprouting. A laboratory technique has been evaluated to screen for grain sprouting. Evaluation of the conductivity of seed leachate method indicates that this procedure is effective in preliminary screening for resistance to preharvest grain deterioration (weathering, grain mold) if grain characteristics are taken into consideration and seed are grown under the same growing conditions.

Further progress on documentations of physical and chemical changes in the seed with progressive deterioration supports the original hypothesis of primary microbial entry through the water uptake system (hylar area) with subsequent movement to the germ and endosperm area adjacent to the germ.

Preliminary chemical and microscopic examinations of seed of resistant and susceptible lines suggest both chemical and structural variations which are related to "levels" of resistance. Studies on chromatographic separations of water extracts from seed indicated differences in the number and width of bands. Structural alterations in the stylar and hilar area of seed, a more complete surface wax coverage, and epicarp cell structure seem primary considerations in understanding mechanisms of resistance to preharvest grain deterioration in sorghum.

Population breeding of disease and insect resistant populations in 1977 included the random mating, in either Texas or Puerto Rico, of the following:

TP8R-sel. (midge)	TP9R2 (lodging-S_1 tested)
TP9R4 (lodging-mass sel.)	TP10RB (MDM)
TP12R (high lysine-Ethiop. source)	TP15 (broadbase conversion items)
TP16RB (high lysine-P721)	TP17R (yellow endosperm)
TP18RB (low smut-S_1 tested)	TP19RB (high smut-S_1 tested)

Three new populations in broad-based disease and insect germplasm backgrounds, random-mated in 1977, were: (1) TP20RB (weathering-resistant, red and white pericarp only); (2) TP21RB (food type, pearly only); and (3) TP22RB (leaf disease resistant). 170 half-sibs from the low smut population (TP18RB) were screened in the Berclair and Kress Head Smut Nurseries, as well as inoculated at College Station.

S_1 testing appears to be very effective in increasing the level of head smut resistance in populations. After only one generation of selection and subsequent random mating, the low-smut population (TP18RB) had 0.7% smut under natural infection at Berclair, while the high smut population (TP19RB) had 6.6% smut. Under artificial inoculation, the difference was 12.7% for TP18RB compared to 31.0% for TP19RB.

The 20-entry Uniform Head Smut Nursery (UHSN) was planted at 12 locations in Texas and 2 locations in Kansas in 1977 to continue the monitoring of changes in the smut pathogen. No major shifts in pathogenicity were noted, but there was evidence for slight broadening in host range.

The International Anthracnose Virulence Nursery (ISAVN), as well as a Converted Line Anthracnose Test (CLAT), were distributed on a limited basis in 1977 (Tables 4a and 4b). The ISAVN is a cooperative program with Mississippi. Cultures of Colletotrichum graminicola, from several U.S. locations, have been received at Texas A&M for comparisons in laboratory and greenhouse trials.

Table 4a. 1977 International Sorghum Anthracnose Virulence Nurseries.

Location	Cooperators
ARGENTINA	A. Angel
FLORIDA (Giville)	V. E. Green
FLORIDA (Marianna)	D. W. Gorbet
GEORGIA	R. R. Duncan
GUATEMALA	A. Plant
INDIA	R. J. Williams
MISSISSIPPI	N. Zummo
MISSISSIPPI	L. Gourley
PUERTO RICO	A. Sotomayor-Rios
TEXAS (Beaumont)	N. G. Whitney
VENEZUELA	D. Tovar
VENEZUELA	M. Riccelli

Table 4b. Converted Line Anthracnose Tests/Nurseries

Location	Cooperators
GEORGIA	R. R. Duncan
MEXICO (Matamoros)	H. Macias
VENEZUELA (Valencia)	M. Riccelli

After a program of development covering several years, and cooperative research among participants at Kansas State Agricultural Experiment Station, the Institute of Tropical Agriculture in Puerto Rico, and the Texas A&M Experiment Station at College Station, a sudangrass germplasm population, RSP3BR, was released jointly by the Science Education Administration and the Agricultural Experiment Stations of Kansas and Texas

The RSP3BR offers a 90% frequency of resistance to downy mildew. It is designed primarily for breeders as a source of resistance in the development of commerically suitable cultivars with a high level of sorghum downy mildew resistance.

TAM 6K 49 and TAM 6K 50 were released by TAES as downy mildew resistant sudangrass bulks and forage sorghum bulks, respectively. These bulks have high levels of resistance to downy mildew, are sweet and juicy, but segregating for several other agronomic and disease-resistance traits.

Three duplicate midge evaluation nurseries containing 3200 plots each were grown at Corpus Christi, Beeville, and Lubbock, Texas. Observations were made for midge resistance, disease resistance, general adaptation, and yield potential. Selections were made that had high levels of midge resistance and that were improved agronomically over their midge-resistant parent.

Regional sorghum midge tests were planted at Corpus Christi, Beeville, and Lubbock, Texas; Stillwater, Oklahoma and Tifton, Georgia. The relationship of damage ratings among locations was good. Of the 42 experimental breeding lines tested, eight did not differ significantly in midge damage from TAM 2566 or SC 423 (IS 2579 C). The breeding lines were derived from TAM 2566, AF 28, SC 414 (IS 2508 C) and TP6B (D). Significantly, one of the lines with a desirable rating was a "B" line, a TP6B(D)-54 selection.

Hybrids with one midge-resistant parent had significantly less midge damage than hybrids with two midge-susceptible parents and hybrids with two resistant parents produced significantly more seed than hybrids with one resistant parent. One midge resistant hybrid produced over 2500 kg/ha more grain than the standard susceptible hybrids tested.

Another source of midge resistance, IS 2757C (SC 319), has been identified. IS 2757 is a Dochna/Nigricans introduced from Uganda. The converted line is resistant to anthracnose but susceptible to head smut, downy mildew, and maize dwarf mosaic virus.

In field tests at Lubbock and Halfway, several lines were identified as corn leaf aphid resistant. Most of the resistant lines were zerazera types but other types such as B Tx 3047, SC 326-6, SC 414 and Tx 2737 were not injured by corn leaf aphids.

Selection was begun from the backcrossing program to transfer genes from all known sources of greenbug resistance to improved agronomic types. Greenbug-resistant sources used in the work are as follows: SA 7536-1, KS 30, IS 809, PI 15264, PI 220248, PI 302178, PI 302231, PI 226096, and Capbam.

Breeding nurseries and evaluation tests were planted for mite resistance evaluation but sufficient mite populations failed to develop. Early plantings of wheat and corn adjacent to the mite evaluation nursery will be made in an effort to enhance the mite population in 1978.

Greenbug resistant sorghum hybrids resulted in a decrease in insecticide use of approximately 50% in supervised pest management programs. State-wide, this reduction would account for about $5.0 million savings in insecticide costs. No new greenbug biotypes were reported.

Converted alien sorghum lines (75 - 100 at several locations) were screened for resistance to sorghum midge, sorghum webworm, yellow sugarcane aphid, and maize weevil. The Sorghum Conversion Program continues to supply the entomologists with diverse germplasm possessing resistance to several sorghum insect pests.

At least one new midge resistant line was identified. AF 28, a midge resistant sorghum from Brazil, is also midge resistant in Texas. This resistant source has been incorporated into the plant breeding-entomology program. Research results continue to show antibiosis to be the major resistance mechanism with death occurring during the larval stage. Nonpreference is also a functioning mechanism. Electron photomicrographs of midge larval mouthparts have provided new clues to the nature of midge resistant sorghums.

A positive relationship was shown to exist with panicle compactness and sorghum webworm numbers. Webworm larval mortality is high, generally higher in loose vs. compact panicles, but mortality factors are not well understood. Head size nor seed endosperm type influences webworm numbers. Eggs are deposited on panicles soon after emergence from the boot and numbers of eggs are not related to panicle characteristics, but subsequent larval

mortality is. The cultural practice of manipulating planting date is effective in avoiding damaging webworm levels.

No effective resistant sorghum sources were identified for the yellow sugarcane aphid. Most tested millet lines are resistant. Damage to sorghum by the aphid is substantial. At initial infestation levels of 1, 2, and 4 adults per plant, a 12, 23, and 36% reduction in plant height and a 22, 25, and 38% reduction in weight resulted, respectively.

Preliminary results indicate quantifiable differences in maize weevil resistance among sorghum grains. Tests are designed to identify grain characteristics influencing resistance based on free and no-choice tests.

In the spring of 1977, an agreement was reached between the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and the Texas Agricultural Experiment Station whereby we could submit entries into some of the International Testing Programs of ICRISAT. TAES can enter materials either by sending seed to ICRISAT for later inclusion after seed increase, or by asking for entries and test locations and then sending seed directly to each cooperator. International ICRISAT nurseries for which such agreements were established are the ISLDN (leaf disease), ISGMN (grain mold), ISDMN (downy mildew), and ISMN (midge). This agreement allows the evaluation of our material in key international locations and comparison with other elite lines available internationally.

Although the plans were finalized somewhat late to permit dispatching seed to all locations in time to plant, listed below are the entries we submitted for the nurseries, and the locations and cooperators to which seed was sent during 1977.

ISGMN

SC 566-14 (IS 7254C)
SC 279-14 (IS 7419C)
SC 97-14 (IS 12602C)
SC 748-5 (IS 3552 der.)
SC 630-11 (IS 1269 der.)

ISLDN

SC 566-14 (IS 2754C)
77CS1 (IS 2930 X IS 3922)sel
SC 599-6(9247) (IS 17459 der.)
SC 326-6 (IS 3758 der.)
CV 54

ISDMN

Tx 430
B Tx 624

ISMN

IS 3071C (SC 237-14)
IS 12666C (SC 175-14)
IS 8100C (SC 242-14)
TAM 2566 X (3197 X 170)-10 sel

ISGMN Entries Sent:

Cameroon (1)	E. Monthe
Ethiopia (2)	B. Gebrekidan
India (2)	N. V. Sundaram
	R. J. Williams
Mali (1)	S. A. Clarke
Niger (1)	O. Sidibe
Nigeria (1)	S. O. Okiror
Senegal (2)	J. C. Girard
Upper Volta (1)	J. A. Frowd

ISLDN Entries Sent:

Ethiopia (2)	B. Gebrekidan
India (6)	N. V. Sundaram
	R. J. Williams
Nigeria (1)	S. O. Okiror
Senegal (1)	J. C. Girard
Upper Volta (1)	J. A. Frowd

ISDMN Entries Sent:

Botswana (1)	D. E. Gollifer
India (3)	N. B. Sundaram

ISMN Entries Sent:

India (1)	J. C. Davies
Mali (1)	S. A. Clarke
Upper Volta (1)	J. A. Frowd

In 1977 a large number of hybrid-parent yield trials were distributed to tropical international locations (Table 5). Hybrids and parents possessing what has been defined as "tropical adaptation in temperate zone sorghums" appear to respond very favorably over a wide range of environments. These materials, selected on the basis of their reaction in South and Central Texas and in Puerto Rico, express this yield-enhancing characteristic in more tropical environments equally well. Indications are that breeding for "tropical adaptation" can be effectively done in South Texas and Puerto Rico.

Data received through 1977 from cooperators, in addition to evaluations made in person on trips into Guatemala, Venezuela, Puerto Rico, Mexico, Bolivia, Brazil, Senegal, Upper Volta, Niger, Sudan and Ethiopia, indicate that our materials selected for "tropical adaptation" in Texas are very high yielding in the low and mid-range elevations of the tropics. Evaluation of breeding materials in the short winter days in Puerto Rico, semi-tropical South Texas, and temperate Northwest Texas, is very effective in selecting for widely adapted sorghums with high yield potential under tropical conditions around the world.

Similarly, these tropically adapted grain sorghums are performing well in State-wide Performance Trials all across Texas. In 1977, tropically adapted hybrids were significantly higher yielding than standard USA developed hybrids at Weslaco, Corpus Christi, Uvalde, College Station, Dallas, Temple and Lubbock. Similar results were obtained in Regional Yield Trials throughout the USA sorghum belt.

Table 5. International Locations of TAES Hybrids and Lines (5 to 30 Entries) for Yield Evaluation (Adaptation) in 1977.

Location	Cooperator
Cooperative with ICRISAT:	
Botswana	D. E. Gollifer, M. Boling Gabarone
Ethiopia	B. Gebrekidan Nazareth
Mali	S. A. Clarke Bomako
Nigeria	M. M. El Rouby Zaria
Senegal	J. C. Denis, Mouboussin Bambey, Sefa
Sudan	M. A. Faris Wad Madani
Tanzania	S. Z. Mukuru
Upper Volta	C. M. Pattanayak Ouagadougou
Other Locations:	
Argentina	F. J. Llobet
Bolivia	C. R. Ward Santa Cruz
Brazil	M. Lira Recife
Chad	J. W. King, Jr. N'Djamena
Guatemala	A. Plant Guatemala City
India	L. R. House, B. R. Barwale Hyderabad (CIMMYT), Bombay

Table 5, Cont.

Location	Cooperator
Mexico	S. P. Singh (CIMMYT)
Niger	C. Harvey Maradi
Papua, New Guinea	M. R. Wanjari Port Moresby
Puerto Rico	A. Sotomayor-Rios Isabela
South Africa	H. Muller Transvaal
Venezuela	M. Ricelli Valencia

Important conclusions have been reached, based on our travels and data received. First, sorghums can be effectively bred for high yield in the tropical sorghum production regions (5 - 15° North or South) by selecting only in Texas (especially those materials which perform well in South Texas and Puerto Rico). TAES experimental hybrids are very well adapted across much of Africa and Central America, where they are high-yielding and of acceptable maturity and height. However, parental lines, as they are selected for hybrid production, are generally too short and too late for direct use as improved varieties; slightly earlier, taller materials with greater exsertion would be more useful.

Hybrids evaluated across the broad belt of Africa and Central America showed wide acceptance by cooperators (BTx 623, BTx 624, 77CSI, RTAM 428, RTx 430, SC0170-6 derivatives, SC0599-11E, SC0326-6, SC0173-14, and 74CS5388). Materials previously distributed from the TAES program (SC0108-9-8-4 -Pickett #3-, 3927-4, Pickett #4-8, etc. with the zerazera background) are widely useful also. The original source material came from the Gambella region of Ethiopia and has many unique and useful characteristics. While some TAES materials are susceptible to sooty stripe and long smut, others have excellent sooty stripe resistance (SC0326-6, BTx378 and BTx 3197) and long smut resistance. Although the anthracnose reaction in West Africa differs from that in the Western Hemisphere, several TAES materials show good resistance (SC0103-12, SC0112-14, SC0279-14, SC0326-6 and BTx 378). In Upper Volta, several of the tropically adapted hybrids showed good tolerance to Striga. In Niger, mature grain weathering resembled that in Texas; and those lines showing resistance in Texas were among the best in Niger.

Generally, apomixis, asexual seed production, was found to be present at a low level in several lines of sorghum. These lines were characterized by multiple embryo sacs and by some maternal type plants in progeny from crossing the putative apomict as a female by a pollen parent with a dominant marker gene.

Detailed cytological observations were made of R473, a line from India reported to be an obligate apomict. Although there were numerous embryo sacs in some ovules there was not clear evidence of obligate apomixis. However, negative information in studies such as these are not conclusive and progeny tests are being made to get conclusive information about the frequency of apomixis in these lines.

Investigations of cytoplasmic-genic male sterility in sorghum have revealed several potential new sterility systems. Reciprocal crosses among lines from the USDA - Texas Agricultural Experiment Station cooperative sorghum conversion program produced some F_2 progenies with male sterile plants. Cytoplasmic-genic steriles were isolated by backcrossing. From test crosses of the most advanced progenies, it appears that some of these steriles may be due to a cytoplasmic-genic system different from our present milo-kafir system. A male sterile, A2Tx2753, with this probable new system, was released to other breeders. If it is a new system, it may provide an opportunity to diversify the nuclear germplasm of female parents. Additional tests to prove the distinctiveness of the cytoplasm of this new sterile will be made after isocytoplasmic lines are developed. Other lines with cytoplasms that induce sterility are IS7506C, IS12662C, IS112C, IS7920C, IS2816C, IS2754C, and IS2198C

Continued effective evaluations of Texas selected "tropically adapted" hybrids and varieties in international locations across the low and mid elevations of Africa, South America and Central America will provide further explanations of yield limitations as well as providing an avenue to distribute desirable and high-yield sorghums.

Handling of data from field observations has been made more efficient by development of computer techniques specifically for this sorghum project. A computer program was developed to compile, sort, and analyze data from yield and performance trials. Storage of data from these tests was computerized after developing a list of descriptors and parameters. Another task completed was the development of a new form for collecting field data on disease readings in the ADIN and IDIN. Progress is being made in establishing a computerized base of previously compiled sorghum data. Compilations of data were made available to USDA where the data were converted to machine-readable form for computer tapes. Copies of the tapes will be installed at this location and the data from them will be available for accessing by scientists here and elsewhere to facilitate the establishment of an international data system.

