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FINAL REPORT

on

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

Contract No. AID/t-a-c 1384

March 1, 1979 - September 30, 1979

Prepared by

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REPORT SUMMARY

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

Contract Number: AID/t-a-c 1384

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Total expenditures and obligations through previous contract year:	$894,946
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NARRATIVE SUMMARY

During the past year some 48 technical articles, papers, and presentations were made on sorghum and sorghum improvement. These papers covered a wide range of topics on sorghum improvement in general, host resistance, cereal chemistry, physiology, and basic genetics. In 1979 two separate programs related to advanced training of scientists from developing countries were conducted by Texas A&M researchers. At Corpus Christi the Annual Grain Sorghum Workshop was highlighted by an interdisciplinary discussion on the merits, definition, and deployment of the trait known as "tropical adaptation." Other aspects of this workshop included a tour of the research nurseries at Berclair, Beeville, Corpus Christi, and Robstown. A technical paper session was used to review on-going research programs and graduate student problems. The International Short Course on Breeding Plants to Resistance to Pests was conducted over a two-week period and coordinated by the faculty at College Station. Essentially all of the project leaders on sorghum improvement participated in this program which included the preparation of a techniques paper. Two releases in 1979 included a twin-seeded pollinator line, Tx431, and a population TP15RB which is a broad base composite developed from converted exotic sorghums. Three major developments were noted on sorghum downy mildew: (1) a new race of the pathogen was found in South Texas, (2) low temperature environments were found to predispose some downy mildew resistant sorghums to the disease, and (3) a new technique was developed in cooperation with Brazilian scientists on the identification of individual plants in F_2 populations segregating for resistance to sorghum downy mildew. Considerable progress was made on the determination of mechanisms of resistance to grain mold to sorghum. Joint observations made by Latin American and African scientists support the hypothesis that there are distinctly

different races of the fungus causing anthracnose of sorghum but some lines possess resistance to all of the isolates.

Midge resistant sorghum varieties that are also resistant to anthracnose, downy mildew, and head smut and low in tannins were released and distributed. These varieties contain both restorer and non-restorer lines enabling the production of midge resistant hybrids.

A line has been identified that is resistant to greenbugs in the adult plant stage but not in the seedling stage. The line is not bloomless, indicating a source of resistance not previously identified.

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 (*Peronosclerospora 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 (*Rhpoalosiphum 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 and insects prevalent in the United States. Some of these sorghums possess extraordinarily broad adaptation across both temperate and tropical areas of the world, excellent cultural traits, as well as 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 of 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 14 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 has opened tremendous opportunities for sorghum improvement in Texas that has relevance throughout the world. The finding of photoperiod insensitive sorghums with wide adaptation across both temperate and tropical zones, makes the Texas program very useful to the tropical environments of the developing countries of the world.

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

During 1979 several unique disease problems were encountered. The season itself was late, cooler than average, and had a very wet, early growing season followed by a dry summer. Initially downy mildew developed at Port Lavaca in a Tx430 hybrid, but only at the earlier planting date, confirming in part other's observations that there is a cool temperature breakdown of Tx430 resistance to downy mildew. Later a distinctly new pathotype of *Peronosclerospora sorghi* was identified from Mathis, Texas. This is a first for the species in Texas. New races can be a mixed

blessing because, while it is almost inevitable that pathogens will vary, this variation tends to erode the value of host resistance. New isolates, however, can be used to define levels of resistance and the nature of variation present in the pathogen. Both bacterial stripe in South Texas and bacterial streak on the High Plains developed to unusually high levels. While neither appeared to cause extensive losses, their dramatic appearance caused considerable alarm to some growers, particularly those who grew hybrids susceptible to bacterial stripe.

A new disease, tentatively named sorghum wilt, caused by a *Phialophora* sp. was identified. This disease develops vigorously in the greenhouse and following inoculation in the field. Further work on sorghum wilt is justified.

THE 1979 DISEASE NURSERIES

Berclair - Head Smut

Grown principally as a head smut nursery for screening for resistance to races 3 and 4 of *Sphacelotheca reiliana*. About 10,000 entries from various programs were evaluated at this site in 1979. The level of disease was lower than usual, although fair evaluations for smut, rust, grey leaf spot, and late season stresses were possible. "Pink sheath rot" caused by *Sclerotium rolfsii* developed on a few entries.

Beeville - Head Smut and Downy Mildew

At Beeville, the nursery is divided into sections based on the types of alternate year spreader crops used to encourage disease development. During 1979 the downy mildew area had an excellent disease severity. Screening of exotic introductions, evaluation of Rid-o-mil® for chemical control and extensive early generation of breeding material was possible. A larger area is devoted to head smut screening; however, in 1979 head

smut was not as high as it was in 1978. Generally, leaf diseases develop extensively at this site, but because of cool weather during the early season and relatively dry flowering period, leaf diseases were moderately severe. Bacterial stripe was generally prevalent, along with moderate levels of grain mold, Fusarium head blight and grey leaf spot. Extensive selections and observations by the breeders were made at this location in 1979.

Corpus Christi

A major epidemic of bacterial stripe developed on the station at Corpus Christi. Good levels of downy mildew and head smut, zonate leaf spot were also present.

Edna - Head Smut

Fair head smut, excellent grain mold, and fine agronomic plant growth characterized the 1979 Edna head smut nursery. Because of the similar race pattern of smut at Berclair and Beeville we elected to abandon this nursery site for 1980.

Robstown

At Robstown, excellent downy mildew permitted evaluation of DMR sudan grass selections as well as the commercial hybrid evaluation program. Low levels of other foliar diseases permitted an ideal environment for controlled inoculations with *Colletotrichum graminicola* and *Gloeocercospora sorghi*.

College Station

In this area little naturally occurring sorghum diseases develop. In 1979 the environment permitted modest control of inoculation, but when augmented by field foggers excellent anthracnose, zonate leaf spot, and grain mold developed.

Lubbock and Halfway

A naturally occurring epidemic of bacterial streak and superb inoculations with maize dwarf mosaic were the major problems associated with the nurseries at these locations. The occasional plant with sorghum wilt was observed.

Chillicothe-Vernon

At this site we evaluated entries for Periconia root rot. Three dates of planting of Colby demonstrated that disease develops aggressively in this susceptible cultivar throughout the season.

IDIN

The 30-entry International Disease and Insect Nursery included seven new entries in 1979 (Table 1). They included a grain weathering resistant line, three agronomically improved midge resistant lines, one greenbug resistant line, a charcoal rot and lodging resistant line, and a tropically adapted B line. The IDIN has been distributed to 14 cooperators in nine foreign countries (see map p. 7) during 1979 (Table 2). Hopefully this continued distribution will assure exposure to the primary disease and insect pests encountered throughout the world's major sorghum growing areas.

Results from recent data indicate severe levels of bacterial stripe and MDMV infestation at locations in Argentina and Venezuela, respectively (Table 3). Very susceptible reactions to bacterial stripe were noted on SC175-14, SC110-14, SC173-14, and SC112-14 while SC599-6, TX7078, SC599-11E, 77CS1, SC376-6, and 120 x 7000 scored very low or resistant-type ratings. With respect to the MDMV reaction, BTx398, B1778, and SC279-14 displayed very good resistance at all locations while, as in 1978, QL3 received a susceptible rating indicating the possibility of a new strain of the virus.

GLOBAL DISTRIBUTION OF TEXAS A&M SORGHUM NURSERIES

1979

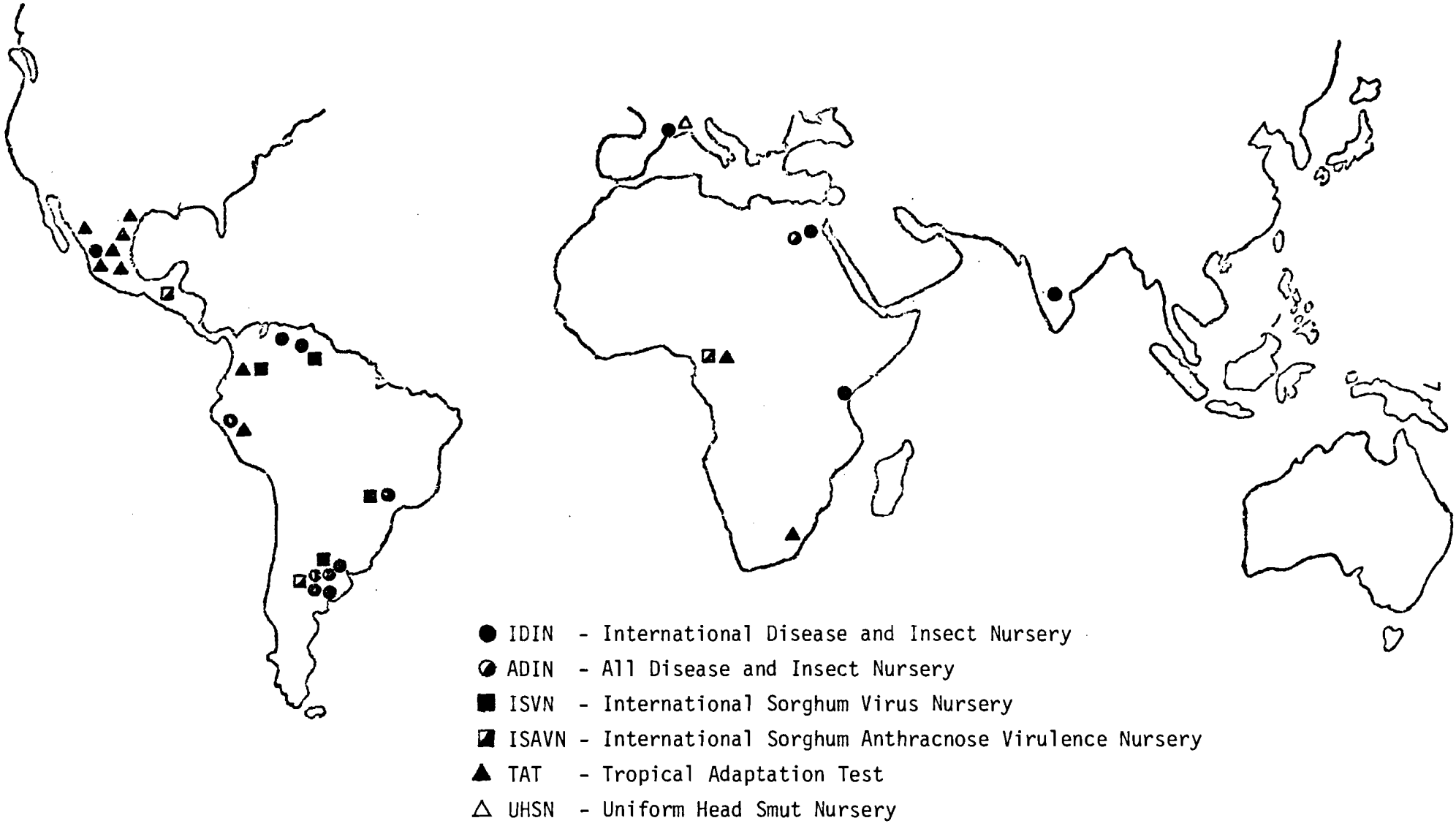

Table 1. International Disease and Insect Nursery (IDIN) - 1979.

Entry No.	Designation	IS No.	Variety, Kind or Group	Plot No. RepI	Plot No. RepII
1	SC 103-12	2403	Caudatum	14	41
2	SC 110-14	12610 C	Zerazera	4	50
3	SC 170-6-17	12661	Zerazera	21	39
4	SC 170-14	12661 C	Zerazera	1	42
5	Sc 173-12	21664	Zerazera	26	54
6	SC 175-14	12666 C	Zerazera	19	32
7	SC 326-6	3756	Nigricans	7	59
8	SC 414-12	2508	Cau-Kaf	11	49
9	SC 599-6 (9247)	17459	Cau-Nig (Rio)	28	46
10	SC 599-11E	17459	Cau-Nig (Rio)	3	38
11	SC 748-5	3552	Cau-Guin	15	53
12	SC 630-11E	1269	Caffr	6	40
13	R 5388	-	(SC599-6XSC110)der	25	34
14	6 BH 4613 (MR 4)	-	2566(3197X170-6)der	13	56
15	6 BH 4654 (MR 4)	-	2566(3197X170-6)der	18	31
16	B 447	-	B2752X(3197X170)der	2	43
17	Tx 2771 (MR 4-R line)	-	2566(3197X170)der	29	52
18	1790 E	-	(SC56XSC33)der	8	36
19	B Tx 623	12661 der	(B3197X170-6)der	23	48
20	R 1750	12661 der	(B3197X170-6)der	5	33
21	77 CS 1	-	(IS2930XIS3922)der	20	58
22	TAM 428	12610 der	Zerazera	10	45
23	Tx 430	12661 der	(Tx2536XSC170-6)der	27	60
24	GPR-148	-	CSV-5	17	35
25	CS 3541	-	CSV-4	22	55
26	QL3 sel	-	C. Kaf. der	30	44
27	B Tx 378	413	Redlan	9	57
28	B Tx 398	412	Martin	24	36
29	Tx 7078	415	Comb. 7078	12	47
30	Tx 2536	10542	Y. D. Fet. der	16	51

Table 2. IDIN distribution and disease severity rating[1]

Location	Cooperator	#IDIN	Sorghum downy mildew	Anthracnose	Rust	Grey leaf spot	Leaf blight	Zonate leaf spot	Charcoal rot	Grain weathering	MDMV	Bacterial stripe
Venado Tuerto, Argentina	Rodolfo Rossi Federico Llobet	2	-	-	-	-	-	-	-	-	+	++
Rojas, Argentina	Elba B. Alessandrini	1	-	-	-	-	-	-	-	-	-	++
Pergamino, Argentina	Eduardo Teyssandier	1	-	++	++	-	+	-	+	+	+	+++
Chidayo, Peru	Marco A. Neciosup	1	-	-	-	-	-	-	-	-	-	-
Aragua, Venezuela	Hector Mena	3	+	+	+	+	-	++	-	++	+++	-
Gaborone, Botswana	Max Boling	1	-	-	-	-	-	-	-	-	-	-
Giza, Egypt	S. I. Salama	1	-	-	-	-	-	-	++	-	-	-

[1]Disease rated according to severity where + = low level of infection, ++ = moderate, +++ = high.

Table 3. Cumulative disease reaction mean of IDIN entries.

	SDM	Anthr.	Rust	Green leaf spot	Leaf blight	Zonate leaf spot	Char-coal rot	Grain weather	MDMV	Bact. stripe
SC175-14	1.8	1.1	0.8	1.5	0.5	1.3	1.4	1.9	1.6	3.3
SC110-14	1.0	1.1	0.9	1.5	0.1	1.7	1.2	2.0	1.7	3.0
R1750	-	0.6	0.8	-	0.8	1.5	1.7	1.5	1.0	2.5
SC599-6	1.5	2.4	0.8	1.5	0.8	1.9	1.2	2.2	2.0	0.8
GPR-148	1.0	1.9	1.8	2.0	0.5	1.9	1.1	2.0	1.7	1.8
BTx398	1.5	1.7	1.8	2.3	0.8	2.5	1.8	1.9	1.3	1.3
TAM482	1.0	1.3	1.8	1.8	1.0	2.0	1.3	1.8	1.7	2.8
SC170-6-17	1.0	2.8	1.7	1.5	0.8	1.9	1.2	1.5	1.7	2.0
SC414-12	1.0	2.0	1.3	1.5	1.0	1.8	1.3	2.0	1.6	1.8
B1778	-	2.5	1.9	-	1.5	3.0	1.0	2.2	1.1	1.1
SC173-12	1.5	1.8	1.1	1.8	1.0	2.3	1.2	1.7	1.6	2.9
SC103-12	1.8	2.6	1.8	1.0	2.0	2.0	1.2	1.7	1.6	1.1
(120 x 7000) sel.	-	3.3	1.7	-	0.3	2.0	1.3	1.4	1.6	0.8
BTx378	1.5	1.0	1.8	1.3	0.3	2.1	1.3	1.7	2.1	0.9
Sc748-5	1.5	1.5	1.7	1.5	0.3	1.8	1.4	1.7	1.7	1.9
Tx7078	2.0	2.4	1.8	1.8	1.3	2.2	1.1	2.1	1.9	0.8
SC599-11E	2.3	2.0	1.8	1.8	0.8	2.0	1.1	1.5	1.7	0.7
SC170-14	1.3	2.2	1.6	1.3	0.5	1.8	1.2	1.7	2.0	2.2
SC279-14	1.8	1.8	0.9	1.5	1.0	1.3	1.6	1.3	1.4	2.6
BTx624	1.8	1.1	1.3	1.3	1.0	1.8	1.9	1.8	1.6	2.5
QL3 sel.	1.7	1.2	1.7	1.3	1.3	2.3	1.4	1.4	1.6	1.0
Tx430	1.0	2.2	0.8	1.5	1.3	1.5	1.3	1.4	1.6	2.4
Tx2536	3.0	1.9	1.2	1.8	1.0	2.3	1.3	2.2	2.2	2.0
SC112-14	1.8	1.8	0.9	1.0	0.5	2.0	1.6	1.8	1.6	3.1
77CS1	-	3.0	1.0	-	1.0	1.5	1.2	1.6	1.5	0.8
SC326-6	2.0	0.9	1.1	2.0	0.5	2.3	1.4	1.4	1.7	0.5
CS3541	-	2.5	1.3	-	0.8	1.0	1.1	1.7	1.1	1.3
SC237-14	2.0	1.3	0.9	1.5	0.3	1.5	1.2	1.7	1.8	2.3
Tx2748	-	1.8	1.4	-	0.8	2.0	1.1	1.3	1.8	2.3
R5388	-	2.8	0.8	-	0.8	1.5	1.3	1.6	1.3	1.8

Research is currently under way to select a new set of host differentials to characterize the strains.

Grain weathering continues to pose a threat to maturing grain in the humid tropics, often being one of the principal factors limiting production. The IDIN presently includes genotypes with good levels of resistance to grain weathering; however, under optimal weather conditions this resistance can be overcome by the pathogen complex. Thus, there is a need to expand our screening program by introducing the nursery in areas where high levels of disease pressure are present.

The entries 77CS1, GPR148, CS3541, Tx430, R1750, SC110-14, and SC175-14 continue to display good to excellent general leaf disease resistance although leaf anthracnose ratings were slightly higher on several of these lines, notably 77CS1, GPR148, CS3541, and Tx430.

Data for charcoal rot from Argentina and Egypt helped to identify several possible sources of resistance. The consistent performance of these lines may provide the genetic background to control this disease.

ADIN

The 70-entry All Disease and Insect Nursery (ADIN) included 22 new entries in 1979. They included grain mold (weathering), lodging, greenbug, midge, rust, and anthracnose resistant lines with improved agronomic traits, as well as lines with tropical adaptation, tan plants, white pearly grain, and good general leaf disease resistance from the TAES breeding nurseries.