Support personnel are being trained to enter data from disease and insect nurseries into the computer and to process these data for presentation in the Annual Report of this project to AID. Graduate students are being advised regarding the efficient computerization and analysis of research data. Work has been initiated on a program to access by computer terminal the sorghum data base.

Table 6. Persons requesting and receiving Adaptation Trials in 1977.

Tropical Adaptation Test:	
H. Muller	AFRICA, Transvaal
J. King	CHAD
A. Sotomayor-Rios	PUERTO RICO
Adaptation Yield Test:	
R. Viner	FIJI ISLANDS
M. R. Wanjari	NEW GUINEA
C. Harvey	NIGER
J. C. Denis	SENEGAL
Texas Adaptation Test:	
F. J. Llobet	ARGENTINA
General Adaptation Test:	
Data taken by L. Reyes at Maracay, VENEZUELA.	

Persons requesting and receiving seed of disease and insect resistant sorghum lines or germplasm in 1977

International:

I. Antohe
ROMANIA

B. R. Barwale
INDIA

L. W. Cazon
ARGENTINA

E. T. Edward
AUSTRALIA

M. M. El Rouby
NIGERIA

J. C. Girard
SENEGAL

C. Harvey
NIGER

L. R. House
INDIA (ICRISAT)

M. Lira
BRAZIL

F. J. Llobet
ARGENTINA

H. Macias
MEXICO

S. Z. Mukuru
TANZANIA

C. M. Pattanayak
UPPER VOLTA

J. H. S. Ponnayya
INDIA

M. Riccelli
VENEZUELA

J. E. Rosas
MEXICO

A. Sotomayor-Rios
PUERTO RICO

E. R. Siklosi
HUNGARY

D. Tovar
VENEZUELA

K. Ujihara
JAPAN

H. van Arkel
KENYA

M. R. Wanjari
PAPUA NEW GUINEA

C. R. Ward
BOLIVIA

R. J. Williams
INDIA (ICRISAT)

A. Plant
GUATEMALA

U. S. -- Private Breeders:

C. D. Berry
P-A-G Seeds

J. D. Carroll
Delta & Pine Land Co.

C. E. Claassen
Pacific Oilseeds

J. E. Curtis
Clay County Seed Co.

L. G. Dalton
Pioneer Hi-Bred International

L. Dean
Harpool Seed Co.

J. L. Ervin
Holden Foundation Seed

J. Faber
Pioneer Hi-Bred International

J. Federle
Monsanto Co.

M. D. Lacy
R. C. Young

A. B. Maunder
DeKalb

B. R. BcGehee
McNair

J. Osbern
NC+ Hybrids

C. O. Sandlin
Funk Seeds International

R. Sidwell
Northrup King

B. Townsend
Garrison Seed Co.

U. S. -- Public Breeders:

R. Duncan
Georgia Exp. Station

J. D. Eastin
University of Nebraska

B. Erion
South Dakota State University

L. Gourley
Mississippi State University

N. Hopper
Texas Tech University

P. T. Nordquist
Nebraskda Exp. Station

B. R. Wiseman
ARS - Tifton, Ga.

Persons requesting and receiving seed of new cytoplasmic-genic sterile, A2 Tx2753

International:

H. J. Pacanini
ARGENTINA

R. A. Parodi
ARGENTINA

L. Luckett
BRAZIL

R. Schaffert
BRAZIL

A. Boyat
FRANCE

M. Riccelli
VENEZUELA

U.S. - Private Breeders:

ACCO Seed
Plainview, Texas

Asgrow Seed Co.
Plainview, Texas

Cokers Pedigreed Seed Co.
Lubbock, Texas

DeKalb Ag Research, Inc.
Glenvil, Nebraska

DeKalb Ag Research, Inc.
Lubbock, Texas

Delta & Pine Land
Lubbock, Texas

F. F. R. Corporation
Lafayette, Indiana

Funk Seeds Inc.
Lubbock, Texas

Garrison Seed Company
Hereford, Texas

George Warner Seed Company
Hereford, Texas

Growers Seed Assn.
Lubbock, Texas

Harpool Seed Inc.
Denton, Texas

Holden Foundation Seeds
Idalou, Texas

Land O'Lakes Inc.
Webster City, Iowa

McNair Seed
Plainview, Texas

NC^+ Hybrids
Hastings, Nebraska

Northrup, King & Company
Eden Prairie, Minnesota

Northrup, King & Company
New Deal, Texas

Pacific Oilseed Inc.
Woodland, California

P-A-G Seeds
Lubbock, Texas

Pfizer Genetics
Doniphan, Nebraska

Pioneer Hi-Bred Inc.
Plainview, Texas

Richardson Seed
Vega, Texas

Ring Around
Plainview, Texas

U.S. - Private Breeders (cont'd):

Taylor-Evans Seed
Tulia, Texas

WAC Seed Company
Hereford, Texas

Weather Master Seeds, Inc.
Dassel, Minnesota

Young Seed & Grain
Lubbock, Texas

U.S. - Public Breeders:

R. E. Atkins
Iowa State University

H. L. Hackerott
Kansas State University

Ken Foster
University of Calif., Riverside

W. W. Hanna
Coastal Plains Exp. Station
Tifton, Georgia

Greg Hinze
Colorado State University

K. S. Porter
Purdue University

W. M. Ross
University of Nebraska

R. L. Voigt
University of Arizona

D. E. Weibel
Oklahoma State University

G. Worker
University of Calif., Davis

J. O. York
University of Arkansas

International Visitors to the Texas Agricultural Experiment Station and its Personnel

H. van Arkel
KENYA

S. M. Ali
INDIA

D. Ariel
ISRAEL

M. Amadou
NIGER

A. Boyat
FRANCE

B. R. Barwale
INDIA

E. Bustamante
COLOMBIA

L. Brader
ITALY

S. Barbosa
BRAZIL

W. Brown
BOLIVIA

T. S. Batenbrock
WEST GERMANY

S. Clamens
FRANCE

F. W. Calder
INDIA

S. L. Chowdhwry
INDIA

Hector Mena
VENEZUELA

B. E. Marges
PHILLIPINES

S. O. Okiror
NIGERIA

H. Pino
VENEZUELA

F. M. Phillips
SENEGAL

M. R. Ruiz
MEXICO

F. Rodriguez
BOLIVIA

B. U. Singh
INDIA

P. Sata
NIGERIA

F. Saura
ARGENTINA

H. Serrate
BOLIVIA

R. E. Symonds
URUGUAY

J. J. Salmeron
MEXICO

I. Tarumoto
JAPAN

A. Dicko
MALI

C. Del Rio
BOLIVIA

P. Garland
AUSTRALIA

V. Guivassi
MEXICO

A. Grobman
COLOMBIA

G. Jada
NIGER

E. R. Juarez
MEXICO

S. Lenoble
FRANCE

F. J. Llobet
ARGENTINA

J. Thomas
BOLIVIA

K. Uzihara
JAPAN

N. J. Van Rensberg
SOUTH AFRICA - Pretoria

M. R. Wanjari
PAPUA NEW GUINEA

P. Wallens
AUSTRALIA

A. L. Wapi
CHAD

C. R. Ward
BOLIVIA

E. B. Wennengren
BOLIVIA

Zen-Noh
KOREA

SUMMARY TRIP REPORTS

Summary Trip Reports Made by TAES Staff During 1977 Contract Year

BOLIVIA

From March 1 to March 5, 1978, Dr. George L. Teetes traveled in the sorghum growing regions and visited several research centers in Bolivia. Additionally, from March 6 to March 9, he participated in the Reunion Internacional De Sorgo in Buenos Aires, Argentina. The purpose of the trip was to observe the insect-pest situation in sorghum, review current research programs, to coordinate research cooperation between the Texas Agricultural Experiment Station and the developing country, and to evaluate TAES sorghum nurseries.

One day was spent in La Paz where the administrative organization and cooperation of the Consortum for International Development (CID), an AID funded program and Centro de Investigaciones Agricola Tropical (CIAT) was reviewed. Time was spent discussing the programs with Dr. E. Boyd Wennergren, CID Chief of Party and Dr. James Thomas, CID-USU Project Coordinator. The many problems associated with CID-AID were discussed, but substantial progress in research and demonstration was being made largely due to Dr. Charles Ward at Santa Cruz. A possible replacement for Dr. Ward will be required since he will probably be leaving during the summer of this year.

At La Paz, the opportunity also arose to visit with Ing. Agron. C. Del Rio, Department Head of Ministerio de Asuntos Campesinos y Agricultura (MACA). He was of the opinion that sorghum production in Bolivia would remain relatively small.

The remaining time spent in Bolivia was spent in and around Santa Cruz. The tour of commercial production and research was coordinated by Dr. C.R. Ward, Entomologist with CID-CIAT. Dr. William Brown, CID-Plant Pathologist stationed in Cochabamba, also made the tour.

A great deal of the time was spent at the CIAT Research Station at Saavedra. The following people contributed to the tour: Ing. Agron. Hugo Serrate-CIAT, Entomologist; Ing. Agron. Florian Rodriguez-CIAT-Encargado Project Maiz-Sorgo; Ing. Carlos Vaca Diez-CIAT Exec. Director; and Ing. Gustavo Peryera-CIAT-EEAS, Station Director.

The Saavedra station is a multi-crop-discipline research farm located in an area typical to the hot-humid lowlands of Bolivia. Crops included sorghum, corn, rice, pineapple, and sunflower. The research is largely of applied nature dealing with immediate problems of which insects are certainly important. The research program was impressive in magnitude, scope, and quality.

The major insect pest encountered in commercial sorghum production was fall armyworm, Spodoptera fregiperda (J.E. Smith). This is to be expected.

Concerning other sorghum insect pests, the sorghum midge, Contarinia sorghicola (Coquillet), and the greenbug, Schizaphis graminum (Rondani), were obvious candidates. The threat of these pests should be a consideration in the research program, and are. TAES sorghums resistant to both pests are included in test trials.

An unidentified aphid species, probably Aphis sp. was found infesting sorghums. The aphid was abundant, but damage was slight and honey dew abundant.

Four sorghum nurseries developed as part of TAES international research effort had been sent to Bolivia and they were rated. They included the Adaptation, All Disease and Insect, International Disease and Insect, and Midge Resistant Nurseries.

Insect (greenbug) reaction to resistant lines appeared to be similar to that recorded in Texas. Apparently TAES resistant lines would function well

in Bolivia. The midge nursery had not yet bloomed and thus was not evaluated at the time.

Anthracnose appeared to be the major sorghum disease, but downy mildew was observed. The latter was not severe at the time.

The tropically adapted sorghums developed in Texas look good in Bolivia, expecially hybrids with Tx 623. ATx 399 and RTx 2536 looked poor. Obviously, the research developments in Texas regarding tropically adapted lines would relate well to the Bolivian environment.

The notes taken on the TAES sorghum nurseries will be made available and will appear in a future report.

A tour was also made of the research in progress by the Menonite Central Committee. Personnel included: Ken Gengrich and Peter Swatsky. One planting of sorghum at the Mule Farm Research Center had been completely destroyed by anthracnose.

At the International Sorghum Meeting in Buenos Aires, a limited portion of the program dealt with insect pests, but they also were discussed in other more general presentations. It was obvious that the sorghum midge is of most importance. There was a great deal of interest in the progress TAES is making in developing the recently discovered midge resistant sources. In all but one area of Brazil, Texas midge resistant sorghums show good levels of resistance. Greenbug resistant sorghums developed in Texas function well in Argentina, where the insect became a pest of sorghum in about 1972.

It was apparent in these travels that the research conducted with sorghum in Texas has direct application to most developing and developed South American countries. Similar insect pest species are present in South America and Texas, consequently the TAES programs appear vital to these developing nations.

BRAZIL

From May 21-27, 1977, John Scheuring was received by the sorghum and millet staff of IPA (Instituto de Pesquisas Agricolas) in Recife and given an orientation of the agriculture of Northeast Brazil. The tour proceeded from Recife to three experiment stations in the state of Pernambuco with IPA officials and ICRISAT scientists. At the Serra Talhada station data were collected on three TAES sorghum nurseries.

The primary interests for sorghum in Northeast Brazil are for forage and feed for livestock and poultry. There is also interest in sweet sorghums to complement sugarcane for alcohol production.

The IPA grain sorghum breeding program has been going on for about five years. After yield selection of over 1000 entries at several locations and years, the present 16 elite lines are predominately the sorghum types bred by Doggett at Serere Uganda. The best adapted lines are all similar to the variety "Serena"; have large tight heads, poor head exsertion, colored testa seed and brown wash pericarp. Brown seed and poor head exsertion both physically resist midge and birds which are prodigious pests throughout Pernambuco.

There were no serious sorghum or millet diseases neither on grain nor foliage. Even poorly exserted panicles had little or no grain mold.

The TAES nurseries had serious blast damage brought about from drought stress during floral differentiation. Many of the TAES hybrid entries compared well with IPA check entries as to lateness and panicle size.

EGYPT

R. A. Frederiksen visited the sorghum pathology program at the Agriculture Research Center, Giza and Faculty of Agriculture, Cairo University, September 26-30. In Egypt, current research stressed control of stalk rots, grain molds, smuts and foliage diseases. Dr. S. I. Salama has used PL 480 monies to develop a broad-based sorghum research program. The unique sorghum environment in the Upper Nile Valley permits the growing of sorghums with very modest levels of foliar disease resistance; but these require strong, vigorous root and stalk systems. Sorghum improvement for both yield and stover appear very promising in Egypt. Dr. J. Craig is the USDA advisor to the PL 480 project in Egypt and we fully expect to expand our current level of cooperative work to include evaluation of U. S. hybrids and food-type sorghums as well as the growing of disease and insect nurseries.

ETHIOPIA

From October 28 to November 1, 1977, Dr. F. R. Miller travelled in the Addis Adda and Nazareth areas of Ethiopia. Principle visit was to the Ethiopian Sorghum Improvement Project at Nazareth to participate in a Project review. The tour was led by Dr. Brhane Gebrekidan and his staff. Also present were Dr. Leland House, ICRISAT; Dr. Hugh Doggett, IDRC; several IDRC staff and local seed producers.

The Ethiopian program was very impressive. Substantial efforts had been made to collect native types of sorghum and to preserve as well as to use them in germplasm manipulation. Approximately 2900 of these items were introduced into the USA through Miller and House's efforts. These sorghums will be stored in the National Seed Storage Laboratory in Ft. Collins, Colorado. In addition, Brhane Gebrekidan has taken the lead in East Africa to produce improved hybrid sorghums. He had some 1600 experimental types in tests. These hybrids utilized much of the germplasm from the TAES project. The tropically adapted types looked very impressive -- Tx622, Tx623, Tx430, 74CS5388, 77CS1 and other zerazera derivatives. On return, 178 of the better tropically adapted germplasms were sent to Brhane.

GUATEMALA

During January 7 to 14, 1978, Dr. F. R. Miller travelled in Guatemala at the request of the Instituto de Ciencias y Tecnologia Agricolas (ICTA) to evaluate and select sorghums exchanged between these countries. The unique similarities in southern regions of Texas and production in regions of Guatemala offer mutual benefits to both areas. A review of the Guatemala sorghum program was presented by Ing. Mario A. Martinez Gutierrez, Gerente General; Ing. Carlos Cristostoma, Technical Leader; and Dr. Albert Plant, sorghum breeder.

Considerable time was spent in the nursery at Cuyuta selecting sorghums which showed substantial "tropical adaptation," anthracnose resistance and high yield potential in a combine height background. In the end, approximately 600 superior lines or plants were chosen for further advancement from breeding materials sent to Guatemala in 1976 under a memorandum of agreement from TAES. Those items selected after four generations of "on-site" evaluation had extremely large panicles with substantially increased numbers of seeds per panicle. Quality of leaves and of the plants in general were outstanding because of resistance to anthracnose, cercospora and zonate. Special attention was given white, white-translucent pericarps with yellow endosperms since much of this sorghum will be destined for human food.

The support base in Guatemala appeared to be good with need for germplasm to evaluate as the limiting key. Scientists were working toward the development of high yielding, disease and insect resistant, nutritious grain sorghums to replace or supplement local types.

At Jutiapa, a TAT was observed in ratoon into the dry season, ATx622 X 77CS1 and ATx622 X GPR148 were among the most drought resistant. Data accumulated by Dr. Plant indicated that TAES hybrids made with ATx622 were the highest yielding under optimum conditions but under stress ATx623 and ATx624 hybrids were superior.

A tour was made into the East and Northeast regions to observe local sorghums and production techniques. Following the tour, a summary discussion was held with the ICTA sorghum breeding group in Guatemala City and with administrative technical advisors.

INDIA

R. A. Frederiksen travelled to Hyderabad, India, December 15-23, 1977, where he worked with R. Williams and the local staff on plans and preparations for the "Workshop on Sorghum Diseases" to be held in December of 1978.

Williams and Frederiksen also reviewed items for inclusion in the Color Sorghum and Millet Disease Handbook.

INDIA

From October 17 - 28, 1977, Dr. F. R. Miller travelled into the sorghum growing regions of India and visited state and national research centers as well as ICRISAT. The purpose of this visit was to review the nature of acceptable food-type sorghums, gain an understanding of food products made from sorghum, review current research in breeding and to coordinate research between TAES and the sorghum program visited.

A tour and review of the ICRISAT sorghum breeding program was held under the direction of Dr. Leland House and the junior staff scientists. Considerable time was spent in the field actually evaluating sorghums and their interrelationships to genetics of crop improvement. Much discussion was made on the influence of single genes to crop improvement versus the concept of breeding toward only the ultimate goal without immediate steps. Key problems of disease and insect resistance, adaptation, stability of yield and general yield potential were discussed. Methods of reaching specific breeding objectives were discussed over the entire trip and in special seminar lectures.

The research objectives and methods were under close evaluation with basic adjustments being made both at ICRISAT proper and in ICRISAT field or country sites. The overall program was well coordinated and was receiving the "team-approach" to problem-solving.

A field tour to Parbhani and Akolu (north-northeast of Hyderabad) allowed understanding of local sorghum production. At Parbhani Dr. N. L. Bhale (Assoc. Dean of Res.), Dr. R. D. Chundurwar and Dr. U. K. Shinde were leaders of the discussion. Several mutual problems were

discussed including diseases, insects, yield and food acceptability. Several selections of local sorghums were obtained for introduction into Texas. A complete demonstration of chapatti preparation was made and both the desirable (M35-1) and less acceptable types of sorghum were evaluated.

At Akola, Mr. N. Y. Deshmukh, Head, Botany Department, and Dr. S. T. Khade, Striga physiologist, led a tour of the All India Sorghum Program's plantings.

At all locations the opportunities to share germplasm and cooperative research were discussed. There appears to be a general trend toward the same general type of sorghum in India and the U.S.: white, thin pericarp, white endosperm, larger caryopsis on a tan plant.

At ICRISAT, major in-depth discussions were held with individual scientists with the objective of developing more complete interaction and cooperation. Of special interest was the need to increase effectiveness of cooperating breeders by increasing the efficiency of international seed movement.

INDIA

From March 6 - 12, 1978, Dr. D. T. Rosenow participated in the International Sorghum Workshop at Hyderabad, India, sponsored by ICRISAT and AICSIP. Portions of two days were spent at the ICRISAT farm looking at their sorghum and millet research program. Although the major nursery season in India is during the wet season of June to September (Kharif), a rather large nursery was planted in the winter dry season (Rabi) to advance generations and demonstrate breeding objectives. Of special interest in the field was population breeding work for essentially all characteristics,charcoal rot work utilizing the dry season, moisture stress screening conducted during the dry season, and shoot-fly, stem borer, and striga breeding techniques. Pearl millet research in the field centered on population improvement, water stress screening nurseries, and a large downy mildew screening nursery. One day was spent at Rajendranager, near Hyderabad, at the headquarters of the All-India Coordinated Sorghum Improvement Program, where highlights of the AICSIP were presented by Indian workers, headed by Dr. N. G. P. Rao.

Following discussions by ICRISAT workers on their research programs, there were presentations of ICRISAT's regional overseas programs. Country reports were then presented by most participants from outside of India, followed by general discussion sessions on research priorities, major problems, coordination and cooperative projects, germplasm and information exchange, international nursery program, and training needs. Dr. Rosenow presented a paper, "Sorghum Improvement in USA", a summary of major U.S. sorghum problems, research efforts, and sources of desirable traits of international importance, which will be printed in the Proceedings.

The major problems to sorghum production in the DC's of the Semi-Arid Tropics were concluded to be: (1) striga (North Africa and India), (2) birds

(East Africa - but no good solution), (3) insect pests (shootfly #1 and stem borers #2) (Africa and India), (4) grain mold (universal). Although the midge was not considered a major problem by the majority of participants, it will become much more important as new uniform, earlier, photo-insensitive types come into use. Also, charcoal rot and grain mold will become more important with the use of such improved varieties.

Although the major ICRISAT breeding effort has been on populations, Dr. L. R. House indicated an increased effort on traditional pedigree-line breeding as well as hybrid development.

Cooperative research including seed exchange and germplasm evaluation in DC's were established by Dr. Rosenow with D. E. Gollifer (Botswana), M. A. Faris and A. E. Kambal (Sudan), B. Gebrekidan (Ethiopia), S. Z. Mukuru (Kenya - now Tanzania), H. van Arkel (Kenya), M. M. El Rouby and S. O. Okiror (Nigeria), E. M. Stickney and Y. Shuga (Yemen), C. M. Pattanayak (Upper Volta), S. A. Clarke (Mali), and N. G. P. Rao, B. S. Rana and S. S. Baghel (India).

A cooperative agreement was reached by Dr. Rosenow with ICRISAT, whereby TAES entries could be submitted directly into the International Testing Programs of ICRISAT. Tests for which we will send entries in 1977 are the ISLDN (leaf disease), ISGMN (grain mold), ISDMN (downy mildew), midge test, and yield nurseries.

JAMAICA

From February 19-21, 1978, D. T. Rosenow visited the winter sorghum nursery site of Pioneer Sorghum International a few miles west of Kingston, Jamaica. The purpose was to explore the possibilities of a Texas Agricultural Experiment Station winter sorghum nursery in Jamaica, in cooperation with Pioneer, as either an alternative or supplement to the current TAES winter sorghum nursery grown annually in Puerto Rico.

Pioneer has permanent facilities and permanent people located in Jamaica to handle the winter nursery program. The nursery is located on and is operated with special agreement of Cayamanas Estates.

Dr. Gene Dalton conducted a tour, assisted by Kay Porter and Joe Faber, (Pioneer breeders from Texas)and Mr. Harold Wilson, General Manager of the Pioneer Tropical Research Station in Jamaica.

Plant growth and development were good and looked very similar to that in Puerto Rico. The climate during January and February is apparently drier and less windy than at Isabela, Puerto Rico, making it more ideal for crossing sorghum. Grey leaf spot and rust were widespread, with some leaf blight, Fusarium head blight, and anthracnose.

It appeared to be an excellent winter nursery site for use if the need arises. Seed import and export are somewhat slower than with Puerto Rico, but should not be a serious problem.

MEXICO

From May 1 - 3, 1977, Drs. D. T. Rosenow, J. W. Johnson, and F. R. Miller visited Dr. Shree P. Singh, sorghum breeder at CIMMYT. The first day we toured research facilities at CIMMYT's headquarters at El Batan, just outside of Mexico City. This is the site of Dr. Singh's high-altitude breeding program, the elevation being 2249 m. Cold-tolerant sorghums, that is, those which set seed under cool conditions, are required at this elevation.

Essentially no sorghum is grown in the high altitude (above 2,000 m.) plateau areas of Mexico and Central and South America. It is believed that a combination of cold tolerance and earliness could make sorghum the preferred food grain for planting of several million hectares of cropland in highland areas of the Western Hemisphere.

The only sorghum at El Batan was some early planted plots, since it was about two weeks until normal planting date. We toured the grain quality lab, and viewed the plants felt by some to be possible crosses between corn and sorghum. An overall description of the maize breeding program was given to us by Peter Goertz.

The second day we traveled to Poza Rica, a lowland, tropical-type Station where Dr. Singh's winter breeding nursery was ready to harvest.

Most cold-tolerant types developed at CIMMYT to date are brown-seeded derivatives of crosses with Ethiopian high-altitude sorghums. Breeding is underway to develop cold-tolerant lines with white, pearly type grain and improved disease resistance. Many white, pearly grained, disease-resistant sources used by Dr. Singh are from the TAES sorghum program. The winter nursery at Poza Rica is used for crossing, generation advance, and selecting for disease resistance. The major diseases were rust and grey leaf spot,

with only scattered plants having downy mildew, maize dwarf mosaic, bacterial stripe, and Fusarium head blight.

Many cold-tolerant lines were low-yielding, early, and spindly in growth, being generally similar to their appearance in Texas. However, their growth habit is apparently much different at high altitudes.

The IDIN unfortunately did not arrive for planting, but a 25-entry Adaptation Yield Test and 62 hybrids for observation were planted at Poza Rica. Excellent rust and grey leaf spot notes were obtained. Yield data was not obtained, but desirability notes were taken. They indicated that many of the so-called "tropically adapted" TAES lines and hybrids, as identified in South Texas and Puerto Rico, are very well adapted to short-day plantings in the Mexican lowlands. These hybrids were by far the best sorghums in the entire nursery. It appears that the TAES selection technique for "tropical adaptation" is very effective in selection for adaptation to this type of climate in Mexico.

Dr. Singh made four recommendations regarding TAES sorghum work in Latin America: (1) More extensive use of a monitoring nursery such as the TAES IDIN, along with follow-up visits to take notes and train locals to take notes; (2) Collect local varieties from countries such as Honduras, Nicaragua, El Salvador, and Guatemala, cross to TAES elite lines, distribute F_2 seed, and possibly help some in selection; (3) Distribute more advanced material, including hybrids, to national workers for evaluation; and (4) Participate in ICRISAT nurseries whenever possible, encouraging us to assume an active role in the care, etc. of such nurseries in Latin America.

MEXICO

L. Reyes and R. A. Frederiksen were invited to evaluate the sorghum disease problems near Chapala, November 3-5, 1977. In Jalisco State, there are approximately 1.1 million hectares of maize and 200,000 hectares of sorghum plus an additional 150,000 hectares grown in adjacent States. Sorghum in this region is grown at 1.5 - 1.7 thousand meters with a normal rainfall of about 800-900 millimeters. At Celaya, yields of grain sorghum may reach up to 12 metric tons per hectare. In La Barca, yields range from five to eight tons per hectare. Essentially all of the acreage is in U.S. hybrid grain sorghum, 20% of which are brown-seeded, bird-resistant hybrids.

Rust, leaf blight, stalk rot, and downy mildew are all important diseases in the area. Fusarium head blight and, apparently, anthracnose are damaging in some years.

In spite of the serious disease problems, sorghum acreage is increasing and further cooperative work is proposed for 1978.

An evaluation of sorghum disease problems.

1. Rust. At this time, rust was the most serious disease in the fields. All commercially grown hybrids were severely rusted. Disease intensities on a 1 - 9 scale ranged from 7 - 9. Since rust apparently developed late in the season, it is difficult to estimate the effect that this disease had on yield or production. However, the nature of the disease suggests that there are both direct and indirect effects on production. The direct effects obviously relate to leaf necrosis, disruption of host cuticle and epidermal layers, all of which would affect the plant during the grain-filling stages. The implied indirect effect is related to the intensity of damage caused by Fusarium stalk rot and head blight. In fields with high plant densities without irrigation, there was moisture stress. The stress-related Fusarium diseases were aggravated by the rust infections.

2. Leaf blight (Helminthosporium turcicum). Leaf blight developed earlier than rust. Had these observations been made three weeks earlier, leaf blight would have been considered the key disease problem. Even at this late date, certain hybrids had as much as 50%-60% defoliation. None of the commercially grown hybrids were free from diseases, although some in the Asgrow Mexicana Experimental plots had considerably less damage. Based on conversations with the Asgrow Mexicana research staff, both rust and leaf blight occur annually and until "tolerant hybrids were obtained, sorghum could not be grown profitably throughout this area."

3. Grey leaf spot. The tear-drop lesion type is common and moderately severe. At least one popular U.S. hybrid was resistant in this area. Resistance to Cercospora has not been noted among commercial hybrids before. Zonate leaf spot also occurred. It appeared as a minor disease problem and the lesions were abnormally small.

4. Stalk rots. Plants in the area were affected by all three phases of the Fusarium stalk rotting pathogens, vis a vis crown rot, sheath rot and head blight. All three phases resulted in either death of plants or heads. Local infections of Fusarium within the head also resulted in small seed. The extreme reaction of Fusarium suggests that it was related to the intense leaf disease problem, particularly rust.

5. Sorghum downy mildew. The most popular hybrids grown in the area are susceptible to sorghum downy mildew. 20%, 30% and up to 40% systemic infection was found in some fields. Quite obviously, the disease is just beginning in this area. The earliest reports of downy mildew stem from the past three years. The relationship between sorghum cultivation and downy mildew and the movement of the disease to maize means that downy mildew can be expected in maize within the next few years. As far as we could determine, downy mildew reactions of the maize cultivars are unknown. Downy mildew resistant

U.S. sorghum hybrids were resistant in the area.

6. Other diseases. Both head smut of sorghum and anthracnose were observed, but the intensities, particularly for anthracnose, were very low in 1977. The fact that these diseases were present, however, suggests that they should be included in hybrid evaluation trials for the area. Both of these are considered as key diseases and have a history of severely affecting crop production in areas where either the host or environment permit their growth.

Maize diseases.

In maize, stalk rots, head smut, common smut and rust were observed. Head smut was found only in the open-pollinated varieties. Lodging due to stalk rots was common in 1977, but the identity of the pathogen involved could not be ascertained from field specimens observed in the area.

Comments regarding the sorghum diseases problems.

It is quite obvious that Asgrow Mexicana and other hybrid seed companies will continue their search for hybrids that either tolerate or resist the major foliage disease problems; however, it would be extremely desirable to determine the actual yield effects that these diseases cause either individually or in combinations. Such experiments could only be carried out in the area by interested state, federal or commercial workers. Certain experimental and available commercial hybrids were observed with resistance to rust, *Cercospora* and leaf blight, but none were resistant to all three. Resistance to these three diseases is available in at least one of the Texas experimental pollinators.

1. Planting rates. Most of the sorghum grown in the region is planted in the dry season shortly before the first rains. The farmers in the area say that it will rain exactly 90 days after the rain that they receive in March. In eight years, Ing. Manuel Gonzalez claims that they have never lost a crop by planting in the dry soil; however, it appears to me that the farmers hedge

their bet by overseeding. Sorghum is also grown on essentially narrow rows (21" - 29" are common).

The International Disease and Insect Nursery (IDIN) and Yield Adaptation Trial should be evaluated in Central Mexico. IDIN's were not planted by Asgrow Mexicana and we did not locate the nurseries planted by FANZA (Master Seed Company of Mexico).

NIGER

From September 27 to October 1, 1977, D. T. Rosenow visited Niger. Upon arrival in Niamey, I met Drs. Bill Hall and Jim Williams, both with the USAID CID team. Upon my return from Maradi on October 1, I briefed Moussa Abba on my obervations on the Texas sorghums growing at Maradi, and how they could be useful in breeding for higher yield and disease and insect resistance.

On September 28, we drove from Niamey to Maradi (700km). Millet is found on approximately 80% of the area along this road. Sorghum is found only on the valley-like areas on the heavier soils. Many sorghums, as one gets closer to Maradi, are not Guinea-like, but are tighter-headed and higher-yielding, many being of Caudatum-Kafir or Durra-Caudatum origin. Most are white, and some have a chalky pericarp; however, some are red, and some even have an undercoat. Most apparently are used for "Twa," the same as "To" in Upper Volta.

Both the local sorghums and the local millets were impressive. The sorghums appear relatively high yielding, and appear only partially photosensitive based on their maturity. Some should also be rather drought tolerant, as sorghum is found north as far as Tahoua, which is close to the northern limit of cultivation. The local pearl millet varieties are tall, with very long heads, but rather densely fruited. Grain smut and downy mildew were the major problems observed in farmers' millet fields. Also common in farmer's fields were the wild-type segregates which occur from the wild Pennisetum grass (growing along the road sides and waste areas) crossing with cultivated millet. According to Dave Andrews, this wild grass crosses readily with millet, the characteristic is multigenic and recessive, and is difficult to remove by selecting and bulking open-pollinated heads as most

farmers do.

At the INRAN Research Station (Tarna Station) just outside of Maradi, I visited with Dr. Clark Harvey, USAID CID breeder, Mr. Moussa Adamou, INRAN sorghum breeder, Onendaba Boturo, INRAN millet breeder, and B. B. Singh, ICRISAT millet breeder. The INRAN millet program is primarily to dwarf the locals, and incorporate some resistance to diseases, primarily grain smut and downy mildew. As in Upper Volta, much of the ICRISAT-developed material performed very poor, while the locals are very productive. High priority should be given to obtaining seed of the local Niger millets for use in U. S. millet breeding programs. Striga was very severe in the millet on the Tarna sandyland farm; however, there was very little striga on the sorghum planted next to millet.