All of the IDIN entries are included in this nursery. Thirty sets were grown at 18 locations in the U.S. and Mexico (Table 4). Evaluation was made on all of the major disease problems of sorghum in the Americas, particularly head smut, downy mildew, anthracnose, maize dwarf mosaic, foliage diseases, and Fusarium head blight. Excellent evaluations were

Table 4. 1979 ADIN (All Disease and Insect Nursery) Locations*

Location	No.	Characteristics Evaluated
Texas		
Beeville	1	Downy mildew, head smut, bacterial stripe, grey leaf spot, zonate, Fusarium head blight, adaptation.
Berclair	1	Downy mildew, head smut, grey leaf spot, zonate, rust, adaptation
Big Spring	1	Drought tolerance
Chillicothe	1	Periconia root rot, drought, bacterial stripe
College Station	3	Leaf blight, insecticide burn, adaptation, MDM
Corpus Christi	1	Bacterial stripe, head smut, downy mildew
Edna	1	Head smut, downy mildew, seed weathering, Fusarium head blight
Halfway	4	Rust, MDM, adaptation, bacterial streak, drought, corn leaf aphid
Lubbock	7	Lodging, drought, bacterial streak, MDM, adaptation
Pecos	2	Mites, drought
Robstown	1	Downy mildew, zonate
New Deal (Texas Tech Farm)	1	Drought
Weslaco	1	Insecticide burn, adaptation
Georgia	1	Anthracnose, foliage diseases
Kansas	1	Chinch bugs
Mississippi	1	Anthracnose, foliage diseases
Mexico		
Rio Bravo	1	Downy mildew foliage diseases
Tampico	1	Foliage diseases, adaptation

* The ADIN contains the 30 IDIN entries plus 40 additional entries.

obtained for grain mold, downy mildew, bacterial stripe, and anthracnose. Bacterial streak reactions were obtained for the first time on ADIN entries. As in previous years certain lines are highly resistant to several of these disease problems. None are highly resistant to all. Generally, the environments within Texas and the cooperating states provide an excellent means for thorough testing of these advance entries.

DOWNY MILDEW

A. Cultural Control

In 1977, two studies were initiated to determine the feasibility of reducing initial inoculum (oospores) of *Peronosclerospora sorghi* through use of cultural methods. The objective was to determine correlations between inoculum density (numbers of oospores per unit of soil) and the actual incidence of SDM. Previous work by other researchers determined that deep plowing to a depth of 12 inches reduced SDM incidence the following season, but our deep plow studies at two locations also analyzed the inoculum density of oospores in the soil profile.

Deep plow plots had less SDM incidence (26% or greater reduction) and a lower inoculum density in the upper 20 cm of the soil profile than normal tillage plots. However, both deep plow and normal tillage plots had approximately the same total inoculum density in the top 40 cm of soil profile. This indicated that deep plowing diluted the current season's oospores throughout the 40 cm of profile instead of just the upper 20 cm as with normal tillage.

A related study conducted at three locations utilized an SDM-susceptible sorghum in continuous culture to stimulate growing of SDM-resistant sorghum and crop rotation practices. This simulation was achieved by continously removing and rogueing (R) the systemically-infected SDM plants from one-half

of the plot and the other half was nonrogued (NR) as a control treatment. Uniform SDM incidence occurred across both halves of each plot in year I, but during years II and III, R plots had a 50% less incidence of SDM than NR plots. Inoculum densities in the upper 20 cm of the soil profile were uniform across each plot in year I, but R plots had inoculum densities 25% less than NR plots in year II and 58% in year III.

There was not complete correlation of inoculum density with SDM-incidence between plots nor in the same plots in successive years indicating that differences in soil environment due to soil type or other atmospheric variables have profound effects on efficiency of initial inoculum.

B. Chemical Control

An experimental systemic fungicide (CGA48988) developed by Ciba-Geigy was evaluated as a seed dressing for control of sorghum downy mildew (SDM) cuased by *Peronosclerospora sorghi* at three locations in South Texas. SDM incidence six weeks after planting was 8-28% in plants from nontreated seed and 0% in plants from seed treated with CGA48988 at rates greater than 0.5 g a.i./kg of seed. At one location there appeared to be reduced local lesion development on plants from seed treated with any rate of CGA48988.

Under SDM favorable conditions CGA48988 used at seed dressing rates of 0.1 to 3.0 g a.i./kg of seed on susceptible sorghum reduced early season SDM, increased number of grain bearing heads, and significantly increased yields. Although high seed dressing rates reduced seedling stands, they were greater than those from nontreated seed.

This chemical has demonstrated a potential for use as a control of SDM in sorghum and represents a needed complimentary and alternative control to the already-implemented plant resistance.

C. Local Lesion Assay

The use of local lesions as a downy mildew screening tool was proposed as early as 1969 but until recently little effort was directed toward using this method. During 1979 Dr. Nelson Gimenez F. determined that IS 12661C, IS 2508C, IS 12612C, CS 3541, and Tx 430 had "resistant" local lesions. F_2 progenies of Tx 430 by susceptible Tx 7078, 77CS1, IS 3757 der., and IS 12610C were evaluated. In all cases parental classes were recovered but ratios of resistance, intermediate and susceptible classes differed considerably (Table 5). F_3 analysis of the F_2 tests are planned. F_1's tended to be resistant. Trials using other DMR sources will be evaluated in 1980.

Table 5. Frequency distribution of F_2 sorghum seedlings of local lesion reaction classes following inoculation with *P. sorghi*

Parents	Reaction Classes[a]		
	R (1-2.9)	I (3-3.9)	S (4-5)
IS 12610 x Tx 430	48	39	13
Tx 430 x IS 3757 der.	72	11	17
(IS 2930 x IS 3992) x Tx 430	13	61	26
Tx 430 x Tx 7078	63	25	11

[a] Based on a 1-5 scale, type 1 local lesions are essentially not visable. Type 2 cause distinct necrosis and remain small. Type 3 are layer, may have some chlorois generally not sporulate. Type 4 and 5 permit rapid colonization of the leaf with death in the case of 5.

D. Affect of Environment on Downy Mildew Development

During 1978 an unusually high incidence of downy mildew (30%) was observed in hybrids utilizing Tx 430 as a downy mildew resistant parent. Extensive testing showed that no new race was present in this field. However, it appeared that lower than normal temperatures during the early portion of the growing season may have predisposed the plants to infection. In 1979, planting date with the coolest soil temperatures had the highest level of downy mildew in the Tx 430 hybrids. However, some genotypes showed a differential response to temperature as the incidence of disease went up in late plantings. This discovery makes it imperative that we examine known sources of resistance to downy mildew at lower than normal testing temperatures to see if they also are subject to these reaction changes.

E. Race 2 of *Peronosclerospora sorghi*

In 1979 sorghum downy mildew was observed in a commercial hybrid known to have had resistance to downy mildew in South Texas for nearly a decade. Subsequent evaluation of isolates of *P. sorghi* from this field with isolates having been used in the laboratory for the past 5 years showed them to differ significantly on three varieties. A paper describing this new race has been submitted for publication.

Physiologic specialization of this pathogen is not unlike that of any other pathogen. We can expect some variation in pathogenicity any time host resistance is used as a means of controlling the disease. We are fortunate that the more popular sources of resistance used in South Texas at this time are not subject to attack by this new race. Nevertheless, only a limited number of sources of resistance have been evaluated to the new race of downy mildew and extensive testing is planned for the summer of 1980.

HEAD SMUT

A population study on sorghum head smut was designed to determine rate at which particular host genotype permits the selection of a particular genotype of the pathogen. Sorghum head smut populations had been observed to shift very rapidly following the growing of specific host varieties. This study was conducted by artificially inoculating 20 monoteliospore cultures of race 3 and race 4 isolates of *Sporisorium reilianum* in four commercial hybrids (RS 610, Pioneer 8311, NK 262, and NK 266). Sori produced from plants of each hybrid were bulked and used as a new population for another cycle. Currently this study is at the 4th cycle. At the 5th cycle cultures of the original race 3 and race 4 isolates will be compared with the isolates produced after five generations on selected differentials.

The potential of using leaf symptoms as a tool for evaluating resistance or susceptibility to head smut was studied. Unlike corn head smut, correlation between sori production and leaf symptoms was poor. Artificially inoculated plants in the Uniform Head Smut Nursery (UHSN) during the 1979 spring field plantings failed to produce plants exhibiting leaf symptoms even though several entries produced smut sori at flowering. Similarly, greenhouse plants inoculated during the hot summer months (June and July) did not produce leaf symptoms but later produced sori.

Chlorotic flecking was observed in sorghum seedlings artificially inoculated in January, 1979 and December, 1979. The slower growth rate of plants at cooler temperatures may influence leaf symptom expression in sorghum. Even so, some plants in variety ATx 618 exhibited heavy clorotic flecking but did not produce smut sori at flowering.

The causal organism of head smut of corn and sorghum belong to the same species, *S. reilianum*. Except for host specificity, knowledge is very scarce regarding differences between them. Results showed that there was no

significant difference in spore morphology (size, shape, color) between the two smuts. The germ tube or the promycelium of corn head smut was, however, significantly longer (1.25μ) than sorghum head smut. Germination of freshly harvested corn smut spores ranged from 4.54 to 23.91% as compared to 0.71 to 5.62% in sorghum head smut. The time for germination varied within corn and within sorghum head smut collections and it was not correlated with percent germination nor with length of storage of smut spores. Corn head smut spores are more benomyl tolerant than sorghum head smut spores. Transmission electron microscopy of cross-sections of spore walls revealed no significant differences. Corn head smut teliospores produced sporidia, although poorly, when grown in a medium composed of heat-killed sorghum head smut sporidia. Sorghum head smut teliospore germinated, also poorly, but did not produce sporidia in this medium.

Several experiments were conducted in an attempt to increase the germination of smut spores. The presence or absence of continuous or discontinuous light did not affect the time of germination, length of promycelium, type of growth (sporidial or mycelial) nor percentage germination of corn and sorghum head smut spores. Similarly there were no differences in spore germination when spores were plated on potato dextrose agar with 0.75%, 1.0%, and 1.5% agar to vary the moisture content of the medium. Oven drying the spores at 35 C $\pm$ 1 at different time intervals up to 72 hours did not increase nor decrease spore germination.

Temperature and relative humidity (RH) greatly influenced viability of spores. There was a significant decrease in germination when sorghum smut spores were kept at 53% RH or higher at room temperature after 9 months of storage. At 3-5 C, however, only those kept at 100% RH had decreased spore germination.

Ultrastructural and histopathological studies of the host-parasite relations of sorghum head smut were conducted. Intercellular and intracellular mycelia were observed in host tissues. Intracellular hyphae from developing sori and parenchymatous cells of older plants behaved like haustoria. There was penetration of the host cell wall, invagination of host plasma membrane, and formation of an encapsulation between the host plasm membrane and the fungal cell wall. The encapsulation was eventually completely ensheathed, i.e., the host cell wall was deposited in the encapsulation.

The cytoplasm of *S. reiliana* contained the usual complement of cellular organelles found in other eukaryotic cells. Differences between vegetative and reproductive mycelia were noted.

ANTHRACNOSE

During 1979 the International Sorghum Anthracnose Virulence Nursery (ISAVN) was distributed to the following locations: Guatemala, Venezuela, Brazil, Indonesia, Nigeria (Table 6). The ISAVN was also planted in College Station, Texas; Robstown, Texas; Meridian, Mississippi; and Experiment, Georgia. In addition, anthracnose evaluations were conducted on the IDIN and CLAT nurseries in Brazil. A new entry, SC 748-5, was added to the ISAVN during 1979.

Data obtained from the IDIN grown in Sete Lagoas, Brazil indicated that the *Colletotrichum graminicola* attacking sorghum in that country differed from that of the United States. SC 110-14, SC 112-14, SC 170-14, SC 173-12, SC 175-14, SC 237-14, SC 599-6-3(9247), SC 599-11E, and TAM 428 are traditionally anthracnose resistant lines, but they were susceptible in Brazil. BTx378 and QL3 sel., which are susceptible in the U.S., had little or no anthracnose in Brazil. SC 103-12, SC 326-6, and SC 748-5 showed very good anthracnose resistance at all locations.

Table 6. Distribution of 1979 International Sorghum Anthracnose Virulence Nurseries (ISAVN).

Location	Number	Cooperator
Argentina	1	
Brazil, Sete Lagoas	2	F. T. Fernandes
Brazil, Sete Lagoas	4	R. Schaffert
Guatemala, Cuyuta	3	A. Plant
Indonesia, Tiupon	2	I. S. Suwelo
Nigeria, Zaria	1	N. V. Sundaram
Venezuela, Aragua	2	H. A. Mena
United States		
Experiment, Georgia	2	R. R. Duncan
Meridian, Mississippi	2	N. Zummo
College Station, Texas	1	M. A. Pastor-Corrales
Robstown, Texas	1	M. A. Pastor-Corrales

The IDIN, CLAT, and ISAVN were evaluated for anthracnose at Experiment, Georgia where excellent anthracnose developed. The most significant finding was that TAM 428, a sorghum line which was traditionally resistant to anthracnose throughout the continental United States was attacked by *C. graminicola*. The symptoms developed in both the foliage and panicle. This indicates that there are variations in the pathogen population attacking sorghum in Georgia and a new pathotype of *C. graminicola* is present.

The ISAVN data obtained from Samaru, Nigeria was valuable. Two distinct types of anthracnose symptoms were observed. Type 1 consisted of isolated spots and type 2 consisted of patchy spots. The traditional resistant lines, Brandes, Rio, SC 599-6(9247), SC 167-14, SC 328, and SC 748-5 had the type 1 symptoms while TAM 428 had the type 2 symptoms. Previously SC 748-5 has been shown to be anthracnose resistant at all locations.

ZONATE LEAF SPOT

Investigations into the disease, zonate leaf spot of sorghum, were conducted for a second year, both in the field and in the lab. Field research included the screening of various sorghum lines for resistance to the causal pathogen, *Gloeocercospora sorghi*. Observation of disease progression on various lines throughout the growing season indicated that disease develops more rapidly on plant material and the effectiveness of the systemic fungicide benomyl as a chemical control was confirmed. Also, individual lesion development was observed and measured daily. Laboratory research was involved with various factors influencing the survival and germination of the conidia and sclerotia. Such factors included the effect of temperature and relative humidity on the survival of the propagules and the influence of different sorghum exudates on the germination of conidia and sclerotia in the soil.

SORGHUM VIRUS PROGRAM

At the International Sorghum Disease Workshop in Hyderabad, India in December 1978 the Sorghum Virus Committee composed of R. W. Toler, USA; D. S. Teaxle, Australia; E. E. Teyssandier, Argentina; M. Ricelli, Venezuela; and S. C. Dalmacio, Philippines developed an international sorghum virus nursery. The nursery is composed of ten lines that have varying degrees of resistance and susceptibility to the sugarcane mosaic virus group which includes the Johnsongrass strains.

The inbreds are to be maintained in Australia by R. G. Henzell and in the U.S. by Fred Miller. The nursery will be sent to anyone requesting seed from either Australia or the U.S. International Virus Nurseries were sent to Argentina, Brazil, Colombia, and Venezuela in 1979 from the U.S.

A uniform data collection sheet with procedures for taking notes was developed and will accompany each nursery. The nursery is composed of OKY8, Tx 3197, Atlas, Rio, Martin, SA8735, NM31, SC9907, Q7539, and QL 11. The nursery approach to identifying of the viruses is to be backed up by electromicroscopy, serology, and other techniques.

The development of an international nursery was prompted by the recent occurrence of a virus or strain observed in Venezuela that infects and causes disease losses in sorghums that have tolerance, resistance, and immunity to SCMV-J (MDMV) from the U.S. and Australia.

At the present we are evaluating the reaction of the differentials in the nursery in the greenhouse to strains A, B, C, E, and F of maize dwarf mosaic virus, brome mosaic virus, and strains A and H of sugarcane mosaic virus.

In 1979 a joint study of inheritance of resistance to MDMV using mechanical inoculation was conducted with Dr. D. T. Rosenow at Lubbock. The inheritance of maize dwarf mosaic reaction involved the following lines in F_1 and F_2 combinations:

1. Martin (TBx398) - Tolerant (takes virus but is not affected adversely)
2. Redlan (BTx378) - Susceptible - Shows "red leaf" necrosis under cool temperatures only
3. Rio deriv (B-SC599 der.) - Susceptible - Shows "Rio reaction" (severe stunting and chlorosis (not red leaf, not dependent on temperature. Under field conditions, normally only a low percentage of plants show symptoms)
4. QL3 - Resistant - Resistant to infection, both natural and artificial.

The following has been determined to date:

a. Martin tolerance is completely dominant over Redlan susceptibility with a single dominant gene indicated.

b. Rio susceptibility is dominant over Martin tolerance and Redlan susceptibility with more than one gene indicated.

c. QL3 resistance is completely dominant over all three. May be a single dominant gene.

DATA SHEET FOR INTERNATIONAL TESTING OF SORGHUM DIFFERENTIAL LINES FOR REACTION TO SUGARCANE MOSAIC VIRUS

Country: Cooperator: Address:

Locality of testing site:

Height above sea level:

Environment of test:
Glasshouse
Growth cabinet
Field
(Tick one)

Type of inoculation:
Natural (aphid)
Manual
Air-blast
(Tick one)

Temperatures during test:
Maximum Minimum

Original host of virus:
Virus strain:

Planting date:
Date results assessed:

Line	% Infection	Symptoms (describe and take color photographs)	
		Inoculated leaves	Systemic symptoms
OKY8			
Tx3197			
Atlas			
Rio			
Martin			
YEF x SSK Wx SA8735			
NM31			
SC0097			
Q7539			
QL11			

Additional comments:

FUSARIUM HEAD BLIGHT

Fusarium head blight (FHB) occurred on grain sorghum grown throughout Central and Southern Texas in 1979. Disease surveys determined that 43% and 91% of the fields in Central and Southern Texas had plants with symptoms of FHB. Weight and size of kernels from FHB panicles were significantly reduced when compared with kernels from normal-appearing panicles. Kernel weights were reduced an average of 12% (ranging from 4 to 22%) in Southern Texas. FHB did not reduce quality of the harvested grain. Based on estimated yield figures, FHB probably reduced yields in Texas by 32 to 72 thousand MT resulting in a $3.2 to $7.1 million loss to farmers. FHB occurrence appears to be related to below normal temperatures and above normal rainfall during the period following anthesis and, possibly, to above normal temperatures and below normal rainfall during the March-April period.

GRAIN MOLDS

The value of artificial inoculation for identifying grain mold (GM) resistant lines was further substantiated. SC0719, a line resistant to grain weathering, appeared fairly susceptible to GM fungi under artificial and natural conditions. *Gibberella fujikuroi* perithecia were found on molded kernels of SC0719; the sexual stage of *Fusarium moniliforme* (FM) may be important in overseasoning and variation of the pathogen.

Histopathological studies were initiated with *Curvularia lunata* (CL) and FM. Macroscopic observations indicated that the basal area of the floret and kernel is the area of colonization by FM and that the glumes and pericarp are the colonized tissues with CL. Microscopic observations indicate that the lemma, palea, and lodicules are the first tissues extensively colonized by FM and CL (within 5 days after inoculation at anthesis). Fungi proceeded to colonize the developing kernels.

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Good progress has been made in developing agronomically acceptable midge resistance "R" lines and such germplasm has been released. On 20 "R" lines tested in replicated trials at four locations (37 entries total) one-half of the lines suffered 44% midge damage or less (as little as 25% damage). Susceptible standard checks suffered 78% midge damage.