The TAES sorghum materials were planted at two locations, the sandyland Tarna farm, and the valley Tarna farm (heavy soil). Although plant growth was erratic and generally poor in the sandy soil, the Texas hybrids generally performed very well compared to other entries in various ICRISAT trials. Anthracnose and long smut were severe at the sandy site, with sooty stripe also being important. Excellent anthracnose, long smut, and sooty stripe notes were obtained on the IDIN at the sandy-soil site. At the valley (heavysoil) site, grain weathering and sooty stripe were severe on the Adaptation Yield Test, and the IDIN, along with considerable grey leaf spot. The same Texas hybrids and lines as those in Senegal and Upper Volta showed good adaptation under both sandy and heavy soils.

The sorghum breeding program of Moussa Adamou is divided into a sandy-soil program and a heavy-soil program. Some promising breeding material is present in both programs, with emphasis on tall tan plants and white grain with mold resistance.

SENEGAL

Following changes in trip plans due to a missed flight, DR. D. T. Rosenow and DR. R. A. Frederiksen spent September 21, 1977 at the ISRA research station at Bambey, Senegal. We toured the sorghum breeding and pathology nurseries with Dr. J. C. Girard, IRAT sorghum pathologist, and Dr. J. C. Denis, IDRC sorghum breeder. Sooty stripe (Ramulisporia sorghi) was the most prevalent disease, with very few items showing resistance. There was also some long smut, zonate, and leaf blight present, and a lot of mosaic or other virus-like syptoms present. Seed mold was very severe in Dr. Denis' early-planted seed mold breeding nursery. Shoot fly damage was the major insect damage observed, and it occurs primarily on late-planted sorghum.

The Texas IDIN was observed at Bambey, and little disease was present, but overall desirability notes were taken.

Of interest from Denis' program is the sorghum line, 3927-4, which is very promising as an improved photo-insensitive variety for farmer use. This line is known as Pickett 3 by other workers, and is a partially converted selection from the TAES-USDA Sorghum Conversion Program. The performance of this line and related materials in Upper Volta, Sudan, Nigeria, Ethiopia, Malawi, and India is an indication that photoperiod insensitive derivatives from tropical varieties are performing well when returned to the tropics.

Frederiksen remained in Senegal and evaluated sorghums at Sefa and Nioro du Rip. Texas sorghum hybrids looked quite promising at Sefa, and as the yield indicated, some are reasonably well adapted. At Nioro du Rip sooty stripe was evaluated on 300 Senegalese experimental sorghums. Some of these sorghum lines were sent to us by Dr. Denis.

A detailed position paper on the sorghum pathology program was prepared and mailed to J. C. Girard, completing the consultant assignment that began in 1976.

SUDAN

R. A. Frederiksen visited the sorghum and millet programs at Wad Medoni and El Gadaref and selected sorghum fields in the Gadaref area. National and Regional programs for sorghum have been strengthened by the support from ICRISAT. Potential for grain sorghum production in the Sudan are as expected, quite impressive. A number of common sorghum diseases and insect pests are present.

Although diseases have the potential of causing considerable damage few were present in 1978. Striga, charcoal rot and leaf blight were common but not limiting.

From November 1 to November 6, 1977, Drs. Miller and House visited the Sudanese Sorghum Project at Wad Medina, Sudan. Extensive discussions and tours of fields and breeding nurseries were held with Dr. M. Faris, ICRISAT; Dr. M. Machmoud, sorghum breeder; Dr. M. O. M. Salih, Director of Ag. Res. Coop; Dean Hassan E. Elhag, Gezira University; Prof. A. A. Abdalla, Minister of Agriculture; and Dr. Ali Kambal, Sorghum Research Director.

There was extensive breeding for drought tolerance, Striga resistance, food quality characteristics. Most of the material is basically hegari types. In-depth interviews were held with demonstrations of several food products made from sorghum. Approximately 150 lines and selections have been returned to the TAES program from Sudan. The tropically adapted materials selected in South Texas appeared to be very well adapted to the irrigated Sudanese sorghum areas. A cross section of 178 germplasm sources have been sent for further selection and evaluation in the Sudan.

There was a very good attitude of cooperation among the breeders and administrative personnel and this should allow continued cooperation to reach full potential between TAES, Sudanese and ICRISAT programs. Discussions of related graduate student training at Texas A&M University were initiated and are continuing.

VENEZUELA

L. Reyes and R.A. Frederiksen traveled to Maracay, Venezuela to attend and participate in the Corn and Sorghum Downy Mildew Workshop. Representatives of most of the downy mildew research laboratories throughout the world attended these meetings. Following detailed sessions on current downy mildew research, tours to sorghum-growing regions and nurseries were conducted.

We visited sorghum nurseries and downy mildew research at Centro de Investigaciones Agropecuarias Region Centro Occidental at Araure and later at the Experiment Station at Yaritagrea. Downy mildew-resistant sorghum from the Texas program were effective in their environment.

A strong effort to increase agricultural productivity is underway and joint Venezuelan-U.S. programs have real merit. In 1978, Dr. M. Riccelli of Proseca, and the University of Maracay, will take a sabbatical leave with the Texas program, where he will conduct research on general adaptation and sterility in sorghum. Dr. Douglas Tovar, National Sorghum project leader, has also developed strong professional ties with several of the Texas sorghum workers.

UPPER VOLTA

From September 22-26, 1977, D. T. Rosenow visited the ICRISAT cooperative Program headquartered at Kamboinse to observe the sorghum breeding and pathology research with Dr. C. M. Pattanayak, plant breeder and team leader, and Dr. J. A. Frowd, plant pathologist. Of prime interest was the evaluation of Texas lines and hybrids planted at Kamboinse. I also had an opportunity to tour pearl millet nurseries with Dr. Peter Lawrence, millet breeder, and with Dave Andrews and Dr. Gupta, millet breeders from ICRISAT. Dr. L. D. Swindale, Director of ICRISAT (Hyderabad), Dr. R. C. McGinnis, Associate Director of ICRISAT, and Dr. Claude Charreau, ICRISAT Project Leader for West Africa, Dakar, Senegal, were in Ouagadougou, September 23-25. I had the opportunity to visit with them, and join their review sessions and field tours with the ICRISAT team headquartered at Ouagadougou (Drs. C. M. Pattanayak, J. A. Fowd, P. K. Lawrence, W. A. Stoop, agronomist, and J. Ph. Van Staveren, agronomist).

Essentially all local sorghums in Upper Volta are tall, late-maturing photoperiod-sensitive Conspicuum types. They had just finished blooming, so their flowering date was September 15 to 25. Pattanayak's theory, which is similar to most international sorghum workers, is that photoperiod-insensitive varieties (or hybrids) should be developed and distributed to farmers. The advantage of these earlier, photo-insensitive types is that they can be planted later (late June), when rainfall is much more reliable than early June, and they will mature about two weeks earlier, thus avoiding the problem of drought in case late rains are not received (rains often cease by mid-September). One disadvantage is that they must possess a higher level of weathering or grain mold resistance than locals, since they will mature earlier during a more humid, higher rainfall period.

The Texas Adaptation Yield Trial and Observation Trial were planted at the Kamboinse Station June 29. Growth and plant develpment were good, and desirability notes indicate that several of the hybrids looked outstanding, being superior to CSH6, an India-developed hybrid which has performed very well across tropical Africa and Asia. Diseases and insects were not a serious problem in the trials, or in any of the nursery at Kamboinse, with sooty stripe being the most severe, followed by zonate. It is noteworthy that SC 326-6 has good resistance to sooty stripe.

Some striga (Striga hermonthica) was present. The leaf damage ratings indicate that much of the Texas germplasm (except SC 236-6) has some tolerance.

The International Disease and Insect Nursery (IDIN) was planted July 2 at Kamboinse by Dr. Andrew Frowd. Diseases were not severe, with no insect problems other than some small sucking bugs in the heads. Desirability ratings were taken and give an indication of overall adaptation and yield. It is of interest that the same group of lines had the best ratings as in Senegal, such as TAM 428, SC 110, Tx 430, Tx 624, SC 170's (IS 2930 X IS 3922), and SC 599-11E.

Dr. Pattanayak is putting considerable emphasis on cooking quality of sorghum grain. Although all characteristics related to acceptability are not known, a white, pearly pericarp and a hard endosperm with grain mold (weathering) resistance are necessary. Drought resistance is another obvious need, being particularly evident in the poor, shallow soil areas.

Most of the millet breeding material was developed at Hyderabad (ICRISAT), although much originally came from Africa. Much of this material does not appear adapted, raising the question of selection in India for

African adaptation. Compared to sorghum, where wide adaptation is obvious from looking at both India and U.S. derived materials across Africa, millet appears to be much more narrow in adaptation. Grain smut was very prevalent and was the most severe disease in the millet nursery, but a considerable amount of downy mildew and ergot were also present. Insect damage was not observed.

One morning was spent in a trip to the research station at Saria, about 80 km west of Ouagadougou. There was much more disease on sorghum than at Kamboinse. Rough spot was particularly severe, but there was also considerable zonate, anthracnose, and grey leaf spot.

Papers presented at the Sorghum Disease and Insect Resistance Workshop. June 20 - 22. Corpus Christi, Texas.

Breeding and Genetics of Sorghum

Sorghum Conversion Program and Related Activities at TAES,
F. R. Miller

Current Status of International Nurseries and Cooperative Programs,
D. T. Rosenow

Mejoramiento de Sorgo para el Bajio de Mexico,
A. Estrada Gomez

Mejoramiento Genetico del Sorgo para los Valles Altos de Mexico,
A. Carballo C.

Mejoramiento de Sorgo para las Partes Bajas del Estado de Nuevo Leon Mexico, C. G. S. Valdes Lozano

Aspecto de la Produccion de Sorgo en Panama,
J. C. Cedeno

El Sorgo en Venezuela,
V. Barrientos y D. Tovar

El Sorgo en la Republica Dominicana,
R. Perez D.

Recent Work with Genetic Male Sterile Facilitated Sorghum Populations,
J. Scheuring

Sorghum Diseases and Resistance

North American Sorghum Disease Nurseries,
R. A. Frederiksen

Seed Molding of Grain Sorghum in Texas,
L. L. Castor and R. A. Frederiksen

Inoculation Techniques with *Sphacelotheca reiliana*, the Cause of Head Smut, R. C. Miller

Physiologic Specializations of *Colletotrichum graminicola*
J. H. Foster and R. A. Frederiksen

Inheritance of Resistance to *Exserohilum turcicum*,
R. A. Frederiksen, D. T. Rosenow and J. H. Foster

ABSTRACTS

Inheritance of Resistance to *Exserohilum turcicum*,
R. A. Frederiksen, D. T. Rosenow, and J. H. Foster

Factors Affecting Infection from Inoculation with Oospores of *Sclerospora sorghi*, J. Craig

Virus Disease Resistance in Sorghum,
R. W. Toler and A. Huebner

Sorghum Insect Problems and Resistance

Stability of Sorghum Midge Resistance Among Different Resistant Sorghums, M. A. Faris

Quality Improvement in Sorghum

Single Seed Selection of High Lysine Sorghum via Scanning Electron Microscopy, R. D. Sullins and L. W. Rooney

The Quality of Tortillas Made from Sorghums with Various Kernel Chracteristics, D. Meckenstock

Field Deterioration of Sorghum: Differences Among Sorghum Lines and the Relationship to Characteristics of the Grain, J. A. Glueck

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SEED MOLDING OF GRAIN SORGHUM CAUSED BY FUSARIUM AND CURVULARIA SPECIES

L. L. Castor, R. A. Frederiksen

ABSTRACT

Seed molding fungi attack sorghum seeds prior to harvest. Fungi of several genera, including Fusarium and Curvularia, appear to be involved in this disease. Generally, rainy weather increases disease damage since it favors fungal development and extends the period when seeds can be attacked by delaying harvest. Experiments were planned to determine which fungi were more important in this disease and to what extent these fungi affect grain yield and quality. Sorghum plants from lines which are resistant and susceptible to seed molding were inoculated at flowering with spores of Fusarium moniliforme, Fusarium semitectum, Curvularia lunata, and Curvularia protuberata. Generally, Fusarium spp were more damaging than Curvularia spp. Fusarium reduced yield, test weight, 1000 kernel weight, and germination compared with non-inoculated controls. Seeds from Fusarium inoculated heads showed a greater prevalence of germination in the head under field conditions (16%), based on split pericarps above the embryos (often with elongated epicotyl and hypocotyl), compared with non-inoculated controls(6%). Fusarium spp and Curvularia spp were recovered from 40% and 23%, respectively, of surface sterilized embryos from seeds of inoculated susceptible lines. Curvularia spp did not reduce germination as much as Fusarium spp on most lines. However, seedlings which developed from Curvularia inoculated seeds exhibited root necrosis while Fusarium inoculated and non-inoculated controls did not.

1977 Proc. Am. Phytopath. Soc., 4:151.

SORGHUM HEAD SMUT

R. W. Berry, D. T. Rosenow, and R. A. Frederiksen

ABSTRACT

Race 4 of Sphacelotheca reiliana causing head smut of sorghum was more severe on hybrids at Edna than at Kress, Texas; but essentially all commercial hybrids are susceptible. None were free in all locations. Up to 315 hybrids were evaluated.

1978 (April) Mimeographed Report, 11 pp.

HEAD SMUTS OF CORN AND SORGHUM

R. A. Frederiksen

ABSTRACT

The nature of genetic variability in Sphacelotheca reiliana is evaluated on the basis of host range within and between the species of sorghum and maize. Virulence to maize is derived from the pathogen population attacking sorghum. Maize smut isolates do not infect sorghum.

Few sorghum cultivars are resistant to all known pathogenic races. Consequently, research approaches for control will be broad-based and proceed utilizing host resistance along with biological and cultural control practices.

Proceedings, American Seed Trade Assn., Corn and Sorghum Section, Dec., 1977.

CURRENT RESEARCH ON SORGHUM DOWNY MILDEW IN TEXAS

R. A. Frederiksen, and A. J. Bockholt

ABSTRACT

Two downy mildews of maize and sorghum occur in Texas. Sclerophthora macrospora, causing crazy top, is widely distributed, endemic and occasionally serious in individual fields or areas of fields that are subject to flooding. Sorghum downy mildew, caused by Sclerospora sorghi, was first observed in Texas (USA) in 1961. Since then, the disease has spread to 14 Southern and Corn Belt States. Losses from sorghum downy mildew have not been grave other than in South and Central Texas and in occasional fields in other states or other locations in Texas.

Early achievements in the Texas program led to the identification and release of sources of downy mildew resistance in both sorghum and maize lines. Programs for monitoring resistance to downy mildew are continuing. In 1977, about 2,500 maize entries are being evaluated in the sorghum downy mildew nursery at College Station and thousands of sorghum entries are being screened in South Texas. Other studies have led to better inoculation techniques, methods of pathogen dissemination, inoculum survival, and inheritance of resistance. Today, resistant cultivars of corn and sorghum are available for use. Resistance to downy mildew in sudangrasses and their hybrids with sorghum are also being developed. Current research programs include: studies of host-parasite interaction, both fine and ultra structure. The method and nature of host colonization suggests that different mechanisms of resistance are available. Studies on the mode of inheritances are continuing as is the development of disease resistant cultivars. New

techniques have been developed to isolate oospores from soil. Oospore concentrations are being compared with disease development to be used in conjunction with cultural control procedures. Other studies include research on oospore germination, survival and their parasitism.

Today, sorghum downy mildew and perhaps the other species of the downy mildew fungi no longer constitute the same threat to American agriculture as they possessed only a decade ago. The diseases can and are being controlled.

Proceedings, Workshop on Sorghum Downy Mildew,
Maracay, Venezuela August, 1977.

GROWTH ANALYSIS OF A SORGHUM HYBRID AND ITS PARENTS

P. T. Gibson and K. F. Schertz

ABSTRACT

Growth rate, leaf area index, net assimilation rate, and distribution of dry matter among aboveground plant parts were determined for sorghum (Sorghum bicolor (L.) Moench) hybrid 'RS 610' and its parents throughout the growing season in a replicated field experiment. Dry weight and leaf area were measured twice weekly before flowering and weekly thereafter. The hybrid developed faster than its parents. It had greater leaf area than its parents until 1 week prior to flowering, and less leaf area than its parents thereafter. The hybrid had greater total dry weight than its parents throughout the growing season. The crop growth rate (CGR) of the hybrid was greater than that of either parent from emergence to panicle initiation, while net assimilation rate and relative growth rate did not differ among genotypes at this period. RS 610 outyielded its parents in grain, and had more kernels per panicle than the female parent, but did not differ from the male parent in this characteristic. The yield superiority of RS 610 was attributed mainly to the combination of the high CGR of the female parent during grain filling with the effective conversion of dry matter to grain of the male parent. More rapid seedling growth and a longer grain filling period were also advantages of the hybrid over its parents.

1977. Crop Science. 17:387-391.

Research supported in part by the United States Agency for International Development through Contract AID/Ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

PHYSICAL AND CHEMICAL CHARACTERIZATION OF SORGHUM LINES WITH RESISTANCE TO GRAIN DETERIORATION

J. A. Glueck and L. W. Rooney

ABSTRACT

The evaluation and selection of sorghum types with resistance to field grain deterioration (weathering) is an essential component of the sorghum quality improvement efforts. Weathered grain has reduced test weight, hardness, density, viability and processing properties. A twenty-five entry replicated test including promising weathering resistance lines was planted at seven locations in Texas in 1975. The best lines based on overall field ratings were SC 748-5, SC 279-14, SC 566-14, 74PR759 (a red-seeded kafir line) and SC 103-12 (a brown seeded line). SC748-5, SC 279-14 and 74PR759 have low tannin content. Under severe weathering conditions at College Station, grain varied from 47.3-62.2 lb/bu test weight, 1.2945-1.3882 g/cc density, 19.3-33.5 g/1000 kernel weight, 1.8-30.3 for hardness value, and 2-93% germination. Although grain from all lines decreased in test weight, density and germination with prolonged exposure to weathering conditions, the reduction was minor for lines with superior weathering resistance. The structure of the outer layers of the seed and chemical composition appear partially responsible for improved weathering resistance. Hybrids developed from more weather resistant lines have improved grain quality.

1976. Cereal Foods World. 21:436-437.

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THE RELATIONSHIP BETWEEN KERNEL STRUCTURE, WATER UPTAKE AND WATER MOVEMENT IN SORGHUM

James A. Glueck and L. W. Rooney

ABSTRACT

Water enters the sorghum kernel through the pericarp especially in the hilum area of the germ. Initial movement of water appears to be through the vascular system of the pericarp with subsequent movement through the germ. Water movement into the endosperm is first apparent in the region bordering the scutellum. Secondary hydration of the endosperm results from movement of water from the pericarp. The mode of water uptake and movement in the sorghum kernel appears similar for a range of sorghum lines and varieties; however, the rate of water uptake and movement is affected by structural differences of the seed. Lines or varieties with higher proportions of floury endosperm and/or a thick mesocarp appear to have increased rates of water movement in the seed. A dense, highly organized peripheral endosperm region restricts water movement from the pericarp to the endosperm. Water uptake and movement in the seed appears closely related to field grain deterioration resistance and processing properties of sorghum grain. Sorghum lines or cultivars with more rapid water uptake and movement seem more accessible to microbial attack and more rapid loss of seed integrity when subjected to conditions favoring deterioration or germination as well as processing.

1977. Cereal Foods World. 22:472.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GRAIN CHARACTERIZATION OF SORGHUM LINES RESISTANT TO FIELD DETERIORATION

J. A. Glueck, L. W. Rooney, and D. T. Rosenow

ABSTRACT

Sorghum bicolor (L.) Moench lines were evaluated during the 1975 and 1976 growing seasons at 7 locations in Texas for resistance to field deterioration (weathering). Grain of resistant lines and susceptible checks was characterized by subjective field ratings, standard germination, test weight, 1000 kernel weight, density, seed size, hardness, tannin content, conductivity of seed leachates, cuticle wax content, and microscopic examination. Grain deterioration due to sprouting in the head, microorganisms or a combination of the two causes reduction in test weight, 1000 kernel weight, density, hardness and viability. Grain with high tannin content usually has high resistance to grain deterioration; however, tannins are not essential since several non-brown grains have good resistance. Grain of resistant lines has slow uptake of water and release of seed components. Subtle differences in glume shape, cuticle wax distribution, and kernel structure especially size and shape of the hilum affect field deterioration. Conductivity values appear promising as a screening technique to evaluate relative resistance of line to field deterioration.

1977. Agron. Abs. p. 116.

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1977. Agron. Abs. p. 116.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

SEED GROWTH RATE OF SELECTED MIDGE RESISTANT AND SUSCEPTIBLE SORGHUMS

J. W. Johnson, J. M. Phillips and G. L. Teetes

ABSTRACT

Seed weight of four sorghum lines were sampled at five day intervals from bloom to maturity. Oven dried seed weight of midge resistant lines TAM 2566 and IS 2579C (SC423) was higher during the first 15 days of growth than the susceptible line, Tx 7000 or the line with a low level of resistance, TAM 428. Rapid seed growth may be one of the factors causing midge resistance in some sorghum lines.

1977. Sorghum Newsletter 20:115.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

DIFFERENTIAL THRESHABILITY OF SORGHUM CULTIVARS

J. W. Johnson, D. T. Rosenow and J. M. Phillips

ABSTRACT

Three sorghum varieties and two advanced lines were planted in single row plots, 6 m long, 101 cm apart in a randomized block design. Panicles were harvested, air dried and threshed with a plot thresher equipped with a rasping-bar cylinder and concave. Cylinder speed and concave-to-cylinder spacing was adjusted to remove less than half the seed of a commercial hybrid before test entries were threshed. Differences between the amount of grain obtained in the first threshing and the total amount of grain obtained by repeated threshings at a higher cylinder speed and closer concave-to-cylinder speed was calculated. A significantly higher percent of grain was obtained from the first threshing of 'Rio' derived lines than from the varieties. Grain samples from Rio derived lines had fewer glumes than the varieties. Hand threshing of individual heads in segregating populations indicate that this 'easy threshing' characteristic can rapidly be transferred to other sorghum.

1977. Agron. Abs. p. 60.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GREENBUG RESISTANCE IN SORGHUM

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

ABSTRACT

Over 5 million acres of sorghum hybrids with high levels of greenbug resistance were grown in the U.S. in 1976. The greenbug resistance of these hybrids was derived from "Tunis grass", a short grassy sorghum, obtained by the Texas Agricultural Experiment Station from the USDA in 1930. This "Tunis grass" has been assigned each of the three following numbers: S.P.I. 38108, T.S. 15679 and SA 1636.

Approximately 50% of the resistant hybrids planted in Texas had an insecticide applied for the control of greenbugs. However in a Pest Management Area located in and around Hale county, Texas, only 6% of the resistant hybrids were sprayed while 99.4% of the susceptible hybrids had an insecticide applied.

The Texas Agricultural Experiment Station has released 23 sorghum lines, Tx2734 through Tx2752, resistant to greenbugs. Tx2734-Tx2748 are R lines and Tx2749-Tx2752 are A and B Pairs. These lines represent improved agronomic types with a broader range of disease resistance than greenbug resistant lines previously released.

1977. Plant Resistance to Insects Newsletter. 3:43.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

MIDGE RESISTANCE OF SELECTED SORGHUM LINES AND THEIR F_1 HYBRIDS

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

ABSTRACT

In field tests conducted in 1976 midge damage to hybrids made with two resistant parents (RxR) were damaged less than hybrids made with one susceptible and one resistant parent. Although the resistant male parents were damaged less than RxR hybrids, the differences were small. These data indicate that when resistant B lines are available hybrids can be produced that will be damaged less than 10 percent by midge populations that will damage susceptible sorghum 70-100 percent.

Two experimental B lines, 76PR626 and 76PR638, are now being sterilized and will be ready to test in hybrid combinations in 1977 or 1978.

1977. Plant Resistance to Insects Newsletter. 3:43.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

GENOTYPIC VARIATIONS IN ROOT SYSTEMS OF SORGHUM

W. R. Jordan and F. R. Miller

ABSTRACT

A solution culture technique (Blum, et al, Crop Sci. 17:149-157. 1977) was used to investigate the morphology of root systems of 10 sorghum lines having diverse genetic backgrounds. Of the 10 lines, 7 were morphologically similar in that the ratio of the length of adventitious roots (RL) to the total leaf area (LA) was constant. The remaining 3 lines were characterized by shorter, more dense root systems. Despite a lower RL/LA ratio, these 3 lines had larger root volumes due primarily to greater lateral root growth. The results from solution culture studies were compared with field observations in dryland plots using a glass access tube technique (Bohm, et al, Agron. J. 64:415-9. 1977). The 3 lines showing low RL/LA ratios from solution culture studies maintained high root densities in the top 60 cm of the profile but had few roots which penetrated below 120 cm. Root densities for the remaining 7 lines were not as great in the upper 60 cm of the profile, but were much higher below 90 cm. After anthesis, root densities generally declined at all depths. Thus, in rooting depth and apparent density, root morphology exhibited in solution culture was reproduced under field conditions.

1977. Agronomy Abst. p. 87.

REGISTRATION OF TP11R SORGHUM GERMPLASM POPULATION (REG. NO. GP 29)

F. R. Miller

The *Sorghum bicolor* (L.) Moench population, TP11R, was developed by the Texas Agricultural Experiment Station in cooperation with the ARS/USDA and released in February, 1976. TP11R combines a wide germplasm base of desirable agronomic traits with the dominant twin-seeded characteristic (TsTs). Original crosses were made to short temperate types at the Federal Experiment Station, Mayaguez, Puerto Rico in October 1969. The original twin-seeded line was assigned the designation 69M1490 and is a tropically adapted sub-glabrescens-milo type. The twin seeds are arranged in the spikelet with embryos on the outside toward the glumes and separated by a palea scale. Connate seeds do not occur, because the florets are separated completely within the spikelet. By 1973, short daylength-insensitive twin-seeded lines had been derived and were used to develop TP11R by crossing with a TAES source population, TP4R-blend, segregating for genetic male sterility, ms_3, from 'Coes', and possessing disease, insect and lodging resistance.

TP11R contains a range of heights (2-, 3-, and 4-dwarf), seed colors, pericarp thickness, maturities, etc. Approximately 15% of the plants are twin-seeded with 50% to 90% twinning of the florets in the inflorescence. The population contains low frequency levels of disease resistance, insect resistance (greenbug and midge), lodging resistance, and improved grain quality. Seed for distribution is maintained by the Texas Agricultural Experiment Station, College Station, TX 77843.

1977, Crop Sci. 17: 676-677.

MANIPULATION OF SORGHUM GROWTH AND DEVELOPMENT WITH GIBBERELLIC ACID

P. W. Morgan, F. R. Miller, and J. R. Quinby

ABSTRACT

This study is the initial step in an effort to understand the nature of the hormone involvement in the genetic control of height, date of flowering, and tillering in Sorghum bicolor L. Moench. The objective of these experiments was to characterize the response of sorghum genotypes varying in dwarfing genes to gibberellic acid. Since height influences commercial production, better understanding of its control may have practical and scientific value. Solutions of GA_3 were applied in the whorl of vegetative plants and the growth and development of treated plants compared to controls. Sorghum grown in the field on Norwood fine sandy loam (Typic Udifluvente) soil exhibited a range of responses to gibberellic acid (GA_3). Plant height of seedlings was universally promoted, but higher GA_3 levels were required to increase final stem height. At concentrations up to 10^{-3} M GA_3 stem height of members of the milo and kafir groups was promoted to a major degree and the Redlan varieties were promoted to a slight extent while hegaris were not changed. GA_3 applied over a period of several weeks drastically reduced tillering and adventitious root development. Early termination of GA_3 application resulted in subsequent promotion of tillering. It was possible to separate the effect of GA_3 on tillering from its effect on stem height. At higher concentrations both processes are modified while at lower treatment rates GA_3 reduced tillering without promoting stem height. The treatments employed did not significantly shift the date of anthesis. Several of these results were verified by experiments in a greenhouse and in the field at a different

location on Hollister clay loam (Pachic Paleustoll) soil. The results support the conclusion that gibberellins function in the control of height and tillering in the genotypes studied.

1977. Agronomy Journal. 69: 789-793.

MANIPULATION OF FLOWER INITIATION, HEIGHT, AND TILLERING IN SORGHUM

P. W. Morgan, F. R. Miller, J. R. Quinby, L. E. Clark, E. N. Williams, L. Williams, and V. R. Isbell

ABSTRACT

In the field the height, tillering and adventitious rooting of sorghum have been modified successfully by several growth regulators but floral initiation has not been altered significantly. Studies in growth rooms with photoperiods marginal for flowering revealed the GA_3 and far red light at the beginning of the dark period hasten floral initiation significantly. Several characteristics of this promotion of flowering have been determined.

1977. Proc. Plant Growth Regulator Working Group, Fourth Annual Meeting.

CURRENT STATUS OF SPIDER MITES IN CORN AND SORGHUM

J. C. Owens, C. R. Ward and G. L. Teetes

ABSTRACT

Spider mites have become of particular concern to growers in semi-arid corn and sorghum producing areas. The current status of spider mites is addressed and a review of literature is included. Tactics for managing spider mite populations are discussed with appropriate citations. Sufficient information is available to form more sound managment approaches than unilateral insecticide control. The latter approach appears futile because of resistance levels.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.
1977. Proc. 31st Annual Corn and Sorghum Res. Conf. p. 38-64.

GERMINATION OF OOSPORES OF SCLEROSPORA SORGHI IN THE PRESENCE OF GROWING ROOTS OF HOST AND NONHOST PLANTS

R. G. Pratt

ABSTRACT

Oospores of *Sclerospora sorghi* maintained between porous membranes in soil germinated at low frequencies adjacent to growing roots of sorghum and other plants. No germination was ever observed in the absence of plant roots. Germination always resulted in formation of single, broad, coenocytic germ tubes which were seldom branched and elongated up to 1.25 mm prior to autolysis. Germination was induced at similar frequencies in untreated soil, autoclaved soil and sand, and also by roots of sorghum seedlings from varieties resistant and susceptible to downy mildew. Germination occurred consistently with oospores stored at 25C for 8 months, but not with oospores stored at 4C; however, when oospores were transferred from 4C to 25C, germination increased steadily after 2, 4, and 6 weeks. Oospores also germinated in the presence of roots of corn, oats, wheat, soybeans and cotton. Most germination occurred within 3 days after growth of roots adjacent to oospores. In all experiments, numerous instances of "false" germination, due to growth of hyphae of mycoparasitic fungi from within oospore walls, were observed. Criteria for distinguishing true and false germination of oospres of *S. sorghi* are discussed.

1978, Phytopathology 68: In Press.

OOSPORES OF *SCLEROSPORA SORGHI* IN SOILS OF SOUTH TEXAS AND THEIR RELATIONSHIPS TO DOWNY MILDEW INCIDENCE IN GRAIN SORGHUM

R. G. Pratt and G. D. Janke

ABSTRACT

Oospores of *Sclerospora sorghi* from soil were concentrated among silt particles following separation of most sand and clay particles from aqueous suspensions of soil by washing and sedimentation. Oospores were counted in aliquots of silt suspensions at 25-50X. An average of 97% of oospores added to soils at three densities were recovered. In three naturally infested soils, oospores were also counted in pieces of organic debris collected on sieves and cleared in potassium hydroxide. At least 97% of oospores were free in soil five months after harvest. Among soil samples from 18 fields, collected from the plowlayer four weeks after planting, densities of oospores of *S. sorghi* ranged from 8-95/g soil. Oospore densities were not correlated with incidence of seedling-systemic downy mildew in these fields, but they were correlated ($P = 0.05$) with disease incidence in seedlings of a susceptible sorghum cultivar grown in the soils. Ratios of infected field plants to oospore densities were significantly correlated ($P = 0.01$) with clay contents of soils. The highest ratios occurred in soils with the least clay. These results indicate that incidence of downy mildew in sorghum seedlings in the field is influenced by oospore densities and soil texture in addition to host genotype.

1978, Phytopathology: In Press.

EFFECTS OF PLANT DENSITY AND ROW SPACING ON THE RATOONING OF SORGHUM (SORGHUM BICOLOR (L.) MOENCH)

R. A. Priwin A.

ABSTRACT

In 1976, two grain sorghum hybrids, ATx378 X TAM428 (nonsenescent) and ATx378 X Tx2536 (senescent) were planted at College Station and Weslaco, Texas. ATx378 X Tx2536 had a higher percent of plants surviving after cutting, more tillers per unit area four weeks after cutting, more reproductive tillers per unit area and more tillers per plant than ATx378 X TAM428.

Grain and stover yield increased with increasing population levels at College Station, but only increased to the 197,000 plants/ha level at Weslaco.

Narrow rows, 67.7 cm wide, were two days earlier in reaching 50% flower and had a higher grain and stover yield. Rows 101.6 cm wide had a higher percent of survival after cutting but rows 67.7 cm wide gave a higher number of reproductive tillers per unit area and reproductive tillers per plant.

Days to 50% flower, exsertion, plant height and head length were less in the ratoon crop, due to the shorter growing period. Stover yields in the ratoon crop were inconsistent with reports in the literature, which show higher hields in the ratoon crop.

Optimum economic return at College Station was found to be highest using ATx378 X Tx2536 at 197,000 plants/ha in 67.7 cm rows, while at Weslaco either hybrid at 197,000 plants/ha in 67.7cm rows gave the highest return.