It is encouraging to see the advancement being made in the development of midge resistant sorghum hybrids. Hybrid screening trials conducted at four locations indicated that resistance is midge density dependent. In tests where midge numbers averaged approximately 5/head/day, hybrids suffered little damage. For example, of 65 hybrids screened at Beeville, five hybrids suffered less than 25% damage (some suffered less than 10% damage) while susceptible hybrids suffered from 70-100% damage. Some of the least damaged hybrids included: ATx 2761 x TAM 2566, ATx 2757 x TAM 2566, ATx 2753 x TAM 2566, ATx 2756 x TAM 2566, and ATx 2761 x TX 2374.

Biology and Population Dynamics: An understanding of the factors influencing diapause termination is essential to accurately describe the population dynamics of the sorghum midge. In an attempt to elucidate these factors, field collected diapausing larvae were subjected to differing combinations of temperature, photoperiod and humidity in the laboratory. It appears that the number of hours of daylight within each 24 hour period has little or no effect on adult emergence. Temperature, on the other hand, has a profound influence on the number of midge and the number of days required for adult midge to emerge from diapause. At optimum temperatures of 25° to 30° C, adults begin to emerge in as few as 15 days, while a higher and lower temperature, 30 to 40 days are needed. Using regression analysis, an emergence threshold was estimated to be 15.3^{o} C. Exposure to high levels of moisture seems to be essential for the termination of diapause. This moisture can be in the form of free water or as high relative humidity. No

adults emerged from sample spikelets not subjected to a prolonger period of high moisture conditions.

From field studies, overwintering sorghum midge began to emerge from spikelets in soil on April 25 which exactly coincided with the first flowering of johnsongrass in the area. The entire emergence period lasted ca. 50 days, with peak emergence on May 15 after which numbers gradually declined and approached zero about June 11.

The activity of adult sorghum midge in relation to emergence of non-diapausing forms and subsequent oviposition in flowering panicles is an important area of study and is needed in support of host plant resistance studies, planting dates, sampling, and insecticidal control. Several factors influence this activity, i.e., temperature, humidity, radiation, etc. Data collected in 1979 indicate that males emerge 1-3 hours before females. Females mate soon after emergence and migrate to flowering panicles. Males remain swarming around the panicles. Peak oviposition occurs during mid-day in most cases, but this may be delayed and prolonged on cool, overcast days. On rainy days adult activity and emergence usually, significantly declines.

Developmental duration of sorghum midge from egg to adult requires 14 to 21 days with most developing in 17 days during the hot days of summer. During cooler periods, development is slowed and it is not uncommon for 20 to 24 days to be required for eggs to hatch and adults to develop and emerge. Temperature also effects adult longevity. During hot days 50% of both males and females confined in plastic cages had died after only 7 hours. On cooler days males (50%) lived 10 hours while females (50%) lived 24 hours. In most cases it appears that females live twice as long as males, but seldom more than one day. Consequently, sorghum is attacked by a new infestation of sorghum midge adults each day.

At least three species of parasites attack sorghum midge. Total parasitism increases as the season progresses, but the population dynamics of the parasite species differ substantially. Also, these parasites significantly influence midge population dynamics; especially numbers of overwintering midge larvae.

Advanced sorghum midge resistant germplasm, improved for agronomic quality was evaluated during 1979. "Summary" nurseries of four trials were screened at at least three locations. Of approximately 200 converted exotic lines, 30 were selected for final evaluation. Likewise, nurseries containing advanced "B" line germplasm and "R" line germplasm and nurseries of these in hybrid combination were screened. Data indicated that good progress is being made in transferring midge resistance into good agronomic parental lines and hybrids. Resistance, however, is midge density dependent.

Knowledge of sorghum midge biology and population dynamics has advanced from studies conducted in 1979. Midge diapause is terminated by exposure of larva to favorable temperature and moisture as indicated by bioclimatic chamber and field experiments. Adult midge oviposition lags behind adult emergence from infested panicles by several hours. Only females migrate to flowering panicles after mating with males which remain near the panicle from which they emerged. Many factors influence adult midge emergence. Females live twice as long as males but longevity for either is usually less than one day. Egg to adult developmental time is 17 days, but this increases as temperature decreases. At least three parasite species attack sorghum midge and this greatly influences midge population dynamics; especially numbers of overwintering midge larvae.

Economic threshold levels for four species of panicle infesting bugs were refined during 1979. Alternate host plants of these bug species were also identified.

PANICLE INFESTING BUGS

Damage to sorghum seed by four species of bugs was assessed during 1978. Seed weight and percent germination generally decreased as numbers of rice stink bugs, southern green stink bugs, leaffooted bugs, and conchuela stink bugs per panicle increased. Mean number of feeding punctures per seed and percent punctured seed generally increased as bug populations increased, especially at the highest infestation level. To some extent, weight of damaged seed decreased as the incidence of punctures increased. Damage to sorghum grain was largely due to direct feeding on seed by bugs, but indirect damage resulted from bugs feeding on panicle stems and rachis branches. Bugs were more injurious to grain in the milk and soft dough stages of development than to grain in the hard dough stage.

TROPICAL ADAPTATION

In 1979, a 30-entry standardized Tropical Adaptation Yield Test which included both parental lines and an array of hybrids were planted at several international and stateside locations. This array of materials was selected to cover the range of items known to have either specific or wide adaptation, as well as a broad base of base metabolic temperature differences. BTx3197, BTx378, and RTx7000 have high base temperatures and are described as more temperately adapted whereas BTx623, RTx430 and RTAM428 have substantially lower base temperatures and are adapted more to tropical areas producing sorhgum. As previously described, the tropically adapted (TA) sorghums are those photoperiod insensitive types which have the capacity to produce a high and stable yield in short-day and high nighttime temperature areas.

Tropically adapted materials have performed extremely well in Mexico, Guatemala, El Salvador, Brazil, Tanzania, Ethiopia, Sudan, and Nigeria. In

1978-79 ATx623 hybrids with RTx430, SC0326-6, 74CS5388, and ADN55 were very high yielding. These hybrids were all white or cream colored and should be useful for human food. In Mexico, the twin seeded TA hybrids under dryland conditions performed most desirably. The hybrids A1399 x SC3541 and ATx623 x SC0326-6 have shown very broad ranges of foliar disease resistance in addition to the high yield and wide adaptation.

Further laboratory data have been collected which demonstrates that the variations in base temperature are heritable. When two diverse lines were crossed ($4.6^{o}c$ x $11.5^{o}c$) the F^2 segregation indicated a near normal curve ranging from $5.3^{o}c$ to $14.8^{o}c$ base temperatures. These observations were based on 183 observations.

It was determined from phenological development studies that the tropically adapted materials spend proportionally more of their growth time in CS1 and this is reflected in higher leaf numbers and substantially higher leaf areas. This advantage in leaf area gives the TA plants the ability to produce higher yields in areas of high night-temperature, as they do not become source limited but rather have sufficient leaf area to supply both the plants respiratory requirements and fill the grain as well.

INTERNATIONAL TROPICAL ADAPTATION TEST (TAT) - 1979

Texas Agricultural Experiment Station
(In Cooperation with USAID - ta-c-1384)
College Station, Texas

Year: _____

Location: _____

Entry No.	Designation 1/	Parent or Hybrid	Variety Name, Hybrid, Pedigree	Seed Source	Plot Number 4/ Replication I	II	III
1	BTx3197	P	Combine Kafir-60	FS	[illegible]	[illegible]	301
2	BTx378	P	Redlan	FS	104	210	309
3	RTx7000 2/	P	Caprock	78CS928	106	212	327
4	BTx623	P	(BTx3197 x IS12661)sel.	FS	117	205	326
5	RTx430	P	(Tx2536 x IS12661) sel.	FS	114	201	308
6	RTAM428	P	BC_1 of IS12610	FS	127	221	325
7	RS610	H	ATX3197 x RTx7078		125	207	318
8	ATx378 x RTx7000	H		TE/79	109	220	307
9	ATx399 x RTx430	H		Warn	112	209	311
10	ATx378 x RTx430	H		WAC	128	224	316
11	ATx623 x RTx430	H		Cros/79	126	217	323
12	ATx623 x RTx7000	H		78CS928	121	225	313
13	ATx622 x RTAM428	H		78CS923	102	204	310
14	ATx622 x RTx2536	H	is (Tx2536)	78CS857	107	227	305
15	ATx623 x SC0326-6	H	is BC_1 of IS3758	1099*	110	202	320
16	ATx623 x 74CS5388	H	is (SC0599-6 x SC0110-9)sel.	1018	105	206	312
17	ATx623 x SC0599-11E	H	is BC_2 of IS17459 (Rio)	893	122	213	306
18	ATx622 x 76CS388	H	is (Tx2536 x IS12661) sel	1026	103	229	321
19	ATx622 x 76CS500	H	(Tx414 x SC0120-6)-3-2-2-1-1	1637	108	215	319
20	ATx622 x 76CS478	H	(Tx414 x SC0108-)-15-1-2-1-1	1610	118	230	317
21	ATx623 x 76CS490	H	(Tx414 x SC0108-)-15-2-3-6-1-R	1631	115	203	303
22	ATx622 x 76CS510	H	(Tx414 x SC0120-6)-3-2-2-1-3	77T5046	119	208	302
23	ATx622 x ADN55	H	(SC0120-6 x Tx7000) sel	78CS1700	123	211	329
24	ATx622 x 76CS5274	H	Twin Seed, dominant	996	129	226	324
25	ATx622 x 72T123-1	H	Twin Seed, dominant	866	130	216	315
26	ATx623 x 76CS4409	H	Twin Seed, dominant	961	124	219	330
27	A1399 x CS3541	H			101	222	304
28	A1399 x 77CS1	H			113	228	322
29	A1399 x 77CS3	H			116	214	328
30	A4R x RTx430 3/	H			111	223	314
31	Local 3/				131	232	331
32	Local				132	231	332

** 8 grams seed per envelope (250-300 seed for 2 short (10-15 feet) or 1 long (20-30 feet)) row. Seed is treated with Captan and Chlordane.

1/ This test contains several hybrids (and some parental lines) with good "tropical adaptation".

2/ Female pedigrees of ATx622, ATx623 and A1399 is BTx3197 x SC0170-6(IS12661) , ATx399 is Wheatland, A4R is A(BTx406 x Rio).

3/ Please add local varieties or hybrids meaningful to the test. Two hybrids with 50 grams each (ATx399 x RTx430, and ATx378 x RTx430) are enclosed for use as border rows or for use in the two open entries if you have no local entries.

4/ Test should be planted using these numbers as plot numbers.

5/ Please take following data if possible:
a. date (days) to flower
b. plant height (and head exsertion)
c. number of harvested heads
d. threshed grain weight
e. 100 kernel weight
f. overall desirability rating (based on yield and overall adaptation)
g. disease ratings on any diseases in test (see rating scheme)
h. insect damage ratings if occur
i. grain weathering ratings
j. any other notes such as bird damage, stand %, etc

6/ We normally hand harvest heads from portions of each plot (as little as 6 feet, 6 inches(of 40 in. row) = 1/2000 of an acre)

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Table 7. 1979 locations of TAES hybrids and lines for yield, adaptation and growth and development evaluations (includes International Tropical Adaptation Trials, yield observations, and variety evaluation).

Location	No. trials	No. entries	Cooperator
Brazil	1	12	R. Schaffert
Colombia	1	30	A. Grobman, CIAT
Egypt	3	30	S. I. Salama
El Salvador	1	30	R. Clara
Guatemala	1	295	A. Plant
Indonesia	1	33	I. S. Suwelo
Nigeria	1	30	H. Van Arkel
Nigeria	1	30	N. V. Sundaram
Peru	2	21	M. A. Neciosup
Somalia	1	6	M. A. Dukseyeh
South Africa	2	30	H. M. Muller
Mexico			
Celaya, Guanajuato	1	30	G. Vega
Culiacan, Sinaloa	1	30	c/o G. Vega
La Barca, Jalisco	1	225	S. Medina
Rio Bravo, Tampico	1	30	H. Williams
Tampico, Tampico	1	30	L. Sottero
Zacatepec, Morales	1	30	A. Avila
United States			
Texas: College Station	1	50	F. R. Miller
Corpus Christi	1	25	L. Reyes
Dallas	1	25	B. Simpson
Lubbock	1	25	D. T. Rosenow
Lubbock	1	50	D. T. Rosenow
Thrall	1	25	F. R. Miller
Weslaco	1	50	R. Creelman
Nebraska: Lincoln	1	25	J. Eastin

POPULATIONS

Population development in 1979 involved the following populations:

1. TP15RB - broad base conversion - released
2. TP17R - yellow endosperm - third random mating
3. TP18RB1 - low smut (head) - second random mating - select S_1's for head smut evaluation in 1980
4. TP20RB - weathering resistant - first random mating following selection of half-sibs for weathering resistance from 1978 random mating
5. TP21RB - food type (white or colorless pericarp) - second random mating following selection of S_1's for weathering resistance and non-stained grain from Lubbock, 1978 planting of $TP21RBO_2$.
6. TP22RB - leaf disease resistant - fourth random mating - select S_1's for evaluation in 1980

Half-sibs from the low smut population, TP18RB, were inoculated with head smut to begin a selection scheme based on half-sib evaluation. Remnant seed from resistant half-sibs were bulked for random mating in Puerto Rico during the winter, 1979-80.

A new population, TP23B, a B-line population with midge resistance was formed and sent to Puerto Rico for its first random mating during the coming winter of 1979-80.

Another new population, TP24R, with white or colorless seed and only tan plants, was developed by bulking seed of various lines and breeding selections. It will be random mated in Puerto Rico during the winter of 1979-80.

Summary of releases during
AID Contracts ta-c-1092 and ta-c-1384

Lines and Germplasm Stocks

TAM 428*	Disease resistant pollinator line - tropically adapted
Tx 430	Disease resistant pollinator line - tropically adapted
Tx 431**	Twin-seeded pollinator line
Tx 622	Disease resistant A & B line - tropically adapted
Tx 623	Disease resistant A & B line - tropically adapted
Tx 624	Disease resistant A & B line - tropically adapted
TAM 2566*	Midge resistant line
TAM 2567*	Greenbug resistant yellow endosperm pollinator
TAM 2568*	Greenbug resistant yellow endosperm pollinator
120 converted lines*	Also temperate and tropical bulks
TAM 2574-TAM 2713	Gaines-Karper nursery breeding stock lines
Tx 2714-Tx 2733	Disease resistant zerazera derivative restorer lines
Tx 2734-Tx 2748	Greenbug resistant restorer lines
Tx 2749-Tx 2752	Greenbug resistant A & B lines
Tx 2753	New cytoplasmic-genic sterile A & B lines (A2 cytoplasm)
Tx 2754-Tx 2761	Midge resistant A & B lines
Tx 2762-Tx 2781	Midge resistant lines
ISR-1	Midge resistant R line (cooperative with Brazil)

Germplasm Bulks

TAM Bk-43*	Greenbug resistant B-line bulk
TAM Bk-44*	Greenbug resistant B-line bulk
TAM Bk-45*	Downy mildew resistant yellow endosperm zerazera bulk
TAM Bk-46*	Downy mildew resistant yellow endosperm zerazera bulk
TAM Bk-47*	Downy mildew resistant yellow endosperm zerazera bulk
TAM Bk-48*	Downy mildew resistant yellow endosperm zerazera bulk
TAM Bk-49	Downy mildew resistant sudangrass germplasm bulk
TAM Bk-50	Downy mildew resistant forage germplasm bulk
TAM Bk-51	Maize dwarf mosaic virus resistant germplasm B-line bulk
TAM Bk-52	Maize dwarf mosaic virus resistant germplasm R-line bulk

Populations

TP1R	Greenbug resistant
TP8R	Midge resistant
TP11	Twin-seeded population
TP15RB**	Broad base, conversion lines
PR2BR	Day length insensitive, ms_3 (cooperative with SEA, AR, MITA, & UPR)
PR4BR	Day length insensitive, ms_7 (cooperative with SEA, AR, MITA, & UPR)
RSP3BR	Downy mildew resistant sudangrass germplasm (cooperative Kansas, Texas, and MITA - Puerto Rico)

* Developed prior to beginning of AID contract, but officially released after contract started.

** Released in 1979.

INTERNATIONAL SHORT COURSE ON BREEDING PLANTS FOR RESISTANCE TO PESTS

A short course on breeding plants for resistance to pests was conducted from July 23 to August 12, 1979 for plant protection specialists and plant breeders from developing countries. The short course was conducted under the joint sponsorship of Texas A&M University and the University of California/AID Pest Management Project. Drs. G. L. Teetes and R. A. Frederiksen served on the Planning and Implementation Committee along with Dr. G. A. Niles and M. K. Harris (chairman).

The first phase of the short course (2 weeks in Texas, July 23 to August 3) included lectures, laboratory exercises, and field demonstrations of the principles and techniques for breeding cotton, sorghum, rice, corn, peanuts, forage grasses, and certain grain legumes resistant to arthropod and disease pests. The second phase of the short course included participation in the IX International Congress of Plant Protection, Washington, D.C. (August 5-12).

Instruction was by professional plant protection specialists and crop breeders with overseas experience and familiarity with agricultural conditions in developing countries. Subject matter for the workshop included lectures on principles of host plant resistance to pests, the integrated approach to pest management and crop production, economics of pest management, and application of plant genetics to breeding for plant resistance. Practical exercises demonstrated techniques for breeding and evaluating plants for pest resistance. Field trips were made to show how insect and disease resistant varieties of cotton and sorghum must be managed on commerical farms to produce maximum profits.

A proceedings of the short course lectures will be published.

SORGHUM WORKSHOP

On June 25-26, 1979 a sorghum workshop was held at the Texas A&M Research and Extension Center at Corpus Christi. The workshop provided visiting sorghum research scientists and others representing commercial companies and public institutions from the U.S. and Mexico with an overview of sorghum research being conducted by Texas A&M University with special emphasis on the Coastal Bend region.

The workshop was initiated June 25 at the sorghum nursery site near Berclair, Texas where workshop participants heard Drs. R. A. Frederiksen, F. R. Miller, J. W. Johnson, and G. N. Odvody discuss the various research projects contained within the Coastal Bend sorghum nurseries. A tour of the Berclair and Beeville, Texas sorghum nurseries followed with special attention to the insect and disease reactions.

On the evening of June 25 a technical papers session was held at the Research Center in Corpus Christi. Staff and graduate students from Texas A&M discussed results of their research on sorghum physiology, breeding, diseases, and insects.

Workshop participants toured the sorghum disease nursery at the Perry Foundation, Robstown, Texas on June 26. The nursery included disease research on anthracnose, zonate leaf spot and other foliar diseases, host resistance, cultural and chemical control of sorghum downy mildew, and grain mold and grain weathering research. Participants returned to the Corpus Christi Research Center and toured the Corpus Christi sorghum nursery.

On the afternoon of June 26 the workshop concluded with a panel discuasion entitled "Environmental Adaptation in sorghum. Sources: Parameters? Limits?" Dr. H. E. Joham, Head of the Department of Plant Sciences, Texas A&M University, acted as moderator. Initial presentations were made by

panel members Dr. F. R. Miller, sorghum breeder, Texas A&M University; Dr. R. A. Creelman, sorghum physiologist, Texas A&M University; Dr. Jerry Eastin, sorghum physiologist, University of Nebraska; and Dr. Gene Dalton, Sorghum Research Director, Pioneer Hi-Bred International, Plainview, Texas. After the initial presentations an open discussion was held amongst panel members and all workshop participants. Portions of the sorghum workshop were attended by Dr. Perry Adkisson, Vice President for Agriculture and Renewable Resources, Texas A&M University.

". . .we find sorghum germplasm from Texas very useful in our breeding program. Breeding materials which have done well and are being widely used in our breeding program are the A&B lines of Tx 622, 623, 624 and recently TS 7701. The R line Tx430 continues to look very promising under our conditions. I feel continuing germplasm exchange and reciprocal visits of staff between our two programs could continue to be mutually advantageous."

from a letter written by
Brhane Gebrekidan to F. R. Miller
on June 12, 1979.

PERSONS REQUESTING AND RECEIVING SEED OF DISEASE AND INSECT RESISTANT SORGHUM LINES OR GERMPLASM IN 1979

INTERNATIONAL:

Argentina:	Arnalda, D. E. Llobet, F. Mustapic, A. H. Pacagnini, H. J.
Australia:	Hare, B. W. Henzell, R. G.
Bangladesh:	Auch, D.
Brazil:	Borgonovi, R. Fonseca, J. N. L. Giacomini, F. Rossetto, C. J. Schaffert, R.
Canada:	Major, David J.
Egypt:	Salama, S. I.
El Salvador:	Andrews, K. L. Clara, R.
Ethiopia:	Gebrekidan, B.
France:	Cogat, M. Kaan, F.
Honduras:	Peairs, F. B.
India:	House, L. R. Jotwani, M. G. Mehra, K. L. Narasimhamurty, K. Nath, Bhola Prasada, M. N. Rao, K. E. P.
Indonesia:	Suwelo, I. S.
Japan:	Hoshino, T.
Kenya:	Dabrowski, Z. T. Pinto, F.
Korea:	Kim, S. K.
Malawi:	Beck, B. D. A. Manda, R. B.
Mexico:	Aranza, E. Camplis, J. V. Guiragossian, V. Santiago, Median D.
Nigeria:	Sundaram, N. V.
Peru:	Neciosup, M.
Philippines:	Dalmacio, S. C.
Senegal:	Chantereau, J. Gahukar, R. T.
South Africa:	Muller, H. M.
Tanzania:	Mukura, S. Z.
Thailand:	Samphantharak, K.
Upper Volta:	Bonzi, S. N.
Uruguay:	Artola, A. P.
Venezuela:	De Cordova, O. R. Riccelli, M. Romero, F. T.

U.S. PRIVATE BREEDERS:

ACCO Seed	Kramer, N. W.
Asgrow Seed Co.	Wilson, J. M.
Battelle	Kidd, G.
Cargill, S. A.	Barberia, C.
Coffey Seed Co.	Coffey, L. C.
Cokers Ped. Seed Co.	McDonald, Lynn
Conlee Seed Co.	Lacy, M. D.
Crosbyton Seed Co.	Boardman, N. R.
DeKalb AgResearch, Inc.	Lambright, L., Maunder, A. B.
Funk Seed International	Rogers, Rod
Gold Kist Inc.	Glueck, James
Growers Seed Assoc.	Nelson, Mike
Harpool Seed Co.	Dean, L.
NC+ Hybrids	Foster, J. H.
Northrup King Co.	Sidwell, Raymond
PAG	Berry, C. D.
Pioneer Hi-Bred Int.	Kidd, H. L., Faber, Joe
Ring Around Seed	Elsworth, R. L.
Taylor-Evans Seed	Allison, James
Texas Triumph Seed Co.	Koepp, Noble
WAC Seed Co.	Ramey, Payton
Weather Master Seeds	Greenley, K. L.
R. C. Young Seed Co.	Arnold, Keith, Melton, H. L.
7700, Inc.	Longoria, J.

U.S. PUBLIC BREEDERS:

University of California	Worker, G. F.
University of Georgia	Duncan, R. R.
Iowa State University	Atkins, R. E.
Kansas State University	Claflin, L., Mize, T. Kissel, D.
Mississippi State University	Gourley, Lynn
University of Nebraska	Ross, Bill
Oklahoma State University	Weibel, D. E.
Purdue University	Axtell, John
Texas A&M University	Hossner, Mustain, Vietor, Sullivan
Texas Tech University	Rao, Arelli; Clegg, Max
USDA, SEA-AR, New Orleans, LA	Neucere, Joe
USDA, SEA-AR, College Stn. TX	Bashaw, E. C.; Craig, J.
USDA, SEA-AR, Florida	Chourey, P.S.
Arizona	Dobrenz, A.
Arkansas	York, J.
California	Worker, G.
Colorado	Hinze, Greg
Georgia	Duncan, R.
Kansas	Hackerott, H.
Nebraska	Clark, R. B.; Eastin, J.
Texas	Reyes, Lucas

PERSONS REQUESTING AND RECEIVING SEED OF TAM Bk-51 and TAM Bk-52

U.S. PRIVATE BREEDERS

ACCO Seed Company	Plainview, Texas
Asgrow Seed Company	Plainview, Texas
Conlee Seed Company	Waco, Texas
Coffey Seed Company	Plainview, Texas
Coker's Pedigreed Seed	Lubbock, Texas
Continental Grain Company	Chicago, Illinoi
Crosbyton Seed Company	Crosbyton, Texas
DeKalb AgResearch	Glenvil, Nebraska
DeKalb AgResearch	Lubbock, Texas
Funk Seeds International	Lubbock, Texas
Gold Kist	Ashburn, Georgia
Growers Seed Association	Lubbock, Texas
Harpool Seed Company	Denton, Texas
Hoegemeyer Hybrids	Hooper, Nebraska
Land O'Lakes	Webster City, Iowa
NC+ Hybrids	Hastings, Nebraska
Northrup, King & Co.	Eden Prairie, Minnesota
Northrup, King & Co.	New Deal, Texas
P-A-G Seeds	Lubbock, Texas
Pacific Oilseeds	Woodland, California
Pioneer Hi-Bred International	Plainview, Texas
Ring Around Research	Plainview, Texas
Taylor-Evans Seed Company	Tulia, Texas
Texas Triumph Seed Company	Ralls, Texas
WAC Seed Company	Hereford, Texas
George Warner Seed Company	Hereford, Texas
R. C. Young Seed & Grain	Lubbock, Texas

U.S. PUBLIC BREEDERS

University of Nebraska	W. M. Ross

INTERNATIONAL BREEDERS

Pacific Seeds	Australia
SARH INIA CIAN	Mexico

PERSONS REQUESTING AND RECEIVING SEED OF TP 15RB

U.S. PRIVATE BREEDERS

Continental Grain Company	Chicago, Illinois
Hoegemeyer Hybrids	Hooper, Nebraska
Land O'Lakes	Webster City, Iowa
NC+ Hybrids	Hastings, Nebraska
P-A-G Seeds	Lubbock, Texas
Taylor-Evans Seed Company	Tulia, Texas
Texas Triumph Seed Company	Ralls, Texas
WAC Seed Company	Hereford, Texas
R. C. Young Seed & Grain	Lubbock, Texas

INTERNATIONAL VISITORS
to the
Texas Agricultural Experiment Station and Its Personnel

NORTH AMERICA

Mexico:

Chaudhary, Hans R.
Garza, Jose
Ramos, Guillermo Federico

Guatemala:

Plant, Albert N.

Cuba:

Castro, Luid Lago

SOUTH AMERICA

Argentina:

Casagrande, Miguel
Mendez, Federico
Scantamburlo, Jose L.
Scheidl, Guillermo H.

Brazil:

Borgonovi, Fenato Antonio
Fernandez, Nelson Gimenes
Giacomini, Fredolino
Schaffert, Robert

Venezuela:

Calabria, Jose Miguel
Giral, Helio Campos
Moros, Atilio A. H.
Suarez, Antonio
Taborda, Felix

EUROPE

England:

McNeil, D. G.

France:

Kaan, Francois

ASIA

China:

Botian, Li
Jiusi, Zhu
Ke, Fu
Qisheng, He
Silin, Tang

India:

Gill, S. S.
Nath, V. Ravindra
Ragnunathan, V.
Reddy, K. V. Seshu
Sahni, V. N.
Sant, M. V.
Seetharama, N.
Williams, Robert J.

Japan:

Hoshino, Tsuguhiro

Nepal:

Pickett, D. R.

AFRICA

Ethiopia:

Brahani, Dr.
Gebrekidan, Brhane

Guinea-Bissau:

Barbos, Ahala Zamora
Da Silva, C. S.

Nigeria:

Sundaram, N. V.

Somalia:

Duksiyeh, M. H.
Dule, A. A.
Fardi, A. J.

Sudan:

Ali, Mahmoud

Upper Volta:

Nacro, Mouhoussine
Quattara, Karamokotie'Boura
Suchet, L. Louis
Toguyeni, Yembila A.

Zambia:

Kapooria, R. G.

South Africa:

McOmie, J. B.
Rensburg, N. J.
Cowie, Trevoa

SUMMARY TRIP REPORTS

CHINA

The following are observations of Dr. Frederick R. Miller, member of the U.S. Germplasm Team, August 13, 1979 to September 13, 1979, in the People's Republic of China.

The mission of the United States Germplasm Team was to study and arrange for the exchange of germplasm with the People's Republic of China. Those crops to be considered were soybeans, sorghum, millets (setaria) and vegetables. Research scientists in both countries share the belief that plant germplasm provides the foundation for a productive agriculture both now and into the future, and that both countries as well as other peoples will benefit from cooperative exchanges of such germplasm.

The team was very well received throughout China where we travelled. Research scientists, especially agronomists and plant breeders, were available to each institute that was visited to explain the respective programs and to discuss exchange of germplasm. Each breeder or commodity worker gave a general statement of the magnitude of each program including data on ranges of diversity of specific traits. The breeding programs were very much similar to those of the U.S. or other areas, especially in their objectives. These were given as higher yields, disease and insect resistance, and some attention to quality or end use characteristics. Discussions generally centered on the amount of diversity, its collection, maintenance, use and exchange. There was particular attention given to the commodities which did not originate in China or where major improvement had been made in the U.S.

Broadly, diseases were not a major problem except in certain commodities such as viruses on tomatoes, peppers and in some areas on maize and sorghum.

Head smut of maize was observed in the Northern areas of Liaoning Province and common smut below Beijing. There were problems with insects but the breeders were vigorously looking for host resistance. Head smut of sorghum and loose kernel smut were present as well as MDMV and in some areas there were yield reductions associated with them.

Arrangements were made to make contacts for seed through Dr. George White's office - Dr. George White, Plant Introduction Officer, Building 101, Room 322, BARC-West Germplasm Resources Laboratory, Beltsville, MD 20705. As seed becomes available, it will be distributed to anyone who wants it. Similarly, requests for seed from China should be directed to Dr. White, who will coordinate and assist in routing the requests to the correct Chinese scientists.

Those persons especially concerned with sorghum are as follows:

1. Xu Yun-Tain, Deputy Director of the Crop Germplasm Institute
   Chinese Academy of Agricultural Sciences
   Beijing, People's Republic of China

2. Yen Shi-Sheng, Associate Researcher, Sorghum Breeder
   Agricultural Academy of Heilungjiang Province
   Harbin, People's Republic of China

3. Kou Xin-San, Senior Researcher in Sorghum
   Henan Provincial Agricultural Academy
   Zhenzhon, Henan, People's Republic of China

4. Chen Bao-Chin, Head, Sorghum Laboratory
   Northwest Water Conservation Institute
   Shaanxi Provincial Agricultural and Forestry Academy
   Wu Kung, Shaanxi, People's Republic of China

5. Mrs. Chang Xie-Ning, Sorghum Researcher
   Shandong Provincial Agricultural Academy
   Jinan, Shandong, People's Republic of China

6. Chao Kai-To, Sorghum Breeder, Director of Crop Breeding Institute
   Liaoning Provincial Agricultural Academy
   Shenyang, Liaoning, People's Republic of China

GUATEMALA

During May 15 to 18, 1979, Dr. Jerry W. Johnson, Mr. James Phillips, and Dr. George L. Teetes traveled in Guatemala to evaluate sorghum midge resistant sorghums. Seed for these nurseries had previously been sent to Dr. Albert Plant, USAID, Sorghum Program Coordinator. The nurseries were planted on the Cuyuta Experiment Station of the Instituto De Ciencia y Tecnologia Agricola (ICTA). The Cuyuto Experiment Station is south of Esquintla which is 55 kilometers south of Guatemala City.

Most of the time was spent in the nursery at Cuyuta. A sorghum midge resistant sorghum hybrid test was evaluated. The test contained 25 entries with four replications. The agronomic qualities of the hybrids were good and the resistance level comparable to that observed in the USA. Sorghum midge density was less than desired, but appeared to be adequate for the second planting which was just past flowering at the time of our visit. One of the technicians at the Cuyuta Station, Ing. Edgar Oliva, assisted in rating the midge resistant hybrid test. He will rate the later planted test and is certainly qualified to do so.

Over 500 selections were made in 750 rows of sorghum breeding material. Selections were made in F_2 and F_3 generation material segregating the midge resistance and agronomic quality. Most of the material in the nursery looked extremely good under Guatemalan conditions in this "off season" planting. Especially encouraging was the quality and yield potential of several midge resistant B-lines. It is hoped that Dr. Plant will begin the process of sterilizing these B-lines as rapidly as possible.

Much of the yellow endosperm material derived from AF-28 x Tx 2536 types had weathered poorly. However, the midge resistance level of AF-28 looked good, but the line is far too tall.

This nursery allowed the opportunity to make some decisions concerning which A-lines to use in future midge resistant hybrids. Special attention was given to white seeded sorghum since much of the sorghum in Guatemala will be destined for human food.

Three technicians from the Cuyuta Station observed the selection process. They were Ing. Jorge Fuentes, Ing. Victor Salguero, and Ing. Hector Villedo. Each of these men appeared well trained, interested, and enthusiastic. It is apparent that Dr. Plant has spent a considerable amount of time with these young men.

It was encouraging to note the progress that the Texas sorghum material has made in regard to tropical adaptation. Much improvement has been made in the last two years and sorghum yield potential in Guatemala is extremely good. Sorghum midge resistant sorghums would certainly add to the stability of yield in that country.

After evaluation and selection in the nursery was completed, a tour was made into the southern, drier areas of Guatemala toward the Pacific Coast. The tour was made to observe local sorghums and production techniques. In the area, most of the small farmers had already planted sorghum and it looked extremely good. Recent rains had provided ideal growing conditions. The "rainy" season had just begun. The tour took us through Taxisco and Chiquimuililla and back to Guatemala City.

In Guatemala City, we had the opportunity to confer with Dr. Carl Koone, Rural Development Officer for the local USAID Mission, and Clem Weber, Assistant Rural Development Officer. The cooperative (Texas-Guatemala) sorghum research activities were reviewed. It was apparent that these activities are mutually beneficial and should continue. Dr. Koone was interested in the Sorghum/Millet Title XII project. He was brought up to date on recent developments and prospects.

MEXICO

From July 10 to July 14, 1979, Victor Bozzuffi travelled in Northern Mexico to observe USDA/APHIS disease monitoring plots and to establish contact with local sorghum workers. Cooperative research activities were discussed with personnel at the Agricultural Research Station located in Rio Bravo Tamaulipas. Among those considered were chemical control of sorghum diseases (sorghum downy mildew and rust) as well as germplasm exchange.

The remainder of the trip was spent observing disease monitoring plots installed at Bio Bravo, Zaragosa and Matamoros, Coahuila and Apodaca, Nuevo Leon. All diseases (grey leaf spot, sorghum rust, MDMV, zonate leaf spot, rough spot, and head smut) had previously been reported in Texas. Commercial sorghum growers were in the midst of harvesting operations, yields being good to excellent (3-4 tons/hectare) due to favorable weather throughout the growing season.

Contacts were made at Rio Bravo with Ing. Enrique Calles, station director and Ings. Rodolfo Giron and Julio Aguirre, pathologists. At the Zaragosa station contact was made with Dr. Raul Flores and Ricardo Lozano, station director and pathologist, respectively. Contact was also made with Ing. Victor Manuel Valdez, Matamoros station director, and Dr. Teodoro Herrera, pathologist. At the University of Nuevo Leon a brief summary on sorghum diseases and our activities in Mexico to graduate students in plant pathology was shared with Ing. Ciro Valdez and Dr. Jose de la Garza.

From August 17 to August 19, 1979, Victor Bozzuffi travelled to CIMMYT headquarters at El Batan, Mexico. He met with Dr. Vartan Guiragossian, ICRISAT sorghum breeder stationed at CIMMYT. A tour was made of

Dr. Guiragossian's upland (high elevation) nursery where he is selecting for cold tolerant, early maturing genotypes. This was followed by a trip to Poza Rica, Veracruz to observe lowland nursery material. Specific screening at Poza Rica includes army worm and stem borer resistance, food types, as well as disease resistance (foliar and grain mold). Objectives here include selection of breeding lines with wide adaptation to tropical and subtropical conditions.

From September 2 to 8, 1979, a follow-up trip was made to CIMMYT at El Batan to observe and evaluate disease reactions of sorghum breeding material at Poza Rica. Cercospora sorghi, Puccinia purpurea, and Gleocercospora sorghi were the evident foliar pathogens while species of Curvulaira, Fusarium, Olpitrichum, Phoma, and Penicillium were found in abundance on the grain. Mold due to the latter organisms was extremely severe while few entries manifest significant levels of resistance. Among those with low (1.2-1.5 on a 1-5 rating scale) were M36368, M36285, 1319A x CS3541, 1319A x 77CS1, ATx611 x GPR148, 1778A x GPR148, SC170-14-1, (IS145 x SC3541)-29-1 L.P., CENTA S-1-76-1.

Material was selected based on plant type, desirability, disease resistance, etc., which will be included in a tropical sorghum yield trial to be distributed to cooperators in Central and South America. Lines with wide adaptation will subsequently be returned to CIMMYT for further crossing to enhance that particular character.

From September 23 to September 25, 1979, October 9 to October 11, 1979, and November 26 to 30, 1979, Victor Bozzuffi travelled to Guadalajara, Jalisco. Contacts were made with local seed company representatives as well as INIA sorghum workers in install chemical control plots for sorghum

rust. Applications were made during the first two visits while harvesting and final evaluations were made during the final trip at which time a disease survey was conducted in the Cienaga region.

Results obtained from the test plots failed to indicate differences between treated and untreated entries. Disease pressure was severe in the area and as a result it was concluded that the product offered no control of the organism. Further studies may possibly be made at a future date. INIA workers were involved in the project and will be encouraged to assume leadership now that the proper techniques have been established.

A disease survey of the Cienaga region (approximately 95 km southeast of Guadalajara) revealed a widespread incidence of sorghum leaf blight. Actual damage could not be accurately assessed due to a severe drought throughout most of the central sorghum production region. Losses in some areas are estimated at more than 50% of potential yield which in optimal years can reach 9 to 10 tons per hectare.