1977. MS Thesis. Texas A&M University, College Station, Texas. 246 pp.

STERILITY RESPONSE OF F_1s OF A2 Tx2753 X CONVERTED LINES AND ESTABLISHED VARIETIES

J. M. Ritchey and K. F. Schertz

ABSTRACT

A2 Tx2753, a sterile with a cytoplasm purported to induce sterility in a system different from that of milo, was crossed by a series of lines of 23 crosses by converted lines, nine produced F_1s with fertility different from that of crosses of a line with milo cytoplasm by these same 23 converted lines. Of nine crosses by established varieties, five produced F_1s with fertility different from that of crosses of a line with milo cytoplasm by these same nine varieties.

1977. Sorghum Newsletter. 20:112-113.

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THE EFFECT OF MICRONIZING ON CEREAL GRAINS AND THEIR POTENTIAL FOOD USE

L. W. Rooney, B. A. Rusnak and R. D. Sullins

ABSTRACT

Micronizing consists of heating grain with gas fired infra-red generators until it nearly everts. Then, the grain is passed through a roller mill. A laboratory micronizer was used to process under identical conditions grain from several cereals including wheat, barley, sorghum and rice. The products of each will be discussed. Micronized sorghum had great variation in bulk density, extent of gelatinization and degree of expansion. The differences were related to genetic differences among the sorghums. Waxy sorghums had the greatest expansion followed by heterowaxy and nonwaxy sorghum. However, great variation existed among the nonwaxy sorghums. Micronized, pearled sorghum had light, white flakes with a bland flavor and more gelatinized starch than micronized unpearled grain.

1977. Cereal Foods World. 22:457.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

BREEDING FOR LODGING RESISTANCE IN SORGHUM

D. T. Rosenow

ABSTRACT

Lodging is a serious problem in sorghum production. It can be caused by or associated with many environmental factors and pests; thus making it a serious threat in all the sorghum growing areas of the United States. Lodged plants interfere with normal harvest operations and usually result in reduced grain yield.

The screening and evaluation techniques we are using in the Texas Agricultural Experiment Station have proven effective in improving resistance to several types of lodging. The major features of the program are: (1) initial identification of lodging resistance by anyone in any nursery, (2) initial screening in single-row observation plots in a lodging nursery left standing over winter, or allowing an entire breeding nursery to stand over winter, and (3) screening in replicated trials at several locations for several types of lodging.

Excellent progress has been made in breeding for sorghum lines and hybrids with improved lodging resistance and improved charcoal rot resistance. Our technique of first selecting for resistance to after-freeze stalk breakage, followed by screening for moisture stress-charcoal rot type lodging resistance has worked well. We have made progress in two areas: (1) we have selected for anatomically stronger plants, and (2) we have selected for plants that have a different physiological response under moisture stress. These plants do not become predisposed to stalk rot susceptibility by moisture stress as easily as common sorghums.

Portions of this program could well be adopted by sorghum breeders, especially those in the more western and northern areas where winters are

harsh. A promising selection technique that could be used anywhere that moisture stress is common is the use of plant senescence ratings. Another promising technique that would work anywhere is the use of puncture pressure as a selection aid.

1977. Proc. 32nd Annual Corn and Sorghum Res. Conf. December, 1977, Chicago, Ill. (In Press).

SORGHUM IMPROVEMENT IN THE U.S.A.

D. T. Rosenow

ABSTRACT

Much new germplasm is now in extensive use in both public and private sorghum breeding programs. Much has been made available through the Sorghum Conversion Program, a cooperative Texas Agricultural Experiment Station-United States Department of Agriculture project in which tall, late-maturing, photoperiod-sensitive exotics are converted, through a back-cross procedure utilizing short winter days in Puerto Rico, to shorter and earlier photoperiod-insensitive types.

Much research is on evaluation of this new germplasm for sources of desirable characteristics. Diseases for which we have found outstanding sources of resistance are downy mildew, head smut, anthracnose, rust, grey leaf spot, leaf blight and charcoal rot. Godd resistance has been found for the sorghum midge, greenbug (aphid), corn leaf aphid, and Bank's grass mite. Resistance has also been found to lodging and the charcoal rot-moisture stress type complex. Outstanding sources of resistance to grain weathering (seed mold) have also been found. Some newly developed lines of tropical origin with an apparent high amount of "Tropical Adaptation" have been developed. These lines appear to be very high yielding under short days in Puerto Rico and South Texas. Some lines with lodging and charcoal rot resistance look promising for drought tolerance, particularly during the grain filling stage. The ability of a plant to remain green and active (non-senescent) during moisture and heat stress may be a useful breeding selection tool. A new cytoplasmic-genic sterility system has

been found. Improved nutritive value looks promising in the high lysine types and in the waxy endosperm types.

A listing of the major sorghum problems, the major research efforts, and sources of some desirable traits are included.

1977. Proc. International Sorghum Workshop, March 5-11, 1977, Hyderabad, India. (In Press).

RELATIONSHIP OF NONSENESCENCE TO LODGING AND CHARCOAL ROT IN SORGHUM

D. T. Rosenow, J. W. Johnson, R. A. Frederiksen and F. R. Miller

ABSTRACT

Breeding for resistance to lodging and charcoal rot in grain sorghum (Sorghum bicolor (L.) Moench) is difficult because it normally involves leaving the nursery in the field for long periods after maturity and because charcoal rot inoculation and subsequent stalk ratings are time consuming. Plant senescence ratings were made on sorghum lines and hybrids in lodging tests in 1975 and 1976. Ratings were made on plants under significant moisture stress during the late grain development stage. In both years, nonsenescence was highly correlated with both lodging and charcoal rot resistance. In the Hybrid Lodging Test, the 13 most nonsenescent hybrids had average lodging, charcoal rating, and senescence rating, respectively, of 1.7%, 2.55 (1-5 scale), and 2.87 (1-5 scale), while 10 standard hybrids had corresponding averages of 40.9%, 4.13, and 4.30. Senescence ratings in sorghum breeding nurseries should be a valuable breeding tool to select for improved lodging and charcoal rot resistance.

1977. Agron. Abs. p. 69.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

REGISTRATION OF A2 Tx2753 AND B Tx2753 SORGHUM GERMPLASM
(Reg. No. GP 30 and 31)

K. F. Schertz

ABSTRACT

A pair of A (male-sterile) and B (maintainer) lines of sorghum with a probable new cytoplasmic-genic sterility system is registered and announcement is made of their availability to breeders. These lines were developed by crossing IS 12662C X IS 5322C and by backcrossing to the male parent. The female parent and source of the cytoplasm is in the Caudatum Nigricans group (Guinea race) from Ethiopia and the male parent is in the Roxburghii group (Guinea race) from India.

Differential responses of test crosses with A2 Tx2753 and A Tx3197 (milo cytoplasm) indicate that the cytoplasm of the new line, A2 Tx2753 may be different from milo in sterility response. Some lines that are restorers in milo cytoplasms produce completely male sterile F_1s when crossed with A2 Tx2753. The availability of this line could add diversity to hybrid sorghum.

1977. Crop Science. 17:983.

Research supported in part by the United States Agency for International Development through Contract AID/Ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

ANATOMICAL VARIATION IN STALK INTERNODES OF SORGHUM

K. F. Schertz and D. T. Rosenow

ABSTRACT

Anatomical features of stalks of 12 diverse lines of sorghum were observed. Most prominent differences were in number of cells with lignified walls and in wall thickness. Vascular bundle sheaths differed considerably. Many entries had vascular bundles with discontinuous sheaths of lignified cells. In contrast, some lines had sheaths that completely encircled the vascular bundles. The sheaths of lignified cells around the vascular bundles were only three or four cells thick in some lines but as thick as 16 cells in other lines. Cell wall thickness varied as did density and distribution of vascular bundles. This great variation in the anatomy of sorghum stalks contributes to the variation among lines in stalk strength. If these anatomical characteristics are heritable it should be possible to select lines that resist stalk breakage, even though the plants are tall.

1977. Crop Science. 17:628-631.

Research supported in part by the United States Agency for International Development through Contract AID/Ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

PERFORMANCE OF TEN GRAIN SORGHUM LINES FROM THE CONVERSION PROGRAM

A. Sotomayor-Rios and F. R. Miller

ABSTRACT

Ten grain sorghum lines (Sorghum bicolor (L.) Moench) selected from the Conversion Program were evaluated at the Mayaguez Institute of Tropical Agriculture (MITA), Mayaguez, Puerto Rico. Grain yield among the 10 lines ranged from 910 to 4,153 kg/ha. Line 9, brown-seeded, was the highest producer. Days to mid-flower among the 10 lines ranged from 71.2 to 76.2. The high-yielding lines were late flowering. Height ranged from 83.5 to 117 cm. Weight of 10 seeds ranged from 1.63 to 2.81 g. Line 4, the lowest grain producer, had the heaviest seeds. Seed volume ranged from 1.21 to 2.20 cm^3/100 seed. Line 4 had the highest volume. Density among the 10 lines ranged from 1.17 to 1.36g/cm^3. Lines 2 and 10 had the highest density. Insect damage caused by armyworms ranged from 3.3 to 4.9 (on a scale of 1 lowest to 9 highest) but no statistical differences were observed among them. Rust, the most prevalent disease observed, ranged from 0.8 to 3.8 on a scale of 1 lowest to 5 highest. The incidence of anthracnose was relatively low, ranging from 0.0 to 2.8. Zonate leaf spot ratings ranged from 0.4 to 3.1. The mean incidence of leaf blight was relatively low, ranging from 0.1 to 1.5. A multiple correlation analysis showed no significant correlation among insect and disease attacks and total grain yield. It was shown that useful sorghum material, with variations in height and maturity, and with good yield potential and resistance to pests is available in the Conversion Program for direct utilization in the tropics.

1977, The Journal of Agriculture of the University of Puerto Rico, 61: 443-449.

HOST PLANT RESISTANCE TERMINOLOGY

George L. Teetes

ABSTRACT

The introduction of greenbug, Schizaphis graminum (Rondani), resistant sorghum hybrids has brought attention to the fact that there are differing opinions on how these plant-pest relationships should be described. Some people prefer to call these sorghums "tolerant", while others choose "resistant." Some in the commercial seed industry express concern because of legal implications and have used "tolerant" to describe these sorghums.

This presentation dealt with several different proposed definitions; stressing the strong and weak points of each. The main issue that was brought to bear was that "resistant" describes qualities of plants that cause them to be less infested or less damaged than plants without the qualities (susceptible). "Resistant" does not denote the cause of the resistance. Tolerance is a type of resistance, and is not a lesser degree of resistance.

It would seem that greenbug resistant sorghums are here to stay, and will certainly be an important component in sorghum insect pest management. The fact remains that there is a need for uniformity in the terminology used, as there is a need for uniformity in data collection.

1977. Grain Sorghum Res. and Util. Conf. p. 3.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved HIgh Yielding Sorghum Cultivars with Disease and Insect Resistance.

CHARACTERISTICS OF RESISTANCE TO EXSEROHILUM (HELMINTHOSPORIUM) TURCICUM IN SORGHUM BICOLOR

Darlene M. Tuleen and Richard A. Frederiksen

ABSTRACT

A cell-free culture filtrate of Exserohilum (Helminthosporium) turcicum reduced transpiration in three sorghum cultivars that were susceptible to leaf blight; a resistant cultivar was not affected. Differential reactions for these four cultivars were determined in field and greenhouse trials. The resistant cultivar was differentiated further from susceptible sorghums by a comparatively greater frequency of a hypersensitive response as the plants matured. The most susceptible cultivar exhibited a diminished capacity to respond to infecting conidia with necrotic flecking. The response in two moderately susceptible cultivars was greater in frequency and duration than in the susceptible, but less frequent and of shorter duration than in the resistant. The hypersensitive reaction developed with greatest frequency in four host differentials at the three-leaf stage of growth; this growth stage was also the most susceptible to infection.

1977 Plant Dis. Reptr. 61: 657-661.

SOIL WATER EXTRACTION AND YIELD OF DIFFERENT CULTIVARS OF GRAIN SORGHUM, COTTON, AND MILLET GROWN UNDER STRESS CONDITIONS

C. W. Wendt, J. W. Johnson, D. T. Rosenow and L. L. Ray

ABSTRACT

Different cultivars of grain sorghum (*Sorghum biocolor* L. Moench), cotton (*Gossypium hirsutum* L.) and millet [*Pennisetum typhoides* (Burn)] were grown under stress to determine if differences exist between species and among cultivars within the same species in the amount of water that the crops can extract from an Olton loam soil (Aridic Palenstall). The soil profile was at "field capacity" at planting. Shelters were used to keep the rainfall off of the crop and no irrigation water was added during the growing season. Cotton extracted the most water from the soil profile followed by grain sorghum and millet. Significant differences in soil water extraction and yield were found by different cultivars of cotton and millet. Differences in yield but no significant differences in soil water extraction were found among grain sorghum cultivars.

1977. Agron. Abs. p. 132.

Research supported in part by the United States Agency for International Development through Contract AID/ta-c-1384 entitled Development of Improved High Yielding Sorghum Cultivars with Disease and Insect Resistance.

ABSTRACT

Histopathology of Sorghum bicolor (L.) Moench
Resistant and Susceptible to the Infection of
Sclerospora sorghi (Kulk.) Weston and Uppal.
(August 1977)
Ying Yeh, B.S., National Chung Hsing University
Chairman of Advisory Committee: Dr. R. A. Frederiksen

Resistance in 5 cultivars of sorghum inoculated with Sclerospora sorghi was expressed in seedlings at three to five days of age. Infection takes place in crowns and roots of three-day-old sorghum seedlings.

Conidia of S. sorghi germinated on sorghum leaf surface by germ tubes, formed appressoria over stomatal openings and penetrated indirectly. Vesicles formed in substomatal cavities and produced intercellular infection hyphae. Infection hyphae grew intervenously downward in the leaf and through the leaf sheath and reached the nodal area where hyphae ramified. Downward growth reached the shoot base. Upward growth was directed toward shoot apex. Hyphae spread in the vicinity and at the base of apical meristem, but invasion of apical meristem was not observed. Hypae invaded leaf initials and leaves not fully expanded.

In resistant cultivars, initial stages of infection were identical in conidial germination, appressorial formation, stomatal penetration and vesicle formation. After infection was initiated, hyphal growth in resistant sorghums was restricted. Collapse and shriveling of host cells in infection sites hindered spread of the parasite. Limited spread occurred,

but it was confined to the local lesion areas where discoloration was accompanied by collapse of host cells.

NEWS RELEASES AND PUBLIC MEDIA ARTICLES

List of News Releases and Public Media Articles

"New 'Tropical' Sorghum Ready for Valley Use," Southwest Farm Press, Rio Grande Valley Edition, March 9, 1978.

"Resistant Sorghums Benefit Consumers," Lubbock Avalanche-Journal, April 18, 1977.

"Disease and Insect Resistance Worth Millions in Texas Sorghum," TAES Agricultural Research Report News Release, March 9, 1977..

"Miller Reviews Sorghum Breeding Program in Foreign Countries," TAES Newsletter, December, 1977 - January, 1978.

"Disease and Insect Resistance Worth Millions in Texas Sorghum," Bryan Daily Eagle, March 27, 1977.

"Sorghum Head Smut Baffles Scientists," Irrigation Age, February, 1978.

"What the Scientist Sees: Head Smut," TAES Agricultural Research Report, February, 1978.

"Lodging Resistance in Sorghum," TAES Agricultural Research Report, March, 1976.

" 'Adaptation' Milo Boosts Awaited in South Texas," Southwest Farm Press, July 7, 1977.

"Research Report," TAES News, April 20, 1977.

"Midge Resistant Hybrid Possible Within 5 Years," Grain Sorghum News, April, 1976.

"Banks Grass Mite Resistant Sorghum," TAES Agricultural Research Report, April, 1977.

"We Can Grow Fuel for Vehicles," TAES Agricultural Research Report, May 4, 1977.

New 'Tropical' Sorghum Hay For Valley Use

Hybrid Sorghum Development Should Add

sorghum breeding lines.

Dr. Fred R. Miller of College Station, widely known sorghum breeder who pulled-in the much-desired trait from a sorghum grown in Ethiopia, says bigger milo yields are definitely on the horizon for farmers across the southern half of Texas. He believes, equally important, the development may help breeders answer a much wider question of sorghum adaptation for much of the world.

Dr. Miller, who also is fostering twin-seeded milo which is another potentially important development, is the first to admit that some of the lingo encircling the "tropical" development is a mite confusing to the layman.

To make it simple, he explains it this way:

Types Defined

"What we've dubbed 'tropical types' are sorghums that make optimum yields under conditions of short days, high temperatures, and higher relative humidities."