Restricted outbreaks of sorghum rust were also encountered, however, they appeared to be much less damaging than those due to leaf blight. All production fields visited were found to be infected with sorghum downy mildew although the incidence was variable among the locally grown hybrids, ranging from a trace to 15% infected plants. Grey leaf spot, bacterial stripe and head smut were also observed although their incidence was considered minimal.

BRAZIL

From February 7 to February 17, 1979, M. A. Pastor-Corrales travelled to Brazil to conduct a disease evaluation, with emphasis on anthracnose, of the TAES nurseries planted in some of the sorghum growing areas of Brazil. Dr. Robert Schaffert, Sorghum Project Leader and Sorghum Breeder for the Brazilian Corn and Sorghum National Project (SNPMS/EMBRAPA) was in charge of the nurseries and coordinated the trip. F. T. Fernandes and N. de Almeida (sorghum pathologists) and R. A. Borgonovi and F. Giacomini (sorghum breeders) assisted with my visits to the field.

I arrived at the Corn and Sorghum National Research Center located in Sete Lagoas, M. G. on February 7, 1979. The following day I departed for Riberao Preto, S. P. where I evaluated some of the Brazilian National Sorghum Trials. Sorghum germplasm from the TAES has been incorporated in some of the sorghum lines tested here. The following nurseries were evaluated: The Sweet Sorghum National Trial (ENSS), The Grain Sorghum National Trial (ENSG), and the Commercial Grain Sorghum National Trial. Anthracnose was present throughout the fields and several lines and hybrids susceptible to the anthracnose pathogen were severly attacked by it. Some of the sorghum material which is resistant to anthracnose in the United States was susceptible here, i.e., sorghum lines Rio and Wiley. Brandes, a sorghum line from the U.S. and its progeny were very resistant to anthracnose. In Sao Paulo I also visited the sorghum field of Sementes Contibrazil Ltd., a seed company located in Cravinho. Much of their concern in this company is the incorporation of resistance in sorghum to anthracnose.

On February 12 I returned to Sete Logoas where I evaluated the International Disease and Insect Nursery (IDIN), The Converted Line Anthracnose Test (CLAT), and the National trials for sweet and grain sorghum, and the Sorghum Disease National Nursery. Anthracnose was more widespread and

severe here, due perhaps to environmental conditions (lots of rain and humidity) very conducive to anthracnose development. Here, again, some of the U.S. resistant sorghum lines were severly attacked by the anthracnose pathogen [TAM428, BTx624, SC110-14, SC112-14, SC170-14, SC173-12, SC175-14, SC237-14, SC599-6(9247) and SC598-11E]; however, some of the traditionally U.S. susceptible lines were not attacked (BTx398 and QL3). Some other diseases observed were: gain molds (*Fusarium* sp., *Curvularia* sp.), rust (*Puccinia purpurea*), zonate leaf spot (*Gloeocercospora sorghi*) and sheath blight (*Sclerotium rolfsii*).

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FUNGAL ANTAGONISM AMONG FOUR SORGHUM GRAIN MOLD FUNGI: IMPORTANCE OF SCREENING PROGRAMS

L. L. Castor, R. A. Frederiksen, K. N. Rao, and R. J. Williams

ABSTRACT

During the 1978 rainy season, 10 Indian grain sorghum lines were grown at ICRISAT Center, Hyderabad, India. Heads were inoculated at flowering with spores of *Fusarium moniliforme* (FM), *Fusarium semitectum* (FS), *Curvularia lunata* (CL), and mixtures of FM-FS (F), and FM-FS-CL (FC). *Phoma sorghina* (PS) occurred naturally on the grain and was uniformly distributed throughout the experimental nursery. Data were taken during grain development and on harvested grain to determine the relative importance and interactions of the 4 fungi. FM and CL were more damaging than FS. FM and CL reduced moisture content, weight, size, and germination of the kernels. FM and CL increased percent molded kernels while FM increased pre-harvest sprouting. FS caused little or no damage compared with the controls. Damage was less with F and FC mixtures indicating an antagonistic interaction with FS. Inoculating with FS at flowering protected the developing grain from FM and CL through harvest. Significantly greater PS occurred on the uninoculated grain compared with grain from fungal inoculated heads. Natural FS inoculum may interfere with the expression of susceptibility to FM and CL in screeing programs. FM, FS, and CL appear to interfere with the expression of susceptibility to PS. Resistance to FM, CL, and PS seems to be polygenic and independent.

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SCREENING FOR STRESS TOLERANCE IN SORGHUM

L. E. Clark, D. T. Rosenow, and A. J. Hamburger

ABSTRACT

Grain sorghum lines and hybrids with early season stress tolerance were identified in tests at Chillicothe, Texas in 1978. Sorghum was under moisture stress compounded by extremely high temperatures from planting through the flowering stage. These conditions resulted in stress symptoms ranging from extreme leaf rolling, bleaching of leaves, leaf firing, blasting of panicles, and delayed flowering. Subsequent rainfall during the following flowering permitted those plants which more effectively tolerated the early stress to respond favorably and produce yields in excess of 4500 kg/ha. Hybrids that flowered in 70 days or less were among the highest yielding, but some exceptions existed. Some hybrids that flowered in 75 to 85 days tolerated early stress and responded to mid and late September rains. Another important factor associated with adaptation of hybrids to these conditions was the rate at which grain drying occurred during October. Grain from many of the higher yielding hybrids was less than 15% moisture at harvest compared to values greater than 20% for other hybrids.

1979. Proc. 11th Biennial Grain Sorghum Res. and Util. Conf. p. 52.

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THE QUANTITATIVE RELATIONSHIP OF *SPHACELOTHECA REILIANA* TELIOSPORES AND INFECTION OF MAIZE HYBRIDS AND INBREDS

J. H. Foster and R. A. Frederiksen

ABSTRACT

The relationship of the number of *Sphacelotheca reiliana* teliospores and infection of maize hybrids and inbreds was investigated using sterilized soil selected from fields with a history of maize head smut and without a history of head smut. Teliospores were harvested from smutted plants and sifted through a #400 mesh screen. Teliospores were added to the sterilized soil with a history of head smut for a 10^{-1} dilution (1 part teliospores to 10 parts soil on volume to volume ratio). Serial dilutions were made through a 10^{-10} dilution. Susceptible maize hybrid P3369A and inbreds SC229, C123 and LH20 were used to determine the relationship between densities of teliospores and incidences of head smut. The resulting infection levels demonstrated a linear relationship between the number of teliospores present and the infection percentages ($r = -0.9642$). When a soil without a previous history of head smut was used, significantly fewer infections occurred in P3369A. This was interrupted as a fungistasis action in the soil without a previous history of head smut. There was no significant difference between the 10^{-1}, 10^{-2}, and 10^{-3} dilutions probably because of teliospore saturation. Significant differences for percent infection occurring at the selected dilutions demonstrated that there were differences in the relative susceptibility of the three inbreds.

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EFFECT OF NIGHT TEMPERATURE ON PHENOTYPIC PERIODS AND YIELD COMPONENTS OF GRAIN SORGHUM

J. R. Gipson, J. W. Johnson, and D. T. Rosenow

ABSTRACT

A temperate hybrid (RS 671) and a tropically adapted hybrid (A Tx 623 x Tx 430) were grown from emergence to maturity under 14 and 22 C night temperature regimes in the field growth chambers in 1977 and 1978. In addition, night temperature control was maintained from emergence to bloom on RS 671, A Tx 623 x Tx 430, and RS 610 in 1977 and on the same three plus A Tx 378 x Tx 430 in 1978. Of the three phenological periods, emergence to panicle initiation (GS-1), panicle initiation to bloom (GS-2), and bloom to maturity (GS-3), the greatest temperature response occurred in GS-2. Although length of both GS-1 and GS-3 were modified by temperature, the overall effect was not as great as in the GS-2 period. Of the cultivars studied, the tropically adapted hybrid, A Tx 623 x Tx 430, was the least sensitive to temperature, while the temperate hybrid, RS 671, was the most temperature sensitive. There were no temperature effects on yield components when treatments were terminated at bloom, but temperature effects were apparent when treatments were imposed from emergence to maturity, with number of seed/head and wt. of seed/head reduced at the higher temperature.

1979. Agronomy Abstracts p. 88.

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INFLUENCE ON NIGHT TEMPERATURE ON PHENOTYPIC PERIODS AND YIELD COMPONENTS OF TEMPERATE AND TROPICALLY ADAPTED TYPES

J. R. Gipson, J. W. Johnson, and D. T. Rosenow

ABSTRACT

Night temperature regimes of 14 and 22 C were imposed on temperate and tropically adapted sorghum hybrids growing in the field in 1977 and 1978. Temperature control was maintained on a temperate hybrid (RS 671) and a tropically adapted hybrid (A Tx 623 x Tx 430) from emergence to maturity each season. In addition, temperature control was maintained from emergence to bloom on RS 671, A Tx 623 x Tx 430, and RS 610 in 1977, and on the same three plus A Tx 378 x Tx 430 in 1978.

The two year average shows that of the three phenological periods, the greatest temperature response occurred in GS-2, i.e., from panicle initiation to 50% bloom. GS-1 was lengthened by 3 days, while GS-2 was lengthened by 5 days by the cold night temperature. Of the three cultivars studied, the tropically adapted hybrid, A Tx 623 x Tx 430, was least sensitive to temperature, while the temperate hybrid, RS 671, was the most temperature sensitive.

There was no temperature effect on yield components of plants when temperature treatments were imposed from emergence to bloom, but temperature effects were apparent when treatments were imposed from emergence to maturity. In the latter case, number of seed per head were reduced by an average of 19% and 18% respectively, with an increase in night temperature from 14 to 22 C. Of the two cultivars receiving season-long temperature control, RS 671 showed greater reduction in seed per head under high temperature than A Tx 623 x Tx 430, but there was little difference between the two hybrids on seed weight per head.

1979. Proc. 11th Biennial Grain Sorghum Res. and Util. Conf. p. 22-23.

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CHARACTERIZATION OF SORGHUM WITH RESISTANCE TO PREHARVEST GRAIN DETERIORATION

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

ABSTRACT

The grain of several non-brown sorghum lines (SC 279-14E, SC 566-14, SC 748-14, and SC 630-11E and Martin) have been identified as resistant to preharvest microbial deterioration. Only one non-brown line (SC 630-11E) was identified as resistant to preharvest sprouting. More resistant lines have an intermediate to corneous endosperm and require less time to reach physiological maturity (the grain develops and dries rapidly). In addition, alterations in the cellular structure and organization in the hilar and stylar areas, more complete coverage of the seed by surface wax, and glume shape affect water uptake and movement in resistant grain.

Water enters the sorghum kernel through the pericarp primarily in the hilum and stylar areas of the kernel. The rate of water uptake and movement is affected by structural differences of the kernel. Lines or varieties with higher proportions of floury endosperm and/or a thick mesocarp appear to have increased rates of water movement into the kernel. Water uptake and movement in the kernel 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 suffer more rapid loss or integrity when subjected to conditions favoring deterioration or germination.

1979. Proc. 11th Biennial Grain Sorghum Res. & Util. Conf. p. 44-45.

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MANAGEMENT TACTICS FOR THE SORGHUM WEBWORM IN SORGHUM

J. R. Hobbs, G. L. Teetes, J. W. Johnson, and A. L. Wuensche

ABSTRACT

Damaging infestation levels of *Celama sorghiella* (Riley) were avoided by early planting of sorghum. Sorghum planted by April 1 and flowering before June 20 in the Coastal Bend of Texas, and sorghum planted by April 10 and flowering before July 1 in South-Central Texas escaped damaging infestations of sorghum webworm.

Sorghum panicle type (open vs. compact) ratings and sorghum webworm infestation levels were positively correlated ($r^2 = 0.8$). Data showed that as sorghum panicles increase in compactness, sorghum webworm densities also increase. There was no positive correlation between sorghum webworm infestation levels and seed endosperm type or panicle size. Also, no association was apparent between egg deposition and panicle type within 6 days of panicle exertion; webworm mortality was high by the 10th day after 50% flower.

Germplasm resistant to sorghum webworm was difficult to identify, but differences in infestation levels indicated possible resistant sources.

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SORGHUM CULTIVARS RESISTANT TO THE SORGHUM MIDGE

J. W. Johnson, G. L. Teetes, B. R. Wiseman, and A. L. Wuensche

ABSTRACT

Sorghum [*Sorghum bicolor* (L.) Moench] cultivars from 20 countries were evaluated for resistance to the sorghum midge, *Contarinia sorghicola* (Conquillet). Cultivars evaluated were tropical sorghums that have been converted to types that flower in temperate areas by the substitution of the appropriate maturity genes. Cultivars were obtained from the TAES, USDA sorghum conversion program. The 210 items evaluated represented 38 of the "working groups" used by sorghum workers in India to classify the world sorghum collection. Midge damage ratings from three tests grown in two states in 1978 indicate that 10 cultivars are highly resistant (less than 30% seed loss) and 21 cultivars are moderately resistant (30 to 60% seed loss). Highly resistant lines had been collected from Sudan, Ethiopia, Uganda, India and Pakistan. Highly resistant types were found in six "working groups": Zerazera, Caudatum, Caudatum/Nigricans, Caffrorum/Darso, Durra and Durra/Nigricans. The ten highly resistant cultivars were derived from the following IS numbers: 12666, 3071, 12664, 2579, 12593, 8263, 8337, 12676, 7142 and 8231.

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THE SORGHUM MIDGE, WHAT'S NEW AND WHERE ARE WE GOING

Jerry W. Johnson

ABSTRACT

The use of plant resistance in midge management appears promising for the future. Genotypes with resistance have been identified in India, Brazil, and in the U.S. Studies have indicated that midge resistance is quantitatively inherited and not dominant. Since all lines that have been identified with high levels of midge resistance are restorer lines, the development of resistant B-lines is the most difficult breeding problem at this time. Eight midge resistant B-lines with moderate levels of resistance, B Tx 2754 through B Tx 2761, have been released. These lines should aid in the development of lines with high levels of midge resistance.

Evaluation of homozygous resistant, heterozygous resistant and susceptible hybrids in 1978 indicate that resistant hybrids will be damaged by extremely large midge populations. Homozygous resistant hybrids produced 1100 percent more grain than susceptible hybrids, 1380 and 120 pounds per acre, respectively. Indications are that the level of midge resistance presently available will be useful in pest management programs or in production situations where yield potential of the crop at flowering does not justify the additional expense of insecticide application. The cultivars derived from PI 383856 (AF28), IS 12666, IS 3071, IS 12664, IS 2579, IS 12593, IS 8363, IS 8337, IS 12676, IS 7142, and IS 8231 appear to have the highest level of resistance to midge.

Additional work is needed to improve the yield potential and disease resistance of midge resistant lines and to combine the highest levels of antibiosis and non-preference in improved parental lines.

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HYDROCYANIC ACID POTENTIAL IN SEVERAL GRAIN SORGHUM BREEDING LINES AS AFFECTED BY N AND VARIABLE HARVESTS

G. G. McBee and F. R. Miller

ABSTRACT

Fifteen entries, mostly grain sorghum [*Sorghum bicolor* (L.) Moench] breeding lines were field grown under two rates of N application, 0 and 112 kg/ha for potential HCN (HCN-p) determinations. Harvests were scheduled for three stages of development: prior to boot, panicle exsertion to prebloom, and after panicle removal. The youngest two leaves from ten plants/plot composed a sample and were analyzed for HCN-p by the CN^- electrode method. Significant variation in HCN-p existed among the various lines. All entries exceeded the "threshold of danger" level (200 ppm) at the first harvest. Four lines, TAM 428, SA 372, Tx 7078 and Tx 7000 were below 200 ppm at the second harvest and these plus Tx 2536, SCO 170-6 and Tx 398 were below the 200 ppm level at the final harvest. Tx 7000 was the lowest entry in HCN-p at all harvests whereas SCO 599-6 (Rio) was the highest. Added N increased HCN-p in all lines even for those inherently low in dhurrin. HCN-p tended to decrease with maturity of the plant, however, SCO 599-6 and SCO 056 contained levels above 200 ppm at the last harvest indicating a need to exercise caution in grazing stover of some varieties after harvest for grain.

1979 Agronomy Abstracts. p. 90.

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LYSINE PLATEAUS IN *SORGHUM BICOLOR* (L.) MOENCH GRAIN

Dan H. Meckenstock, F. R. Miller, and L. W. Rooney

ABSTRACT

The lysine concentration of five sorghum lines was evaluated by regressing percent lysine onto percent protein. An individual regression equation for each genotype was used to make comparisons among lines. The assumption of parallelism, i.e., equal slopes, allowed comparison of genotypes over a protein range. Effectively, the regression model resolved differences in the lysine concentration between corneous non-waxy, corneous waxy, and floury non-waxy genotypes. No differences were identified within the major genes controlling endosperm texture and starch type.

1979 Agronomy Abstracts. p. 69.

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UTILIZATION OF INTRODUCED GERMPLASM IN CROP IMPROVEMENT PROGRAMS

F. R. Miller

ABSTRACT

Utilization of germplasm through both public and private breeding programs has been large. Most breeders acknowledge from 25-95% of their current activities include exotic germplasm contributions for maize, oats, wheat, rice, cotton, soybeans, sunflowers, and sorghum. Sources of this material are from world, national or personal collections and cooperative breeders. Disease and insect resistance, stalk quality, yield stability, productivity, quality factors, alternate sources of cytoplasm are major identified traits that have been exploited. Crown-rust resistance from A. steriles, resistance to soybean cyst nematode, expansion of the cytoplasmic sterility system in sorghum, high oil in sunflower, etc. are other examples. Breeders feel that both major and minor traits still exist in untapped resources which will expand and increase the quality of all crops. The need for many as yet unneeded traits, unrecognized conditions and even unimagined improvement characteristics for which there is genetic variation will allow further use of domestic and alien germplasm resources. Most scientists recognize the major contributions of germplasm resources, but at the same time point with caution and urgency to the need for careful storage and preservation of naturally occurring genetic resources.

1979 Agronomy Abstracts. p. 116.

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SINK CHARACTERIZATION IN SORGHUM SEEDLINGS

R. J. Newton, D. A. Baltuskonis, D. H. Meckenstock, and F. R. Miller

ABSTRACT

Two sinks, sorghum (*Sorghum bicolor* Moench) seedling roots and shoots, were characterized while growing in dark at 25° in sand and/or paper towels. By utilizing radio-gas-chromatography it was established that sucrose was synthesized in the scutellum and was the primary sugar translocated to the growing shoots and roots. Sugar accumulation in sink regions correlated well with their disappearance in the source tissue, the endosperm. At peak levels of accumulation, glucose followed by fructose and then sucrose, were the primary sugars identified in both shoots and roots. Malate levels in the root were intermediate between sucrose and fructose levels. An unidentified carbohydrate, comprising 2-3% of the dry wt and nearly 50% of the total soluble carbohydrates, was found in the shoot. Levels of the unknown compound were highest in the growing protion of the shoot. Inhibition of shoot growth rate with water stress correlated with decreased levels of the unknown. This suggests that the unknown compound is intimately associated with growth processes.