"They are also sorghums that will fully mature going into longer day lengths."

Stop and think, continues the researcher, and you'll recall that normally a crop—almost any crop—matures out as the days get shorter and cooler, such as on the High Plains of Texas in the fall. Shorter, cooler days usually trigger a plant to end its normal growth cycle.

Growing conditions in June and July when milo is harvested in the Rio Grande Valley are anything but cool with shortening days.

> "Until now, sorghums planted and grown in the southern half of Texas just haven't been able to give the high yields of sorghums grown elsewhere across the sorghum belt of the U.S."

Short On Yield

"Until now, sorghums planted and grown in the southern half of Texas just haven't been able to give the high yields of sorghums grown elsewhere across the sorghum belt of the U.S."

"You can frankly say that tropically adapted sorghums are a totally different breed of sorghum cat" added Dr. Miller explaining he prefers instead to call them as "wider adapted" sorghums to break the confusing tropics labeling.

While the tropical name is perhaps misleading to Texas growers, the new types are put into proper focus by recognizing their potential in truly tropical countries of the world. Dr. Miller said they promise to be a boon in perennial warm weather climes such as is found in Puerto Rico, Niger, Ethiopia, India, and Guatemala, plus other tropical locations.

The real significance is that sorghum in these countries is planted and grown mainly for use as a human food grain.

Long Tested

Here in the Valley, Dr. Miller has had his testing work ongoing for several years with workers at the Texas A & M Agricultural Research and Extension Center at Weslaco. Evaluations are

Southwe

continuing this year.

To demonstrate how one hybrid is adapted in one part of the state and not another, and to illustrate the potential for the tropical types, Dr. Miller and an associate, Geoff Thomas, last year grew several "normal" sorghum hybrids at three different locations across the state - - Weslaco, College Station and at Lubbock.

The identical hybrids were produced under the same general care at all locations.

One hybrid in the group was the old standby RS-610, one of the early state released hybrids of a few years back. The RS-610 yielded only 4,127 pounds to the acre at Weslaco. It turned a stronger 6,200 pounds to the acre at College Station.

At Lubbock where growing conditions were poor due to a hot, dry summer and fall growing season, the same hybrid yielded 4,890. It normally would have [illegible] much higher there.

Multi-Seedings

Several of the tropical types were seeded at the same locations also. One, designated only at A1x623xTx430, yielded 8,721 pounds per acre at Weslaco, 7,767 pounds at College Station and 4,197 pounds at the Lubbock location. That's a 1,594 pound gain over RS-610 in terms of Valley production.

Just how much more grain Valley farmers may be able to make from tropical commercial hybrids is not fully known at this point, but it is potentially thought to offer growers a 30 to 50 percent increase.

Adaption of any plant, say the scientists, is its inherent ability to produce satisfactory yields under "a given climatic regime."

"We are all aware of the fact that some sorghum varieties will produce good yields in certain climatic areas, and not as well as when moved to another locale," Thomas told the Texas Seed Trade Association Production and Research Conference in Dallas recently.

"A hybrid that is truly temperate in Nebraska will not perform the same in Texas, as an example," he said.

'Specifically Adapted'

Varieties which behave in this manner are what's called "specifically adapted" to a given climatic regime.

Thomas explained that in its [illegible] climatic niche a plant [illegible] the proper amount of [illegible] energy for the [illegible] temperature [illegible] which favor [illegible] development.

[illegible] acceptable [illegible] When this same variety is [illegible] a different climate [illegible] the environmental [illegible] does not necessarily [illegible] [illegible] of yields that could [illegible] acceptable. Thus [illegible]

Generally Adapted

[illegible] varieties which are adapted to a wide variety [illegible] climates are often referred [illegible] generally adapted types.

[illegible] on Dr. Miller [illegible] and later the release [illegible] lines of the tropical type sorghums, Thomas told seed-[illegible] that even the best "generally adapted" milos have [illegible] good results under [illegible] tropical conditions, such as [illegible] tropical Rio Grande Valley of Texas where normally farmers harvest only 3,500 [illegible] of grain to the acre [illegible] conditions [illegible] recounted, are characterized by short days, high [illegible] temperatures and by low [illegible] changes in temperatures. [illegible] conditions include relatively high humidities and are in a location where crops are faced with normal maturity as the days get longer, not shorter.

Rapid Developments

As agricultural developments go, this one has come on fast.

Just in the past three years Dr. Miller found that hybrids with what's called zerazera material from Ethiopia have shown to be unusually well adapted to tropical areas.

This does not mean, Thomas pointed out, that tropical adaption is limited to what breeders recognize as the zerazera type. "Other sorghum groups also have tropically adaptive types."

[illegible] material [illegible] Miller's [illegible] breeding material [illegible] to "backcross" [illegible] necessary genes for a much wider adaptation, actually [illegible] into a generally adapted category as sorghum classification goes.

The list of 10 breeding lines recently turned over the coming [illegible] are those for Miller feels can be useful in adding to production in tropical areas, or in regions where planting is done in short days and grain filling occurs in longer days with increased temperatures.

Better Understanding

Concludes the principal researcher, "Apart from the obvious benefits of raising production of sorghum in tropical areas of the world, hybrids with this wide adaptation characteristic may provide us with a key to a greater understanding of overall sorghum adaptation."

"They may in the future provide us with knowledge to let us forecast how a given genotype will react in a given climatic situation. Information of this type would be very useful to plant breeders who are involved in international crop improvement programs," he said.

Different avenues are being further explored to understand the phenomenon as part of Texas A & M's continuing sorghum breeding program. One thought is that plants with the zerazera derivaties are able to produce such good yields under tropical conditions is that perhaps these plants have a lower respiration rate and therefore during the long hot tropical nights do not use as much photosynthate for the filling of seed and hence raise yields.

Resistant Sorghums Benefit Consumers

BY ROBERT L. HANEY
Texas Agricultural Experiment Station

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 the consumer and producer.

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 grains 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.

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.

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, pest 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 $26 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 insecticideuse was cut by half, according to Dr. George Teetes, Experiment Station entomologist at College Station.

And onclosely supervised fields, only 6.4 per cent of resistant sorghums were treated with no loss in yields, compared with 99.4 per cent of susceptible sorghums.

Frederiksen sums it up, "The whole purpose ofthe resistance program is to build a brod base of resistance to disease and insects.

Since both insects and pathogens (diseases) can mutate (change genetically) so rapidly, we must anticipate and be able to supply asneeded new sources of genetic resistance in the sorghum plant."

Lubbock Avalanche-Journal, April 15, 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.

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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.

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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

KLEBERG ANIMAL AND FOOD SCIENCE CENTER OPENS

Activities on Texas A&M University's new West Campus will increase significantly Monday with the opening of the Robert Justus Kleberg, Jr. Animal and Food Sciences Center.

The $8.4 million facility will serve some 2,000 students and house approximately 200 faculty and staff members, notes Dr. O. D. Butler, head of the Animal Science Department.

In addition to the Animal Science Department, the building will serve the Poultry Science Department and provide temporary facilities for 4-H and other youth activities conducted by the Texas Agricultural Extension Service.

Formal dedication ceremonies are scheduled April 3.

The 165,000-square-foot edifice contains two large lecture halls, four other classrooms, 10 teaching laboratories, 40 research labs, eight conferences rooms, nearly 100 offices, and library space.

It also houses a wool and mohair laboratory, the state milk testing lab, animal rooms and data processing facilities.

The center is named for the late longtime leader of the famed King Ranch organization. Kleberg, one of Texas' outstanding ranching figures, was a 1941 recipient of an honorary doctor of agriculture degree from Texas A&M, one of the few persons to receive an honorary doctorate here.

The animal and food sciences center is the second major project completed on the West Campus. The first, the Soil and Crop Sciences and Entomology Center, opened last fall.

Eventually, the West Campus will contain approximately 10 buildings to augment the programs of the nation's largest college of agriculture and the agriculturally related research and extension thrusts for the Texas A&M University System statewide.

MILLER REVIEWS SORGHUM BREEDING PROGRAMS IN FOREIGN COUNTRIES

Dr. Fred R. Miller, TAES sorghum breeder, evaluated breeding programs in India, Ethiopia and the Sudan Oct. 17-Nov. 8, 1977. Miller reviewed the sorghum breeding program at ICRISAT, Hyderbad, India where TAES sorghums provide a substantial germplasm base.

He and Dr. Leland House of ICRISAT participated in an IDRC program review of the Ethiopian Sorghum Improvement Project, Nazareth, Ethiopia. Miller and House, later travelled to Wad Madoni, Sudan to evaluate TAES and ICRISAT sorghums and the Improvement Program.

Miller returned to the TAES with more than 300 collections of sorghum germplasm. Miller reviewed the making of several different bread products from sorghum and other food items.

BIRD ELECTED TO ADVISORY COMMITTEE

Dr. Luther S. Bird has been elected by TAES staff to the Advisory Committee to implement the "Texas State College and University Employees Uniform Benefits Act" enacted during the most recent legislative session.

The Act is intended to provide uniformity in basic group life, accident, and health insurance coverages for employees of public higher educational institutions and systems.

Disease, 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 livesteck industry, though corn is

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, an thracnose, 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 reseach 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 utilitzation 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.

Sorghum head smut baffles scientists

For southern grain sorghum growers head smut is a disease which is causing greater concern and loss of production. So far there is no real cure.

Dr. D.T. Rosenow, plant researcher at Texas A&M, Lubbock, said it's a real problem because researchers have been unable to find a resistance that will hold.

"You can find a resistance, and all the companies incorporate it into their materials," Rosenow explained. "They put it out and, within a couple of years it breaks down. So we have a problem of finding something that will hold over a period of years.

"We're really struggling right now in terms of finding something that people can use," he said.

What makes the problem more serious is that there isn't a chemical treatment for it.

"It's a soil borne organism, and so far we haven't found any type of seed treatment or anything that works," Rosenow said. "There are some treatments that have been effective on some of the small grains, but we haven't found any that have had any effect on sorghum head smut."

It appears that head smut is more of a problem for irrigators than for dryland producers.

"We see more smut in irrigated fields than we do in dryland," Rosenow said. "Of course, in the southern part of the state (Texas) there isn't much irrigation, and it's pretty well all over the area down there.

"Again, soil type may be involved to some extent. We find smut more in the heavier soils. We have not found that much of it in the lighter soils, and more of the dryland sorghum is on lighter soils," Rosenow said.

A producer can gain some relief through crop rotation, but it's temporary.

"It helps some, but it's not really a complete cure," Rosenow explained. "It will reduce, that is, rotating every second or third year will help some, but we do know that the smut spores are capable of living in soil for six or more years. So you won't completely eliminate the problem. Going back into an area that was highly infected, even after a couple years, with a highly susceptible hybrid – you'll still get some."

But Rosenow believes rotation is worth considering since researchers have not been able to find a resistance that will hold.

Dr. D.T. Rosenow, shown with samples of charcoal rot, has done considerable research involving sorghum diseases.

There's no question that head smut can be devastating to sorghum yield.

"A plant that gets it early and the main head is affected will not produce any grain," Rosenow said. "In a lot of cases, you have a fairly linear relationship between smut damage and yield loss. In some conditions, a smutted plant will be very stunted and very small and smutted. In that case you will not have such a relationship because it is crowded out.

"But other times the plant will develop normally – they look completely normal – except that they get up to the point where grain should be and then all you have is a smut pod. So in those cases you have a pretty definite yield reduction," Rosenow said.

"As a general rule, we use the 10% level as a cutoff point. If you have less than 10% you're probably not getting hurt that much or will lose that much. But when you get above 10% you'll probably suffer a substantial loss," he said.

So far the problem is more or less confined to the southern areas. It's a severe problem in the gulf coast area of Texas and east but farther north in the Great Plains area it becomes less of a problem.

It's a problem for which Rosenow and his associates would like to find a lasting answer. ▼

WHAT THE SCIENTIST SEES

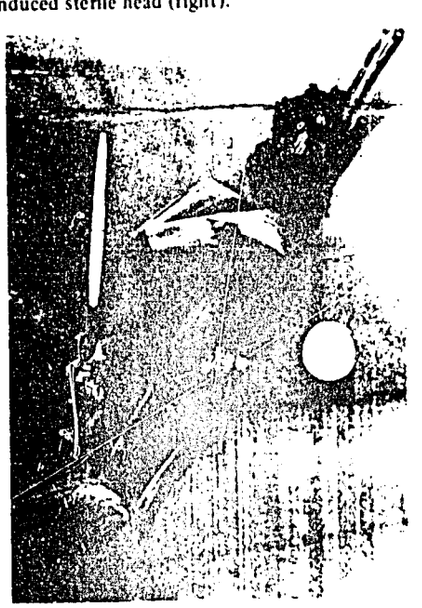
Head smut is one of the traditional production hazards in many sorghum growing regions in the U.S. In 1976, it appeared that nearly all commercially available hybrids were susceptible at one test site. Similarly, in 1975 and 1976, head smut of corn caused major losses in several commercial fields on the High Plains of Texas. Fields with some of the plants smutted (some as high as 50 percent) occurred in 1975, and one field with 80 percent smut was found in 1976. Scientists with the Texas Agricultural Experiment Station identified smut-resistant corn. Breeders are incorporating this characteristic into seed corn. It is thought that control is nearly achieved.

In sorghum, smut resistance seems to be a more complex problem. Scientists are cautiously optimistic that a higher degree of stability of resistance to head smut is possible, particularly as more hybrids become available with different smut-resistant backgrounds. Meanwhile, alternate controls need to be reevaluated, including chemical, cultural, and biological approaches, in order to provide farmers with optional disease control strategies. Source: Richard Frederiksen, College Station. Tel. 713/845-7522.

RICHARD A. FREDERIKSEN
DEPT. OF PLANT SCIENCES
CAMPUS

Various symptoms of head smut in sorghum:
A. Typical mature sorus

B. A leafy inflorescence caused by smut, (left) compared with smut-induced sterile head (right).



Corn smuts:
C. The head smut pathogen has completely replaced an ear with a typical smut sorus (note the vascular strands).

D. The common smut is characterized by irregularly shaped galls often at the nodes.

For more information on research briefs contact the scientists directly or write Robert L. Haney, Science Editor, TAES, Department of Agricultural Communications, Texas A&M University, College Station, Texas 77843 Telephone (713) 845 2211

Brief Reports on...

Agricultural Research in Texas

THE TEXAS AGRICULTURAL EXPERIMENT STATION

Vol. 4, No. 3
March 1978

ALTERNATIVES TO DESICCATION The increasing problem of obtaining desiccants for cotton points up the need for reasonable alternatives. Some options are to 1) improve harvesting equipment to alleviate need for harvest aids, 2) develop and use a self-defoliating cotton plant, 3) wait for a killing frost, 4) defoliate and harvest with a picker, and 5) defoliate and harvest with a mechanical stripper. Scientists with the Texas Agricultural Experiment Station found that under favorable conditions, a "hot" defoliant combination applied when bolls were 95 to 100 percent open would work on a variety of cotton which can be defoliated, such as SP-37. (Some "stripper" varieties are very difficult to defoliate.) A "hot" defoliant combination such as sodium chlorate at the rate of 1.0 to 1.5 gallons/acre with 1.5 pints/acre of Accelerate was very effective. Stripper harvest was initiated when maximum defoliation was attained. Source: C. S. Miller, College Station. Tel. 713/845-7311.

(4 - 3 - 1)

CONTROL OF TWO RICE DISEASES Two distinct diseases are attributed to *Cercospora oryzae* in Texas. One is narrow brown leaf spot which has long, narrow, tan to brown lesions found on leaves, sheath, and panicles. The other is called brown sheath stain. It begins as a small tan to reddish brown lesion on the sheath and can ultimately spread over the entire sheath. The disease can prematurely kill all of the leaves on the rice plant, including the flag leaf. In three years of study, benomyl (0.56 kg/ha), triphenyltin hydroxide (0.53 kg/ha), chlorothalonil (0.91 kg/ha), and captafol (1.12 kg/ha) were found to effectively control *C. oryzae* in naturally infected field tests, according to scientists with the Texas Agricultural Experiment Station. In timing studies, two applications (boot and 14 days later) were found to be most effective in reducing disease incidence of both narrow brown leaf spot and brown sheath stain in rice. Source: N. G. Whitney, Beaumont. Tel. 713/752-2741.

(4 - 3 - 2)

LODGING RESISTANCE IN SORGHUM Lodging, a serious problem in sorghum production, refers to any bending or breaking of any portion of the stalk in such a way as to interfere with normal harvest operations, result in loss of grain, or both. Lodging is an all-inclusive term and is the end result of one or more plant, environmental, or pest factors. The types of lodging that scientists of the Texas Agricultural Experiment Station are concentrating on in lodging resistance breeding work are 1) root lodging, 2) weak neck, 3) moisture-stress, charcoal-rot type lodging, and 4) after-freeze stalk breakage. The major features of the program are a) initial identification of lodging resistance by anyone in any nursery, b) initial screening in single-row observation plots in a lodging nursery left standing over winter, or allowing an entire breeding nursery to stand over winter, and c) screening in replicated trials at several locations for several types of lodging. Another promising selection technique that can be used anywhere that moisture stress is common is the use of senescence (premature death) ratings. Station scientists found significant correlations between non-senescence and lodging resistance and charcoal-rot resistance. Non-senescing lines had higher leaf-blade chlorophyll content and 26 percent higher leaf-area duration than senescing lines. Still another useful technique that would work anywhere is the use of stalk-puncture pressure as a selection aid. Station scientists, using a combination of these methods, have made significant progress in developing lines with superior lodging resistance. Source: D. T. Rosenow, Lubbock. Tel. 806/746-6101.

(4 - 3 - 3)

PEANUT RESISTANCE TO THE LESION NEMATODE Lesion nematodes are estimated to be an economic deterrent to peanut production on 20 percent of the growing areas in Texas. Shell penetration sites by the nematodes can serve for entrance of fungal diseases. These nematodes can also cause serious injury to roots, pods, and pegs. Nematicides can cut losses but are an added production cost. Resistant varieties have been sought by the plant breeders of the Texas Agricultural Experiment Station since

'Adaptation' Milo Boosts Awaited In South Texas

By Fred R. Miller
TAES Sorghum Breeder

The tropical adaptation characteristic in temperate-zone-adapted sorghums has a real potential for South and Central Texas farmers.

These sorghums have been developed by the Texas Agricultural Experiment Station (TAES) and distributed to commercial seed companies. Distribution of seed was made in the late winter of 1976 and most companies are making hybrids for observation and preliminary sales in 1978.

More seed of these grain sorghums will be available in 1979 for wide-scale plantings.

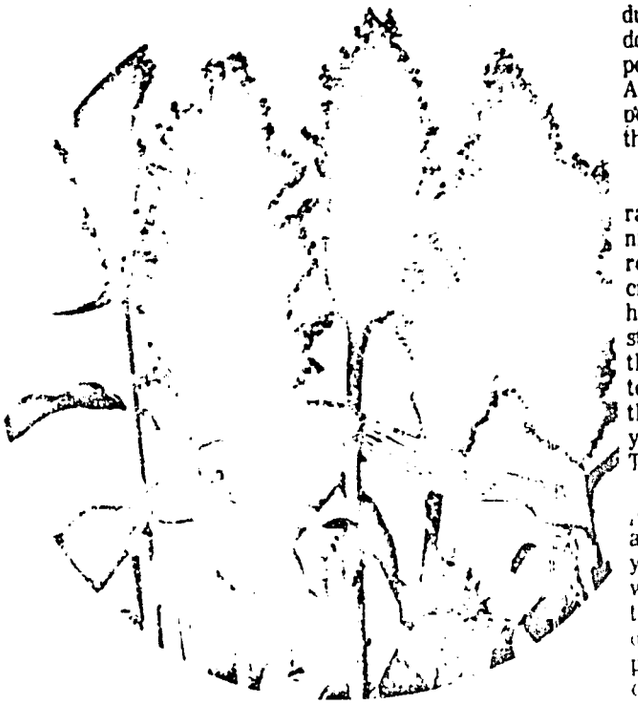
Tropical Adaptation?

What is tropical adaptation? As plant breeders use this terminology, it means the ability of some selected temperate sorghums to grow better and convert the energy of sunlight and leaves into starch or grain at a greater rate than normal sorghums, under hot days and hot nights.

The sorghum plant is just like you and me in its desire to remain cool, particularly at night. So if we are to grow sorghum for grain in South Texas from an early season planting and have grain filling occur in June, it will have to live at a faster rate to keep cool. To live faster to keep cool requires energy – energy which normally would be stored as grain.

Those hot nights which give you problems are also giving your sorghum crop problems, resulting in lower yields.

You are aware that yields are higher from Lubbock, Tex. northward. Why? Perhaps it is because the high plains farmer plants in the long days of May and you plant in February or early March. Or is it because his sorghum crop is filling the seed in the head from September to October when nights and day time temperatures are rapidly declining?



BREEDING MATERIALS of "tropically adapted" sorghums for South and Central Texas are now in hands of commercial firms, released by the Texas Agricultural Experiment Station late last winter. A Texas breeder expects a 25 percent yield gain for South Texas growers, maybe more. Dr. Fred Miller says he foresees sizeable plantings by 1979.

Environment Factors

Your grain sorghum is filling its grain under a very hot night and day time situation and probably each night gets a little warmer. I believe you see the picture now. The northern farmer has no magic formula to increase yield but that one or two factors in the environment are working for him and against you.

In experiment station breeding work, I took a female used in producing hybrid grain sorghums and crossed it with a good-looking, disease and insect-resistant line collected in the lowlands of Ethiopia. This region has hot nights and short daylengths, which may have helped select a superior sorghum for our use. This cross was grown at Lubbock where selections were made. Later I grew them at College Station, Puerto Rico, Corpus Christi – back to Puerto Rico and then to College Station, finally.

This type of selection in the short day areas of Puerto Rico and South Texas has allowed us to find those tropically adapted temperate zone sorghums which have greatly increased yield potential in hotter night temperatures.

These new female lines have a major increase in the number of seeds per head. All our research has shown that the increased number of seeds is the yield component we need most in South Texas.

Because of the hot nights during grain filling, size of seed does not allow us to develop yield potential as it does further north. Above Dallas, size of seed is perhaps the most important of the yield components.

Higher Yield

Now, by combining the lower rate of living to keep cool at night, which we call a slowed respiration rate, and the increased number of seeds per head we have a rather substantial yield increase. We feel that tropical adaptation in temperate zone sorghums has the potential for increasing yields at least 25 percent in South Texas across the board.

[illegible] com- [illegible] that tropically-adapted females gave dramatic yield increases when crossed with a male line. The resultant tropically-adapted hybrid far outyielded conventional hybrids produced by the same male line crossed with a normal female.

Dr Teetes

NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION / J. E. Miller, Director / The Texas A&M University System
College Station, Texas 77843 Telephone (AC 713) 845-2211

4-20-77 RESEARCH REPORT FOR RELEASE ON RECEIPT

COLLEGE STATION, April____--(Spl)..... A Texas Agricultural Experiment Station entomologist is participating in a meeting of the United Nations Food and Agriculture Organization Panel of Experts on Integrated Pest Control April 21-28 in Rome, Italy.

Dr. George Teetes, associate professor of entomology, will review Experiment Station research in developing insect-resistant sorghums and the Texas program of integrated insect control for sorghums.

The entomologist also will report on the U. S. Agency for International Development-sponsored program in which the Experiment Station is working toward pest-resistant sorghum lines for possible use in developing countries.

The UN/FAO panel has asked Teetes to be the principal author and editor of a handbook for use in developing countries. Guidelines will be provided for integrated pest control of sorghum and millet.

Dr. P.L. Adkisson, head of the Texas A&M University Entomology Department, said members of the panel are recognized as top international authorities on crop protection.

"Selection of Dr. Teetes to participate in the panel meeting comes in recognition of his outstanding research accomplishments and his leadership in the United States in developing sorghum insect control methods that are recognized as the best in the world," Adkisson said.

-dg-

Midge resistant hybrid possible within 5 years

By Dr. George Teetes, Entomologist
Texas A & M University

Contrary to some published public media accounts, Dr. Jerry Johnson and Dr. George Teetes say they are "not one bit discouraged" about the progress being made concerning sorghum midge resistant sorghums.

In a personal interview with Dr. Teetes, the scientist said that he is "encouraged and quite happy" about the progress that is being made in sorghum midge research and professed to being optimistic and to having "all the confidence in the world that within the next five years we will have midge resistant hybrid grain sorghum."

Dr. Johnson (a sorghum breeder) and Dr. Teetes (an entomologist) began their research soon after the discovery of sources of midge resistance in 1973 in materials from the Sorghum Conversion Program.

Since that time the scientists have been working to breed that resistance into agronomically acceptable types for use in sorghum hybrids. According to Teetes, "This has not been easy."

Dr. Teetes said the greatest difficulty is created by the nature of the inheritance of resistance. Midge resistance must be in both parental lines in order to be most effective. Most of the original sources of the resistance were in types suited only for male parents. Consequently, it is necessary to develop resistance in male sterile lines.

Dr. Teetes

"Fortunately," continued Teetes, "good progress has been made in this area also and certain test hybrid combinations look very good for midge resistance."

Teetes assesses the damage done by the midge as "the largest and most costly problem confronting sorghum growers worldwide."

Though Kansas and Nebraska sorghum producers do not have midge problems and farmers on the High Plains of Texas have usually been able to escape the insect's infestation by shifting planting dates from June to May, the problem is not so easily solved farther south where a great portion of the world's sorghum is grown.

"Still," says Teetes, "there would be great advantages to farmers on the High Plains if the midge problem was solved." Presently, to avoid the insect, High Plains producers are locked into a planting date which may not enable them to use natural rainfall patterns to their best benefit.

A midge resistant sorghum hybrid would allow Texas farmers greater flexibility in planting. Additionally, late season plantings wouldn't need as many insecticide applications.

During the sorghum flowering stage the midge adult lays its eggs in between the glumes near where the sorghum seed is beginning to develop. When the larvae hatch they feed on the developing seed and destroy it.

How they actually feed has been the object of much research. It had been thought that the larvae had a way of piercing the developing seed and then eating the juicy part inside.

But, recent research by Dr. Teetes' graduate student Allen Wuensche indicates that the larvae may not in fact have mandibulate mouth parts. "This suggests," according to Teetes, "that the larvae actually secrete a digestive enzyme which enables the larvae to feed on the seed."

"If this is true," continued the scientist, "it opens new opportunities for screening for sources of midge resistance and gives us a better understanding of the causes of resistance."

Dr. Teetes' scientific emphasis has been on (1) the mechanisms of resistance (the insect-plant response) and (2) the causes of resistance.

There are two basic mechanisms functioning in the resistant sorghums according to research of student Wuensche: (1) Non-preference—a quantitative difference in the preference of the midge adult for the susceptible over the resistant plant; and (2) antibiosis—the fact that certain plants have adverse effects on the insect's biology.

In the first—"non-preference"—Dr. Teetes is probing for the reason adult midges prefer the resistant plants less than the susceptible ones.

In the second—"anti-biosis"—Dr. Teetes and his student have discovered that when midge attack certain resistant plants a given percentage of the insects do not survive.

"Resistance is relative," noted the scientist, "and though midge resistant hybrids may not completely do away with midge damage, they would add a needed dimension to sorghum midge management and reduce chemical expenditure dramatically."

Brief Reports on...

Agricultural Research in Texas

TEXAS AGRICULTURAL EXPERIMENT STATION

Vol. 3, No. 4
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IMMATURE PEANUTS HURT QUALITY

Peanuts harvested at any time will include immature fruits due to the indeterminate growth characteristic of the species. Several unsuccessful attempts have been made to reduce or eliminate the proportion of immature peanuts at harvest by terminating flowering late in the growing season. Altering neither day length nor plant density accomplished this. Ways of breeding peanuts that produce more mature fruits at harvest are being investigated. Plant breeders of the Texas Agricultural Experiment Station find that although both intra-row spacing and environmental conditions do affect maturation, peanut strains differ in their MPMF (maximum percentage of mature fruits). Selection for high percentages of mature fruit can be made based on easily measured correlated genetic traits. Intentions are to develop varieties with fewer immature nuts at harvest. Source: Olin Smith, College Station, Tel. 712-845-2424.

(3-4-1)

AERIAL PHOTOGRAPHY IN BRUSH CONTROL

Ecological changes following brush control were studied on two honey mesquite infested deep hardland range sites in north central Texas. In this Texas Agricultural Experiment Station study, low altitude color infrared aerial photography was used to document the initial effects of brush control on secondary plant successions. The first aerial photo mission was flown prior to treatment in the spring of 1973, and has continued to be taken each spring and fall through 1976. Supportive field data were collected in conjunction with each photo mission. Together, the field and aerial photo measures provided information on plant response to brush control which could not have been available using either technique alone. Source: K. C. McDaniel, J. H. Brock and R. H. Hass, College Station. Tel. 713/845-7012.

(3-4-2)

GRASS STIMULANTS

A positive plant-animal-soil relationship has been found to exist by Texas Agricultural Experiment Station scientists. Additions of both bovine saliva and thiamine (vitamine B1) resulted in significantly higher plant yields when grown in a sandy soil opposed to those grown in more fertile clay soils. Plant root growth was also stimulated by additions of thiamine and bovine saliva. Under certain soil conditions or otherwise depleted farm or range lands, an actual increase in plant vigor or yields from additions of thiamine or from good grazing management can be expected. The complete exclusion of domestic livestock from places such as wilderness areas may eventually be harmful to existing grassland associations. Source: P. O. Reardon, Uvalde, and L. B. Merrill, San Angelo. Tel. 512/278-9151.

(3-4-3)

BANKS GRASS MITE RESISTANT SORGHUM

The Banks grass mite, a spider mite, is a serious pest of grain sorghum. Concern over the mite stems from the severe damage it may cause to sorghum and recent evidence of resistance to most acaricides. Because of the unreliability of chemical control, Texas Agricultural Experiment Station scientists have been searching for plant resistance to the pest. Advancements to date look extremely encouraging, as sources for resistance to the Banks grass mite have been identified in exotic germ plasm from the Sorghum Conversion Program. In field evaluations at Pecos among grain type sorghums, certain converted "Rio" selections showed consistently lower damage. Characteristically, these sorghums are higher in sugar than most grain sorghums and are "non senescing" (ability of plant to stay alive) types. These types of sorghum appear to have certain physiological qualities that make them uniquely suited not only for mite resistance research, but also for drought and disease resistance research. Source: George L. Teetes, College Station. Tel. 713/845-1535.

The Texas Agricultural Experiment Station/J. E. Miller, Director/The Texas A&M University System/College Station, Texas

News file

The Scientists Tell Me...

We Can Grow Fuel for Vehicles

By Robert L. Haney
TAES Science Writer

The feasibility of supplementing our fuel supplies with alcohol is being investigated by scientists with the Texas Agricultural Experiment Station (TAES), in cooperation with Louisiana, Florida and USDA.

An automobile engine can be adjusted to run on fuel that's partly alcohol. And alcohol can be made from many of the crops we raise as food or feed.

Already many countries are having to cope with shortages and fuel prices that make our situation in the U. S. look desirable.

Brazil, for example, has gasoline prices three times as high as ours, in the range of $1.80 to $2.00 per gallon.

At present, Brazil is using an estimated 500 million liters of alcohol per year in their gasoline (a 5 percent alcohol-gasoline mixture). Plans call for an increase of alcohol production to 3,000 million liters per year by 1980 to allow for a 20 percent alcohol-gasoline mixture.

Sugar cane and cassava are used in Brazil for manufacturing alcohol, according to Dr. Fred Miller, an Experiment Station grain sorghum breeder.

Miller recently returned from Brazil where he conferred with agricultural officials. Acting on his recommendation that they consider TAES improved sweet sorghums as an additional resource, Brazilians have ordered tons of seed from here.

Estimates are that Brazil's present production of about 66 million metric tons of sugar cane will have to be increased to 100 million metric tons to provide the additional alcohol.

Though no more sugar will be produced, Brazil will still benefit in two ways: 1) it will reduce the drain of money for imported fuel, and 2) it will increase employment in sugar agriculture.

In the cooperative research being conducted by Texas Experiment Station scientists and those in Louisiana, Florida and USDA, "total biomass" are key words. This means all of the plant material that can be produced per acre, according to Dr. Sim Reeves, a TAES agronomist specializing in sugar crops. Reeves explains that the total plant, not just the sugar, can be converted to fuel production.

Reeves is located at the TAES Weslaco Center and is conducting research on the use of sweet sorghum for alcohol production. Scientists in Florida and Louisiana are working on sugar cane for the same purpose.

In recent years, TAES scientists have greatly improved sweet sorghum varieties to extend both the milling season of Texas sugar mills and the area of production. Sorghum can be produced in areas not suited to sugar cane.

According to Miller and Reeves, the improved Rio variety can be grown to harvest in 135 days and in South Texas this permits two crops per year. This gives yields per acre of about 3½ tons of sugar per year. Another variety, Roma, is expected to give even higher yields.

Alcohol production from this sugar is about 250 gallons per acre per year. Even the leaves and stalks can be converted to another fuel, methanol, or can be used to fuel the sugar mills.

In the years to come, Texans may have cause to doubly bless the relatively new sugar industry the Experiment Station and USDA were instrumental in developing. Their sugar mills may help fuel their cars as well as sweeten their food.

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.