1979. Agronomy Abstracts. p. 14.

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

PRESENCE OF *COLLECTOTRICHUM GRAMINICOLA* FRUITING STRUCTURES ON SORGHUM SEEDS

M. A. Pastor-Corrales and R. A. Frederiksen

ABSTRACT

Previously undescribed symptoms of sorghum anthracnose were observed in experimental plots in Cuyuta, Guatemala, and Robstown, Texas. Fruiting structures of *Collectotrichum graminicola* (Cesati) Wilson, the causal agent of anthracnose of sorghum [*Sorghum bicolor* (L.) Moench] were found on sorghum seeds. Clusters of acervuli occurred as minute black structures growing superficially in concentric rings on the pericarp around the style area. Acervuli were also present on the surface of rachis branches, but not on the glumes. BTx 398, TX430, SC170, TP3, 77SC1, and Pioneer Brand 846 were among the lines and hybrids which showed the described symptoms. Anthracnose infected seeds were found on plants inoculated at flowering or soft dough stage of grain development in the Texas plots and on plants inoculated before flowering in Guatemala. Seeds were fixed and observed under the scanning electron microscope. These seeds showed mature acervuli crowded with short conidiophores bearing single falcate conidia and septate setae tapering at their tips.

1979. Proc. IX International Congress of Plant Protection. #537

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.

INTEGRATED CONTROL OF MAIZE AND SORGHUM DISEASES IN TROPICAL AND SUBTROPICAL AREAS

B. L. Renfro and R. A. Frederiksen

ABSTRACT

Several control methods are employed to minimize losses to maize and sorghum caused by diseases in tropical and sub-tropical regions. These are most often integrated by the farmer, the ultimate judge and practitioner. Host resistance and avoidance are most frequently applied and are the principal methods used in attempts to control the sorghum grain and head molds, maize ear rots, stalk rots, anthracnose, downy mildew, head smut and virus and spiroplasm incited diseases. Fungicidal seed treatment is often used to protect from seed decay, seedling blight, most smuts and, likely, for the future control of downy mildew. While generally uneconomical, other means of chemical control have occasionally been used to control insect vectors, foliar pathogens and bacterial stalk rot of maize. Storage rots are mainly controlled by avoiding grain moisture conditions above 12 percent. In the future multiple measures will need employment for successful disease control. These will need to be integrated with other pest control and management systems for economic reasons and because insects, nematodes, weeds, soil conditions, agronomic practices and host reaction have profound influences on disease development. Research must be flexible, cognizant of changes and, most critically, develop a better transfer system of technology.

1979. Proc. IX International Congress of Plant Protection. #415

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.

DEVELOPMENT OF MULTIPLE DISEASE RESISTANT SORGHUMS

D. T. Rosenow and R. A. Frederiksen

ABSTRACT

Multiple disease resistant (MDR) sorghums have been developed in the TAES pathology-breeding program. Most sources of resistance were found in exotic germplasm recently converted to earlier-maturing types. Our initial selection scheme for sources of resistance in South Texas was by means of a MDR screening nursery. Further screening and selection for various diseases is done at Puerto Rico, Georgia and several locations in South and West Texas. The breeding procedure involves continual intercrossing of source lines and agronomically improved breeding lines with MDR. This multi-location screening of diverse breeding material for disease resistance across environments in natural occurring multi-disease nurseries has proven effective. The continual intercrossing of new sources and breeding lines even of early generation progeny rows has allowed us to select materials which possess an unusually high frequency of MDR. High levels of resistance to the following diseases exist in various combinations in these lines: Head smut (*Sphacelotheca reiliana*), downy mildew (*Peronosclerospora sorghi*), maize dwarf mosaic, anthracnose (*Colletotrichum graminicola*), rust (*Puccinia purpurea*), zonate leaf spot (*Gloeocercospora sorghi*), grey leaf spot (*Cercospora sorghi*), leaf blight (*Exserohilum turcicum*), Fusarium head blight (*Fusarium* spp.), charcoal rot (*Macrophomina phaseolina*), and grain mold (*Curvularia*, *Fusarium* and others). Examples of multiple disease resistant lines are TAM 428, SC 326-6, SC 170-6, SC 748-5, and SC 599-6. The original lines from which these were derived are IS 12610, IS 12661, IS 3758, and IS 17459.

1979. Proc. IX International Congress of Plant Protection. #579.

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.

ECONOMIC THRESHOLDS OF *HELIOTHIS* SPECIES IN SORGHUM

G. L. Teetes and B. R. Wiseman

ABSTRACT

Based on the research data available, and considering the factors discussed in this chapter, the economic threshold of *Heliothis* in sorghum would appear to be 1 to 2 larvae per panicle. The number of bushels of grain that must be saved to equal the cost of control is determined by dividing treatment cost by the value of a bushel of grain. If a market price of $2.20 per bushel (bu) and a treatment cost of $5.50 per acre are assumed, a saving of at least 2.5 bu of grain per acre would be necessary to offset the cost of treatment. If a grower produced 50 bu per acre at $2.20 per bu, the per acre value would be $110. A 6 percent loss (1 larva per panicle) and a 10 percent loss (2 larvae per panicle) would result in a monetary loss of $6.60 and $11.00 per acre, respectively, provided that all larval damage could be prevented by one treatment. The losses express the maximum potential damage attributable to a given level of infestation if it is assumed that the larval stafe is completed by all individuals and that no environmental factors adversely affect the larvae.

Direct control tactics applicable to managing *Heliothis* in sorghum include growing open-panicle varieties, manipulating planting time, and the use of chemical controls based on the economic threshold level. Another possibility for control of *Heliothis* is sorghum would seem to lie in exploitation of the polyphagous feeding habit of these insects. Manipulation of the species by cultural, biological or chemical means in one crop host in the agroecosystem could mitigate infestations in other crops. Lopez and Teetes reporting on the relative similarity of sorghum and cotton in terms of species composition, noted a closely woven relationship, one that through

the season, progressively acquires greater intimacy. An uncharted opportunity for pest management seems to lie here.

1979. Southern Coop. Series Bull. 231:57-61

INSECT RESISTANCE IN SORGHUM

G. L. Teetes and J. W. Johnson

ABSTRACT

The state of the art of insect resistance in sorghum is discussed. Sorghums resistant to insect and mites are tabulated. Resistance has been reported in 17 U.S.A. sorghum pests. Details are given of the status and impact of resistant sorghums for management of chinch bug, greenbug, sorghum midge, sorghum webworm, spider mites, corn leaf aphid, and yellow sugarcane aphid.

1978. Proc. 33rd Annual Corn & Sorghum Res. Conf. 33:167-89.

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.

MECHANISMS OF SORGHUM MIDGE RESISTANT SORGHUMS

George L. Teetes, Allen L. Wuensche, and Jerry W. Johnson

ABSTRACT

Within the past decade, sources of sorghum midge, *Contarinia sorghicola* (Coquillett) resistance have been identified in temporate-type sorghum, *Sorghum bicolor* (L.) Moench, from the Texas Sorghum Conversion Program. In three years of study five lines (TAM 2566, TAM 428, SC 423, SGIRL-MR-1, and AF 28) were used to determine relative levels of resistance and mechanisms involved in the resistance exhibited by certain of these lines. High levels of midge resistance were exhibited by TAM 2566, and SGIRL-MR-1 in comparison to either SC 423, TAM 428 or the susceptible check, Tx 7000, in both yield and adult emergence studies. Results of experiments in which the development of sorghum midge in the spikelets of each of the five lines was observed, indicated that antibiosis was a major resistance mechanism in several lines, particularly TAM 2566. In addition, studies demonstrated that fewer female adults were captured on panicles at anthesis of several resistant sorghums than susceptible sorghums. Nonpreference was shown to be a mechanism involved in the resistance exhibited by TAM 2566. Tolerance did not appear to be an important resistance mechanism in any of the five lines tested.

1979. IX International Congress of Plant Protection

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

DAMAGE TO SORGHUM BY FOUR SPECIES OF SEED-FEEDING BUGS

G. L. Teetes and D. G. Hall, IV

ABSTRACT

Damage to sorghum seed by four species of bugs was assessed during 1978. Seed weight and percent germination generally decreased as numbers of rice stink bugs, southern green stink bugs, leaffooted bugs and conchuela stink bugs per panicle increased. Mean number of feeding punctures per seed and percent punctured seed generally increased as bug propulations increased, especially at the highest infestation level. To some extent, weight of damaged seed decreased as the incidence of punctures increased. Damage to sorghum grain was largely due to direct feeding on seed by bugs, but indirect damage resulted from bugs feeding on panicle stems and rachis branches. Bugs were more injurious to grain in the milk and soft dough stages of development than to grain in the hard dough stage.

1979. Proc. 11th Biennial Grain Sorghum Res. and Util. Conf. 12-13.

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.

GROWTH ANALYSIS OF TEMPERATE AND TROPICALLY ADAPTED SORGHUM HYBRIDS AND LINES

G. L. Thomas and F. R. Miller

ABSTRACT

During 1978, 7 plantings were made at monthly intervals at College Station, Texas. Five sorghum genotypes were sown at each planting date. Two genotypes, RS610 and NB505, were considered temperately adapted (tea) while the other 3 genotypes, BTx623, RTx430, and ATx623 x RT430, were considered tropically adapted (tra). Green leaf area, number of green leaves and plant height were measured for each genotype for each planting date at the following phenological stages: 1) floral differentiation; 2) 50% anthesis; 3) black layer at the bottom of the head. Analysis of variance for all plantings where all measurements were made gave the following results. Significant (α = .05) differences in total leaf area between the tra lines and other entries. For stage 1 and all plantings the tra genotypes were significantly taller. Stage 2 and all plantings the tra genotype had significantly more leaves than tea genotypes. For stage 3 the tra genotypes had significantly greater leaf areas and numbers than the tea genotypes. It would appear that the two tropically adapted lines and their hybrids have greater leaf producing potential than do the temperately adapted hybrids.

1979. Agronomy Abstracts. 71:111

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

GROWTH AND SOIL WATER EXTRACTION BY DIFFERENT GRAIN SORGHUM AND MILLET CULTIVARS

C. W. Wendt, H. P. Harbert III, D. T. Rosenow, and J. W. Johnson

ABSTRACT

Eight grain sorghum cultivars were grown on an Amarillo loam soil at Lubbock, Texas 1976-1979. The soil profile was at "field capacity" prior to planting. No additional irrigation water was added after planting. Mobile shelters were used to prevent rain from falling on the plots. Parameters measured include soil water content, plant water potential, dry weight, leaf area, and sugar. Grain sorghum cultivars investigated include Tx 7000, SC 599-6, SC 56-14, 1790E, B 35, B Tx 378, A 35 x SC 599-6, and A 599 x SC 56-14. The amount of soil water extracted varied from 14.0 to 20.4 cm. There were generally more differences in soil water extraction between years than between cultivars in a particular year. However, there were major differences in extraction among cultivars in the time and location within the soil profile.

Soil water content changes indicate that depths greater than 210 cm should be investigated because major changes occurred at this depth.

Differences existed in leaf area index and dry weight among cultivars. The sugar content of the stalks and leaves were significantly different among cultivars. There was no relationship between the leaf and stalk sugars.

Yield data between cultivars were not consistent between years because of differences in planting date and infestation by Banks grass mite and midge.

Millet cultivars investigated included the Senegal population and RMP1(s)C1. The cultivars were found to be difficult to establish, poor extractors of soil water (9-11cm) and poor yielders of grain (537-575 kg/ha).

1979. Proc. 11th Biennial Grain Sorghum Res. and Util. Conf. p. 49.

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.

FLORAL INITIATION IN SORGHUM HASTENED BY GIBBERELLIC ACID AND FAR-RED LIGHT

E. A. Williams and P. W. Morgan

ABSTRACT

Floral initiation in sorghum was hastened by five minutes of far red light given at the beginning of the 12 hour night period plus gibberellic acid. The time of application of GA_3 was not critical, but the two treatments were more effective together than either alone. Flower initiation was hastened several days by these treatments.

1979. Planta. 145:269-272

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 RESPONSE OF SORGHUM CULTIVARS TO DROUGHT STRESS

C. A. Woodfin, D. T. Rosenow, L. E. Clark, and J. W. Johnson

ABSTRACT

Sorghum genotypes were evaluated for tolerance to drought stress under field conditions during the past two years. Notes were taken when plants were under drought stress at two stages; early in the season before flowering, and later in the season during the late grain development stage. Notes on leaf rolling, excessive leaf erectness, leaf bleaching, and leaf tip and margin burn were taken early in the season and combined into one drought stress rating, their presence being considered a poor response. During the late grain development stage, ratings on premature leaf and plant death were used to indicate an undesirable drought response. Early season stress susceptibility results in head blasting and delay in flowering. Premature plant death caused by late season stress often results in lodging and reduced seed size. Distinct differences in drought response among cultivars were found at both growth stages. There were distinct differences in drought reaction within cultivars at the two stages. No cultivars were found with high levels of tolerance at both growth stages.

1979. Agronomy Abstracts. p. 82.

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.

NEWS RELEASES

AND

PUBLIC MEDIA ARTICLES

NEWS RELEASES AND PUBLIC MEDIA ARTICLES

1. ICRISAT Hosts Five Workshops in Busy Winter. At ICRISAT, Jan/Feb/Mar 1979.

2. Will Sorghum Feed and Power the Future? Farm Journal, Feb. 1979

3. Sorghum Yield Barriers Beginning to Fall. Four Down, One to Go. Earlyriser, March 1979.

4. Sorghum Pathologists Meet. Phytopathology News, March 1979.

5. Kansas Hosts Utilization Meet. Grain Sorghum News, April 1979.

6. Looking into Sorghum's Future. Horizons, Department of Soil & Crop Sciences Newsletter, April 1979.

7. New Twin-Seeded Sorghums are Tested. Irrigation Age, May/June 1979.

8. Twin-Seeded Sorghums are Trend of the Future. Seedmen's Digest, May 1979.

9. Seed Treatment Will Stop Herbicide Injury. Southwest Farm Press, May 24, 1979.

10. Research Report - Brazilian Researcher Confers with A&M Scientists on Downy Mildew, TAES News, June 14, 1979.

11. Sorghums Pose Energy Hope. Beeville Bee-Picayune, Vol 93, No. 10, July 2, 1979.

12. Research Report - College Station. TAES News, July 16, 1979

13. Host Plant Resistance to be Explored at A&M Conference. TAES Newsletter to Station Staff, July, 1979.

14. Hydrocyanic Acid in Sorghum Lines. TAES, Brief Reports on Agricultural Research in Texas, Vol 5, No. 7, July 1979.

15. You Can Improve Your Sorghum Yield Record. The Farmer-Stockman, August 1979.

16. What the Scientist Sees. TAES, Brief Reports on Agricultural Research in Texas, Vol 5, No. 8, August 1979.

17. Crop Management in the South. Successful Farming in the South, September 1979.

18. Dr. Fred Miller Invited to Study Sorghums in China. TAES, Newsletter to Station Staff, No. 9, September 1979.

19. Research Miller Invited to Study Sorghums in China. Grain Sorghum News, September 1979.

20. Midge Resistant Sorghum Cultivars. TAES, Brief Reports on Agricultural Research in Texas, Vol 5, No. 10, October 1979

21. Midge Resistants are Closer. Grain Sorghum News, October 1979.

22. Broader Role for Sorghum? The Furrow, November/December 1979.

23. Crops to Fuel New Enthusiasm Needs Caution, Southwest Farm Press, December 1979.

AT ICRISAT January February March 1979

ICRISAT Hosts Five Workshops in Busy Winter

ICRISAT was host for five international workshops in a period of three months and 10 days in late 1978 and early 1979.

The busy winter program started with an International Workshop on Agroclimatological Research Needs of the Semi-Arid Tropics November 22-24. Twenty-five participants from 11 countries discussed techniques, methodologies, approaches, instrumentation and means of agroclimatological research.

ICRISAT and Texas A & M University jointly sponsored the International Workshop on Sorghum Diseases December 11-15 in Hyderabad. Fifty-six papers were presented from Asia, Africa, North America and South America on individual diseases of sorghum, including smuts, grain molds, downy mildew, head blights, and stalk rots, ergot, leaf diseases and virus diseases. Research priorities were recommended for each group of diseases.

A consultants' group discussion on Resistance to Soil-borne Diseases of Legumes was held by ICRISAT's Pulse Pathology section January 8-11 with 10 consultants attending from Australia, India, the Netherlands, UK and the USA. Visits to experimental fields stimulated in-depth discussions of ICRISAT's work in this area.

The International Workshop on Intercropping January 10-13 attracted some 35 delegates from 15 countries and highlighted the tremendous interest recently developed and the rapid improvements being made in experimental approaches to intercropping. At ICRISAT the work is based mainly on four intercrop combinations of the five ICRISAT crops: sorghum/pigeonpea, millet/groundnut, sorghum/chickpea, and sorghum/millet.

ICRISAT's Economics program was host for an International Workshop on Socioeconomic Constraints to Development of Semi-Arid Tropical Agriculture February 19-23. It was attended by 46 participants from 13 countries and 40 ICRISAT scientists. Papers and discussions emphasized the need to analyze labor bottlenecks in West Africa, to learn more about the goals of farmers throughout the SAT, to study in depth possible mechanisms for the improvement of agricultural produce markets, to extend to areas other than India the village level economic studies and research on farmers' attitudes to risk conducted here, and to assess the potential for development inherent in the transfer of already existing technology, such as irrigation tanks in India to countries with relatively lower levels of intensity in use of agricultural resources.

The International Workshop on Chickpea Improvement February 28 to March 2 drew 51 delegates from 14 countries and 31 ICRISAT scientists. Topics discussed included breeding strategies, including germplasm work and nursery trials; yield-improvement through kabuli-desi introgression; recent developments in chickpea agronomy and physiology; microbiology research in chickpeas; and plant protection. Two separate sessions were devoted to country reports, and special attention was given to the ICRISAT/ICARDA program.

Proceedings of these workshops are in various stages of preparation. Copies may be obtained by

Director Swindale examines sorghum disease identification book with Co-Authors Williams (left), Frederiksen and Girard

Sorghum/Millet, Chickpea Disease Handbooks Published by ICRISAT

Two pocket-size handbooks, with clinical quality color photographs for identification of sorghum and pearl millet diseases and for wilt-like disorders of chickpea, were among ICRISAT publications in 1978.

The "Sorghum and Pearl Millet Disease Identification Handbook," published in cooperation with Texas A & M University, includes a disease-identification key and descriptions of the symptoms of 32 diseases. It has 59 full-color illustrations. The co-authors are R. J. Williams of ICRISAT, R. A. Frederiksen of Texas A & M, and J.-C. Girard of IRAT (France). Copies are available in English, French and Spanish.

"Diagnosis of some Wilt-like Disorders of Chickpea (*Cicer arietinum* L.)," is the result of an attempt to clarify the considerable confusion in diagnosing various chickpea disorders, particularly wilt and root rots. In the past, these disorders were frequently classified under the general heading of "wilt complex;" ICRISAT pathologists have shown that the condition is actually a number of distinct diagnosable diseases.

This handbook describes the characteristic features of the main disorders of chickpea, and includes 37 diagnostic photographs. In addition to a disease-identification key, the handbook contains a summary of the chickpea wilt surveys conducted on the subcontinent of India. The authors are Y.L. Nene, M.P. Haware, and M.V. Reddy, pulse pathologists at ICRISAT.

The handbook is printed in English, and we are exploring possibility of supplements in Spanish and Arabic.

Single copies of both handbooks may be obtained free of charge by writing Head of Information Services, ICRISAT, 1-11-256 Begumpet, Hyderabad 500 016, A.P., India. Please specify by title in ordering.

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EARLYRISER March, 1979

Sorghum yield barriers beginning to fall. Four down, one to go

The year 1979 could be the year when traditional sorghum yield barriers begin to topple. It could be the beginning of a period when Southeastern, Mid-South and Southwestern sorghum yields start to catch up with the yields grown in the more favorable conditions of the High Plains.

Why? Because until recently, insects and diseases have kept the lid on sorghum performance in the Southern states. But downy mildew, anthracnose, head smut and greenbugs are now being whipped through improved genetic hybrid resistance. Only the midge remains as a major insect challenging sorghum producers—and work is well underway to build hybrids with resistance to that long-term sorghum pest.

In short, sorghum plant breeders can now put less emphasis on "putting out fires" and get down to the serious business of increasing genetic yielding ability.

"We have always placed paramount importance on yield," says Dr. Rodney Rogers, Funk's manager of sorghum research. "But yield potential has been limited seriously by the severe insect and disease problems existing in the South. So we have concentrated our efforts on solving these problems so that our hybrids could reach their full genetic yield potential."

Funk now has a comprehensive line-up of widely adapted hybrids that carry resistance to whatever problems a sorghum producer might have. Downy mildew and anthracnose have been two major disease problems, but now G-589, G-522DR and G-722DR grain sorghums, G-88F sorghum-sudan and G-102S silage sorghum carry resistance to these two diseases of the Southeast. G-499GBR, G-642GBR and G-622GBR fill the need for greenbug resistant hybrids in areas where that pest has been a problem.

Dr. Norman Wilson, Funk sorghum breeder in the Southeast, has been working with Dr. Rogers on boosting hybrid yielding ability across the South. Dr. Wilson is testing hybrids at Funk locations in Greenville, Mississippi; Coolidge, Georgia; Corning, Arkansas; Lamar, Missouri; and Progresso, Taylor, Victoria and Lubbock, Texas.

He screens his sorghum hybrid candidates at these locations for a variety of factors and uses data compiled at many Funk Research Evaluation Plots (or REPs) located across the South and Southwest. The REP tests are made by farmers—under normal growing conditions. Testing done in the REPs is the final research stage before sorghum hybrids are produced in commercial quantities for public release.

While Drs. Rogers and Wilson will continue to bring insect and disease resistant hybrids onto the market, they have trained their guns on improved yield and have two hybrids in development that promise to be bell ringers.

The first is G-611, a new hybrid that was just numbered this winter. Formerly carrying the experimental number 2216, G-611 will be seen in limited commercial quantities for the first time this coming year. It is tropically adapted and carries the same disease resistance as G-722DR and G-522DR. It is also greenbug resistant.

But G-611 also pays off in the

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SORGHUM YIELD BARRIERS BEGINNING TO FALL.

FOUR DOWN, ONE TO GO (continued)

yield column. Early tests show that it will yield as well as or better than G-522DR, a hybrid that consistently has placed high in yield trials. It set a new state sorghum yield record in Arkansas in 1978 with an irrigated yield of 11,588.3 lbs per acre.

A second hybrid likely will receive its "G" number in 1980. Carrying the experimental number 2194, it too provides wide resistance to diseases and insects. Early tests for 2194 indicate that its yield potential is equal or superior to existing hybrids of comparable maturity.

Both G-611 and the experimental hybrid 2194 are tropically adapted. Dr. Wilson feels that tropical adaptation is one research effort now paying big dividends in the yield column for Southern sorghum producers. Tropical adaptation allows many South Texas, Mid-South and Southeastern sorghum growers to achieve yields comparable to those grown in the High Plains.

"In fact, tropical adaptation has proven to be a real yield booster in all areas where night temperatures and humidity are high during the growing season," Dr. Wilson says.

"The advantage from tropical adaptation seems to be more a function of elevation and rainfall rather than latitude."

These new Southern-adapted sorghum hybrids with tropical adaptation show multigenic resistance to many different sorghum disease and insect problems and will withstand harvest-time rainfalls and other weathering problems better.

Hybrids carrying tropical adaptation have immediate usefulness in the Southern sorghum belt because this area is characterized by warm night temperatures and high humidity during the crop growth and development stages.

Dr. Wilson developed the first commercial grain sorghum hybrids with tropical adaptation, a concept based on early work by Dr. Fred Miller of Texas A & M University, using World Sorghum Collection germplasm.

Sorghum midge still remains as the one nearly universal, and as yet unsolved, problem facing Southern producers. Drs. Rogers and Wilson expect to have at least a partial solution to that problem within a few years.

According to Dr. Rogers, sorghum midge is a minute orange fly which lays its eggs in the developing grain of the sorghum head. This egg hatches into a tiny maggot which feeds inside the kernel, causing head blasting and heavy yield losses.

The problem usually occurs in sorghum planted later than adjacent sorghum fields, the later plantings being subject to higher insect population levels.

"Dr. Wilson has been successful in selecting parent material with midge resistance," says Dr. Rogers. "We are making an intense effort to bring resistant hybrids on stream and will be evaluating some prototype hybrids in 1979."

"However," Dr. Rogers cautions, "when we do have midge resistance it will probably not be the complete solution. In other words, sorghum growers may still have to use an insecticide in combination with the resistant hybrid when midge populations are high."

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Phytopathology News

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY MARCH 1979 VOLUME 13/NUMBER 3

Sorghum Pathologists Meet

Pathologists from 20 countries met at Hyderabad, India, on December 11–15, 1978, to review the status of internationally important sorghum diseases. Organized by the International Crops Research Institute for the Semi-Arid Tropics and the Texas Agricultural Experiment Station of Texas A & M University, this was the first meeting of pathologists from North and South America, Australia, Africa, Asia, and Europe to establish internationally coordinated goals and priorities.

Sessions on smuts, grain molds, virus diseases, downy mildew, leaf diseases, stalk rots, head blights, ergot, and utilization of resistance were held separately during the International Workshop on Sorghum Diseases.

Recommendations were drafted and will appear in the technical proceedings of the conference. The proceedings will reflect the current state of the art on sorghum pathology.

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GRAIN SORGHUM NEWS April 1979

Kansas Hosts Utilization Meet

The Bi-Annual Grain Sorghum Utilization Conference was held in Wichita Kansas on February 28-March 2. The Conference which has been held each year since 1957, was co-sponsored this year by Grain Sorghum Producers Association, Texas Grain Sorghum Producers Board, Kansas Grain Sorghum Growers Association, and Sorghum Improvement Conference of North America.

The three-day conference featured reports on research in entomology, cultural-management practices, plant breeding, physiology, chemical and nutritional improvement.

Arrangements for the conference were made by Kansas Grain Sorghum Board. Over 100 persons attended the Conference.

Sorghum specialists at the Bi-Annual Grain Sorghum Utilization Conference are Left to Right: Dr. Jerry D. Eastin, Professor, Department of Agronomy of University of Nebraska; Dr. R.A. Frederickson, Professor-Plant Pathology of Texas A.and M. University; and Dr. Richard Vanderlip, Professor-Agronomy of Kansas State University.

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HORIZONS

APRIL 1979

DEPARTMENT OF
SOIL & CROP SCIENCES
NEWSLETTER

OUTREACH

LOOKING INTO SORGHUM'S FUTURE

Just keeping track of all the projects Dr. Fred Miller of the Agronomy Field Lab has going would be a full time job for any average person. He is in charge of sorghum improvement for the southern two-thirds of Texas, along with providing tropically adapted types to countries such as Mexico, Brazil, India, Honduras, and Tanzania for evaluation.

On leave from TAMU, Dr. Miller spent five years in Puerto Rico in charge of developing a sorghum conversion program for the USDA. The program involved converting a tall, photoperiod sensitive African sorghum to a shorter sorghum, insensitive to photoperiod and that would develop a seed head in the Puerto Rican latitude. When Dr. Miller returned to College Station in 1970, Dr. M.E. Bloodworth challenged him to develop a sorghum adapted for South Texas. South Texas sorghum producers were attaining yields of only a third to one-half of farmers on the High Plains and further north.

Step one in the process was to look at the world collection of sorghums. Dr. Miller selected a tropical Ethiopian type to cross with a local type of greater yield potential. The hybrid was sent to Puerto Rico in the winter of 1971 and test planted. Results were good, and these sorghum types have been released and proven effective for use in South Texas.

The next question was, why did this plant yield well in South Texas and the types grown further north did not. An Australian graduate student, Geoff Thomas, made a computer analysis of a number of types and found that the major variable was the germination temperatures. Tropical varieties germinate at a lower temperature compared to temperate varieties. The opposite would thought to have been true, but this is believed to be a compensation mechanism for the shorter day lengths in southern or tropical climates. High Plains varieties grown in the south may not be able to achieve high productivity due to the fact that during the day their relatively high heat requirements are not fully met. This, plus high respiration losses during the hot nights of what little is produced may account for the low yields. At least this is a theory.

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A total of nine graduate students are presently working on sorghum improvement. Project topics range from practical agronomic aspects of growing sorghum and development of high lysine kernels to pathological and physiological studies. Armando Valdez, a doctoral student from Mexico, is determining if selection of a sorghum type can be made based only on temperature phenotype (of germination), when a low base temperature sorghum is crossed with a high base temperature type. This would allow for testing to be conducted at only a limited number of places instead of the numerous locations now used to account for varying climatic ranges. Substantial saving of time and money spent testing will particularly benefit the seed industry.

Another student is experimenting with an Ethiopian sorghum type which produces shrunken kernels of high lysine content, crossing it with a full kernel producing type with a lower lysine content. Where 1.9% of the protein of most sorghum is lysine, this hybrid will yield a lysine content of 2.2-2.3% of the total protein.

It has been theorized that sorghum is potentially capable of yielding 35,000 pounds per acre. This goal could be approached through work conducted with twin seeded heads and control of genetic indeterminancy of head size. Research is also beginning on the root system, as little is really known except that there are differences, probably related to the climate of evolution. In addition to the improvements specifically bred for, many of these new tropical types are proving better insect, drought, and disease resistant, and of good nutritional quality.

Seed company agronomists and breeders periodically visit the campus field lab and nursery to view developments and express problems experienced in their particular area. Dr. Miller's strong belief in keeping the door open to the public and maintaining a direct line of communication with the seed industry allows for a steady flow of interchanging ideas and concepts. This often stimulates the establishment of new research projects.

Cooperation between A&M and foreign sorghum producing nations is also strong. In fact, for the first time, A&M and a foreign country will jointly release a sorghum type. Probably within a year TAMU and Guatamala will release a tropically adapted sorghum type while Mexico and A&M will release a random mating population.

It is obvious that the concept of the "perfect" sorghum is an ever expanding idea, and will likely never be attained as someone always has an idea for improvement, especially Dr. Miller and his coworkers.

New twin-seeded sorghums are tested

The release of a twin-seeded hybrid sorghum by Northrup King for field testing may be the start of a new trend in sorghum production, according to Paul Menge, director of hybrid sorghum research at Northrup King.

"Twin-seeded sorghum has shown as much as a 50% yield advantage over conventional hybrids. However, we feel a 15 to 20% yield increase is a more reliable expectation."

Northrup King is releasing its first twin-seeded hybrids to growers for field planting tests this year. The new twin-seeded hybrids could be available for widespread distribution in 1980.

Texas A&M scientists first recognized the economic potential of the twin-seed characteristic and have been the leader in developing breeding material. Their research agrees with NK's; a 15 to 20% yield increase could be typical, Northrup King officials said.

The difference is in the heads. Each floret contains two flowers instead of the traditional one. The result is two sorghum seeds, explained sorghum plant breeder Menge.

While your first impression may be that yields should either be doubled or the seed size is smaller, neither is true.

"Twin flowering seems to reduce the number of florets per head. A typical sorghum head has around 2,500 seeds, twin-seeded types, 50% more," Menge explained. "The seed size depends most on the genetic material in the plant. We have some twin-seeded selections that have a large seed size. There is one difference though, the twin-seeded hybrids tend to produce a flatter seed."

The hybrids Northrup King has available for field testing and the hybrids Texas A&M are testing have the twin-seeded characteristic added only on the male side.

Northrup King has also developed a female line that has the twin-seeded characteristic. By having the twin-seeded characteristic on both male and female lines, Menge believes that nearly 100% of the florets will be more likely to set twin seeds.

Northrup King has found that the twin-seeded characteristic can be added to regular breeding lines, without changing the plant's other characteristics.

"We should be able to add the twin-seeded characteristic to our existing hybrids and expect them to maintain the characteristics that have made them popular with growers," concluded Menge. ▼

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SEEDMEN'S DIGEST May 1979

TWIN-SEEDED SORGHUMS ARE TREND OF THE FUTURE

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Seed Treatment Will Stop Herbicide Injury

sorghum hybrids sold by the two seed firms for sales to farmers in 1980. For purposes of its own brand identification, Funk will market the safened seed under a trade name, Herbishield.

Final Testing Phase

The two new herbicides are in final phases of testing and registration with the Environmental Protection Agency (EPA) now.

The first new herbicide to be released and sold along with safened seed will be named, Bicep.

According to company officials, Bicep is a combination of Dual, a registered pre-plant herbicide for most annual grass and certain broadleaf weeds in corn and soybeans, plus AAtrex. Dr. J. W. Peek of Greensboro, the chemical firm's manager of its biological research department said the two chemicals in combination will give farmers the broad-spectrum weed and grass control tool they need for successful sorghum production.

The second new herbicide, due out a year later, is to be named Milocep. It is a combination of Dual and Milogard.

The active ingredient in Dual herbicide is metolachlor.

Detoxify Metolachlor

Peek explained the seed safener serves to detoxify the metolachlor. Without first chemically safening the seed, Peek pointed out, using Dual (metolachlor) on sorghum would kill sorghum outright.

The label on Bicep, according to Peek, will cover the following annual grasses: barnyardgrass or watergrass, crabgrass, cupgrass, three foxtails – giant, green and yellow – goosegrass, yellow nutsedge fall panicum, signalgrass and witchgrass.

Broadleaf weeds covered under the anticipated registration includes carpetweed, cocklebur, lambsquarter, Florida pursley, ragweed, smartweed, velvetleaf, morningglory, pigweed, purslane and puncturevine.

Company officials say Bicep also gives partial control of both seedling Johnsongrass and sandburs.

Exactly how the safener detoxifies the herbicide's active ingredient is subject of further research, Peek said.

Broadens Options

Both Bicep and Milocep, said the company, are expected to be cleared for use by farmers as either a pre-plant incorporated herbicide or as a pre-emergence herbicide, broadening considerably farmers' choices in their pest plant control programs.

Peek told the seminar that since it was proving so difficult for his firm and others to find a good grass herbicide which was selective for sorghum, researchers at the firm's Basle, Switzerland, headquarters moved several years ago to find a herbicide antidote that would permit an existing grass herbicide to be used on sorghum.

What eventually has become Concep was discovered in 1974 and carried the experimental designation CGA-43089.

Chemical and seed firm officials said test marketing next year will involve use of Concep-treated Funk hybrid sorghum seed and the initial herbicide, Bicep.

Registration of Bicep is expected to be completed this fall.

Exact areas of initial marketing are being chosen at this time.

Hybrids Selected

The initial hybrids to be Concep-safened and sold as Herbishield seed, according to the seed company, will be G-499GBR, G-550xx, G-522, G-522A, G522DR, G-611, G-623GBR, and G-642GBR.

Some problems with seed germination have been encountered in cold, wet soils.

A Texas researcher who has evaluated the system is Dr. Allen Weise, weed control researcher at the Texas Agricultural Experiment Station at Bushland, near Amarillo.

He said the method no doubt will be helpful to the state's sorghum producers. "This revolutionary idea will help farmers control grasses and weeds in sorghum that escape other herbicides," Weise said. "Nutsedge is a good example."

After a little more research with the protectant, we will know if Bicep and Milocep can be used safely on sorghum growing in sandy soils. If it works, our growers will be able to control sandburs in sorghum for the first time.

"Controlling volunteer sorghum or shattercane in sorghum fields with the new herbicides is another possibility."

Weise said seed safeners are a viable approach to better grass control. He noted that several others are currently on the market. Stauffer Chemical Company's Eradicane is a combination of Eptam and a chemical seed safener, applied directly on the soil for weed and grass control in corn. The firm's Sutan Plus is a combination of Sutan plus a safener.

Gulf Chemical Company also has available such a product, called Protec.

Other major firms are known to be in pursuit of antidotes.

Noted Weise, "Safeners may be easier to find and less costly on manufacturers than new herbicides themselves, considering the many environmental factors which must be met and fulfilled before marketing can begin."

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NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION/Neville P. Clarke, Director
The Texas A&M University System/College Station, Texas/Telephone (AC-713) 845-2211

6-14-79 RESEARCH REPORT FOR RELEASE ON RECEIPT

BRAZILIAN RESEARCHER CONFERS WITH A&M SCIENTISTS ON DOWNY MILDEW

COLLEGE STATION--The Texas Agricultural Experiment Station's continuing research emphasis on downy mildew in corn and sorghum has attracted one of Brazil's top authorities on this fungus disease.

Dr. Nelson Gimenes Fernandes is a visiting professor at Texas A&M University during June and July, and his stay here is described as a good example of the mutually beneficial co-operation that can exist between nations.

Gimenes not only will study the Experiment Station's latest downy mildew (DM) findings, but he also will lecture on his own work and experiences to A&M graduate students.

The scientist, a plant pathologist at Paulista State University in Brazil, is working with Dr. Richard Frederiksen of the A&M Plant Sciences Department, and Dr. Jeweus Craig, a downy mildew specialist with the U.S. Department of Agriculture.

Gimenes says DM, when it occurs, is confined to about three states in Brazil. Fortunately, the malady has had little effect on corn, which is a far more important crop than sorghum in Brazil.

The disease did hit sorghum fairly hard about three years ago, but it has since been checked by the introduction of resistant varieties.

While at A&M, the Brazilian will concentrate on DM inoculation techniques in the greenhouse. Frederiksen and Craig will work with him on identifying resistance in corn and sorghum, and on determining the genetics and inheritances of that resistance.

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Downy mildew has never ravaged corn and sorghum crops in the United States, but it receives considerable research attention because it is potentially a real trouble-maker, Frederiksen says.

The disease has been kept under control, particularly in corn, through use of resistant varieties and certain cultural practices. Frederiksen calls this continuing preventive campaign "a great success story in agricultural science."

In some other countries, however, DM is a "crop limiting factor," meaning that it can devastate corn and sorghum production. Worldwide, it is one of the most serious diseases of corn.

The Texas Agricultural Experiment Station has completed its first phase of DM research and now has excellent sources of resistant plant material for sorghum and corn. Next on the program is to evaluate that resistance and to test it to any potentially new isolates of the DM pathogen.

In addition, Frederiksen says, this resistance can be combined with resistance to other pests such as insects--sorghum-damaging greenbugs, for example.

Gimenes, Frederiksen and Craig agree on the worth of the philosophy of working with scientists from other countries.

"Such an exchange of ideas provides a stimulus for us, and I think it certainly contributes to a better understanding among nations," Frederiksen said. "it just makes sense for scientists in different countries to communicate on their research."

Craig described the interchange of information among scientists as a major step in "building a framework for better worldwide plant disease control."

DM is an exotic disease introduced to the U.S., he said.

"In establishing this kind of cooperation with scientists from other nations, we are better able to investigate and learn about other diseases that might be introduced," Craig explained.

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Beeville Bee-Picayune

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Our 93rd Year

Vol. 93—No. 10 Beeville, Texas 78102, Monday, July 2, 1979 Two Sections—18 Pages

Sorghums Pose Energy Hope

Foreign Varieties May Yield Food, Gasohol

By GARY KENT

These days, with gasoline and diesel in such demand, the perfect farmer's crop would produce as much fuel as it yields edible fiber. Surely many farmers have dreamed of such a crop.

Well, Texas A&M sorghum researchers think they are on the verge of coming up with such a plant that is adaptable for growth in South Texas. Information concerning the research was actively sought when a group of over 100 sorghum research workers from all over the world visited Beeville recently as part of the 1979 Sorghum Workshop.

Like rice to the Orient, nutritious grain sorghum has provided sustenance for people throughout India and parts of Africa for centuries. Varieties of the plant, commonly known as milo, have been growing in Texas for over 100 years.

Many tropical varieties of sorghum grow a tall cane that is heavy with a sweet sugary pulp. The pulp from the cane can be distilled into alcohol which can be used as fuel.

The idea is not new. Some of the grain produced in the American Midwest today is being converted into alcohol and mixed with gasoline to make "gasohol." Gasohol is also the product being used to power an automobile at the A&M Research Station at Weslaco. The scientists are making alcohol out of sorghum but instead of distilling useful grain to get their product they are using the rich pulp of the plant's stalk.

The Brazilians were among the first to use tall sorghum cane as a source of fuel. Because of shortage of oil in Brazil the nation has found it economical to produce a reported 20 to 30 percent of its fuel from the pulp of sorghum cane.

Although workers at the A&M Research Station in Beeville are not directly involved in gasohol experiments they are testing a number of sorghum varieties and hoping to help come up with a breed of the plant that will produce an abundant head of grain plus a thick, juicy stalk filled with distillable sugar.

In sorghum breeding and disease nurseries at the Beeville station and on the Otto Hertel Farm researchers have given special interest to grain sorghum hybrids which have been developed from converted tropical introductions. The new tropical introductions allow the hybrids to grow better in the hot, dry climate of South Texas.

The influence of the tropical varieties of sorghum has also aided in the development of a midge-resistant breed of the plant. Control of the midge disease is crucial because most milo has to be planted at a time when it will be subject to midge damage in order to meet seasonal timing requirements necessary in producing an optimum crop.

Extensive research involving many of the more than 12,000 varieties of sorghum in the world has been carried out since the early part of the century at stations throughout Texas and lately in Mexico and Puerto Rico. Recently developed members of the sorghum family, with dwarfed stalks for easier harvesting with a combine, have made milo a highly productive crop. Researchers are now hoping that a new variety of sorghum with a stalk of about six feet in height will soon be available.

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BEEVILLE BEE-PICAYUNE

Beeville, Texas
Monday, July 2, 1979

SORGHUMS (continued)

Developing new sorghum hybrids requires a long and complicated process. Sorghum flowering is hastened by long nights, meaning the number of hours of darkness determine when the plant will mature. That makes the development of hybrids from both tropical and temperate varieties of sorghum very difficult. The time required for a sorghum plant to mature directly determines how tall the stalk will grow and how well the plant will produce grain.

The original intent of the researchers was, of course, to develop a variety of sorghum that is disease resistant. To accomplish this the scientists had to start by crossing resisting tropical varieties with temperate varieties in tropical locations. In 1961 work began in tropical Mexico and another project was approved between researchers in Texas and the U.S. Department of Agriculture station at Mayaguez, Puerto Rico, in 1963.

In the conversion process tropical varieties of sorghum are crossed with temperate varieties and the first generation is grown in the tropical climate. The second generation of the new variety is grown in the temperate zone. The result, after crossing and backcrossing the different varieties, is a sorghum plant that can function well in both climates and produce a maximum amount of grain and fiber. Hybrid varieties developed in Texas are being exported to other countries throughout the world.

Research in agriculture has put the United States ahead of the rest of the world in food production for many years. Disease resistant and early maturing crops are nothing new to farmers here. But the idea of producing fuel from stalks of grain sorghum, after the grain has been harvested, is something that has been brought about by the severe shortage of oil.

If the research proves successful and economical distillation methods can be developed, South Texas farmers may some day play an important part in the production of this country's fuel, while providing much of its grain at the same time.

Tarzan's Trail?

Lucas Reyes, left, and Dr. Fred Miller inspect the differences in short-statured, grain bearing sorghum plants and the taller, canelike tropical sorghum plants. Reyes, a research agronomist at the Corpus Christi Research and Extension Service Center, and Miller, a Texas A&M University sorghum plant breeder, were in Beeville inspecting test plants as part of the recent 1979 Sorghum Workshop, which drew over 100 sorghum research scientists from all over the world. (Harrison Photography)

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14—Section A Beeville Bee-Picayune Monday, July 2, 1979

Worldwide Workshop

The recent 1979 Sorghum Workshop, which toured the sorghum test plots at the Texas A&M University Research Station in Beeville, attracted more than 100 sorghum experts from all over the world. Among those attending the workshop here were, from left, R. Fredericksen and J. Craig of the A&M Department of Plant Pathology; R. Giron and J. Ignacio Aguirre of the Rio Bravo Station in Tamaulipas, Mexico; Page Morgan, head of the Department of Plant Physiology at A&M; Darrell Rosenow, A&M plant breeder; Agustin Sanchez of the Monterrey School of Agriculture in Mexico; Dr. Fred Miller, A&M plant breeder; Jose Esparza of the Rio Bravo Station; Lucas Reyes of the Corpus Christi A&M Research Station; Nelson Jimenes of Brazil; Dr. Howard Joham of the Department of Plant Science at A&M, and Jose Amador, extension agronomist of the Weslaco Research Station.

Getting Ahead

Lucas Reyes of the Texas A&M Research Station at Corpus Christi is shown with examples of grain sorghum heads grown at the Beeville Experiment Station. On the left is an African hybrid which could possibly be adapted to South Texas production for human consumption. On the right is a common variety of grain sorghum grown in this area. Reyes noted that while the darker grain grown locally is marketed by weight and used primarily in livestock feed, the lighter-colored African species contains more nutrients and food value, which might serve to make it a more profitable export product in the future. (Mike Bedwell Photo)

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TAES

NEWS

THE TEXAS AGRICULTURAL EXPERIMENT STATION/Neville P. Clarke, Director

The Texas A&M University System/College Station, Texas/Telephone (AC-713) 845-2211

7-16-79 RESEARCH REPORT FOR RELEASE ON RECEIPT

COLLEGE STATION---A sudden surge of a disease variously known as grain mold and grain weathering is showing up in Coastal Bend sorghum, one of that region's most important cash crops.

The malady is believed to result from the unusually wet spring and is caused by parasitic fungi, plus natural deterioration by alternate drying and wetting.

Farmers whose crops have been affected so far are much disappointed because the overall season seemed to offer near-ideal conditions for bountiful sorghum production. The problem became apparent when they noticed grain weights weren't what they should be.

"It's all a surprise to us," said Lucas Reyes, research scientist with the Texas A&M University Agricultural Research and Extension Center at Corpus Christi. "We learned about the problem when farmers began complaining about their bushel and truck weight being way down."

He discribed the Coastal Bend sorghum country as bounded by a line from Kingsville to Port Lavaca, inland to Austin, down through San Antonio and Cotulla, and back to Kingsville.

Although the acreage is down a little this year, farmers usually put about a million acres into the grain. That acreage, when disease doesn't strike, can gross an estimated $90 million at current prices.

Reyes said the amount of acreage hit by the mold has not been determined yet, "but farmers are losing money."

A good average figure on sorghum production here is 56 pounds per bushel. But he said that has dropped to 52 to 54 pounds, and farmers have found that their truck weights are 10 to 20 percent lighter.

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Figures on affected acreage should be available sometime next week, when the bulk of the crop will come out of the fields, Reyes said. And there may be some answers to other questions.

"If we can pin-point which new hybrids are causing most of the trouble, then maybe we can take steps to correct the situation in the future," he added.

He said mold-damaged grain is still usable, Small quantities can be blended with normal grain and fed to livestock.

Dr. Richard A. Frederiksen, plant pathologist with the Texas Agricultural Experiment Station, emphasized that the mold is not one that has drifted in from tropical climes. Instead, the fungi lurks in the soil all the time, waiting for the right conditions to strike.

Those favorable conditions occurred this spring, when frequent rains activated more molds than usual. Much of that moisture came as the sorghum was flowering, a time when some varieties apparently are more susceptible.

Frederiksen said grain mold may possibly be the most damaging sorghum disease world-wide, and it can "erode genetic progress" in plant breeding efforts.

He said the mold seems to come in three-year cycles, and that 1968 was a classic year.

Loral Castor, Experiment Station research assistant, said the mold causes reduction in kernel size and grain filling. Sorghum plant heads can look about normal and still have damage. Such damage may not show up until after harvest and the grain is weighed.

He said it is possible for sorghum varieties to have good weathering resistance and still be susceptible to mold fungi.

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"This is because breeders sometimes base their weathering resistance findings on mature head conditions instead of the early flowering stage," the researcher explained.

On the positive side, Castor said there are sorghum lines vastly superior in resistance to these molds, both in early and late infection stages. The lines are on the way, and their mold resistance will eventually show up in new varieties.

The mold and weathering problem is being watched and monitored by a team of Experiment Station scientists. In addition to Frederiksen, Reyes and Castor, other members are Dr. Fred Miller and Dr. Lloyd Rooney of the A&M Soil and Crop Sciences Department, and Dr. Darrell Rosenow, based at the Texas A&M University Agricultural Research and Extension Center at Lubbock.

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NEWSLETTER TO STATION STAFF

THE TEXAS AGRICULTURAL EXPERIMENT STATION / Neville P. Clarke, Director
Texas A&M University System / College Station, Texas

HOST PLANT RESISTANCE TO BE EXPLORED AT A&M CONFERENCE, JULY 22-AUG. 4

The most fundamental approach to resolving insect and plant disease problems--plant resistance--will be explored in a special conference July 22-Aug. 4 at Texas A&M University.

Participants in the Short Course on Host Plant Resistance, sponsored by A&M and the University of California AID Pest Management Project, will hear about 35 lecturers from entomology, plant breeding, plant pathology and related fields.

Dr. Marvin K. Harris, short course chairman, said the short course is significant in light of the large amounts of the world's food and fiber that are ruined each year by insects and plant diseases.

Short course lecturers have been drawn from Texas A&M, the U.S. Department of Agriculture, other universities, international institutes and scientific organizations. Harris said all major agricultural crops will be discussed, and sorghum, corn, cotton and peanuts will be seen in the field near College Station.

Short Course participation is limited to 35 persons, Harris said. Participants so far are entomologists, plant pathologists and plant breeders, and many are coming from Asia, Africa, Central and South America.

Harris said a proceedings of the formal presentations will be published after the short course.

Brief Reports on . . .

Agricultural Research in Texas

THE TEXAS AGRICULTURAL EXPERIMENT STATION

Vol.5, No.7
July 1979

HYDROCYANIC ACID IN SORGHUM LINES

Several factors influence the level of hydrocyanic acid (HCN-p) that may be present in sorghums. Major causes may be genetic; stage of growth; nitrogen fertilization; or stress, especially that due to moisture or frost. Fifteen sorghum lines, including thirteen grain sorghums, one sudangrass and one sweet sorghum, were grown under field conditions for studies on HCN-p potential. They were planted on a Ships clay on land not fertilized the previous year and uniformly cropped with maize. Soil samples indicated levels of N, P_2O_5, and K_2O were less than 34, 114 and 970 lbs/acre respectively, for a depth of 6 inches. Findings of scientists with the Texas Agricultural Experiment Station include: 1) potential levels of HCN-p were increased by adding nitrogen, even in lines or varieties that are inherently low; 2) two entries were consistently low in HCN-p at all harvest dates and only exceeded the "threshold of danger" (200 parts per million) at the preboot stage; 3) as expected, HCN-p tended to decrease with maturity of the plant; 4) but, two of the entries still retained HCN-p in excess of 200ppm, indicating a need to exercise caution with some varieties when allowing cattle to graze stover after grain harvest. Source: George McBee, Fred Miller, College Station, Tel. 713/845-2541.

Agricultural Research in Texas

Vol.5,No.10
October1979

MIDGE-RESISTANT SORGHUM CULTIVARS

Sorghum cultivars from 20 countries were evaluated for resistance to the sorghum midge by scientists with the Texas Agricultural Experiment Station (TAES). The 210 cultivars were obtained from the TAES-USDA sorghum conversion program. Midge damage ratings from three tests grown in two states in 1978 indicate that 10 cultivars are highly resistant (less than 30% seed loss) and 21 cultivars are moderately resistant (30 to 60% seed loss). Highly resistant lines had been collected from Sudan, Ethiopia, Uganda, India and Pakistan. These resistant lines are being improved for agronomic quality. Indications are these materials will serve as sources of resistance for commercial breeders. Source: J. W. Johnson, Lubbock, Tel. 806/746-6101; G. L. Teetes, A. L. Wuensche, College Station, Tel. 713/845-3411.

The Farmer-Stockman, August 1979

NO MATTER what your sorghum yield will be this season, you can beat it. Probably by a considerable margin.

And that doesn't just go for weedy, neglected crop. It also applies to those bin-busting pampered fields that have come from good seed, proper fertilization, weed control and adequate moisture.

That kind of challenge might not have meant so much in the last few years, but with a degree of optimism showing up in grain markets, better yield might be worth thinking about again.

That statement about improvement is not idle talk. Startlingly, Dr. Fred Miller, a sorghum breeder at Texas A&M, estimates that the grain sorghum plant has the potential under ideal conditions to yield up to 35,000 lb. of grain per acre.

The grain sorghum plant has the potential under ideal conditions to yield up to 35,000 lb. of grain per acre.

Mind you, that's under ideal conditions. No one's done it yet. But the potential is there. And you can use some of the planning going into that figure in order to improve your own crop.

In order to do that, Extension agronomist Dr. John E. Bremer advises use of a "total management system," which would include proper hybrid selection, land preparation and cultural practices such as crop rotation, proper fertilization including correct timing and placement of the fertilizer elements, proper planting, insect, disease and weed control.

"Through genetics," he says, "we've been able to come up with better hybrids than most would have ever believed possible. Higher yields, stronger stalks, tropically or wide area adapted hybrids, twin seeded sorghum, disease and insect resistance."

Bremer says with some of the newer adapted sorghum hybrids, planting has become very critical. Especially important is adjusting plant populations to given soil and localized moisture conditions. Improper planting rates cut yields. And even more important, poor, uneven stands invite weed problems and further yield cuts.

"**We know** from experience that crop rotation is very important for two main reasons. The first is to control sorghum diseases. And second, weeds can become problems when a continuous crop of sorghum is grown on a given tract of land year after year."

Bremer also cites research done at the Blackland Research Center at Temple that shows yields can be increased an average of 19 percent by narrowing rows from 40 in. to 30 in.

"We feel that certain tillage practices can be reduced by the judicious use of chemicals," he says. "With continued concern over the fuel shortage and higher fuel prices, minimum tillage techniques are once again being considered by many producers. Fewer trips across a field with heavy equipment can mean the difference between a profit, a break-even situation or even a loss. The plow isn't outdated. There still is a definite place for it, but in many cases perhaps a reliable herbicide application might be used as a more economical substitute."

Improper planting cuts yields. Poor, uneven stands invite weed problems and cut into yields still further.

Tropical Adapted Sorghums

TROPICALLY adapted sorghum hybrids hold lots of promise. If you're not already acquainted with them, here's a definition from Dr. Fred Miller of Texas A&M.

Tropical adaptaion simply refers to a hybrid bred from at least one "tropical" parent line. It refers to the ability of a sorghum hybrid to maintain high yield potential under short day length and high night temperatures.

One way it differs from "normal" temperate hybrids is that temperate hybrids mature faster when moved to southern climates because of their genetic makeup. Shorter day lengths and long, hot nights cause rapid maturity in places like South Texas. Since the temperates mature faster when moved south, they don't set as many leaves, don't fill out heads as well as in northern zones, don't have the stalk quality they might normally have, and don't yield as well. This acceleration of the plant's maturity is the major reason southern sorghum yields have been traditionally lower than northern yields, according to Miller.

In contrast, tropically adapted hybrids grow well in areas where day length is short and nights are long and hot. In fact, he believes tropically adapted hybrids slow down their nighttime respiration rate, expending less photosynthate for plant maintenance and leaving more for grain.

A temperate hybrid might flower in 75 days at Lincoln, Neb., and flower at 50 days at Corpus Christi. On the other hand, a tropically adapted hybrid might flower in 70 days at Lincoln and 75 days at Corpus Christi.

New research indicates tropical hybrids have a lower base metabolic temperature. In laboratory tests at Texas A&M to measure temperature required for germination, tropical hybrids germinated at 44 to 45 degrees while temperate hybrids needed 50 to 51 degrees for germination.

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Agricultural Research in Texas

THE TEXAS AGRICULTURAL EXPERIMENT STATION

Vol.5,No.8
August 1979

WHAT THE SCIENTIST SEES

5-8-5

Larvae of the sorghum midge, *Contarinia sorghicola* (Coquillett), are so small that one or more can complete development within a single sorghum spikelet, where they usually feed upon the developing plant ovary. Despite their small size, such larvae can, when present in large numbers, severely damage developing seeds and greatly reduce yields. Because sorghum midge larvae can cost Texas farmers millions of dollars annually in yield losses or chemical control measures, Texas Agricultural Experiment Station (TAES) scientists are seeking improved management strategies for the control of this pest.

In these new management strategies, plant resistance is expected to be a major component. TAES scientists studying the mechanisms involved in plant resistance believe that a better understanding of how the larvae feed is important. Light microscopes cannot provide the high magnification and fine detail required for study of the minute mouthparts. However, under the direction of Dr. George Teetes, associate professor of entomology, graduate research assistants Ron Petralia and Allen Wuensche have devised ways of using a scanning electron microscope (SEM) to provide magnifications of the larval head as much as 7500 times actual size. By means of SEM micrographs such as the one shown below (left), they have been able to identify and describe individual mouthparts. The results of their study indicate that midge larvae feed on plant fluids rather than by chewing plant tissue, and that extra-intestinal digestion probably aids in the production of sufficient quantities of fluid for larval development. In addition, the SEM micrographs have been used by Dr. Ann Sorensen to prepare the first detailed illustration of a larval sorghum midge head (right, below). (Source: Dr. G. L. Teetes, College Station, Tel. 713/845-3411.)

Plate 6

The electron micrograph, shows the external morphology of the mouthparts of a late larval instar, including: labro-clypeal plate (lp), mandible (m), mandibular ridges (black arrows), mandibular lobe (black and white arrow), maxilla (mx), labium (l), ligula (li), and sitophore (s).

Plate 8

This is a diagramatic frontal view of the larval head and mouthparts, based on many SEM micrographs, X7500 (illustration by A. A. Sorensen).

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Crop Management in the South

Successful Farming in the South 9/79

Minimum tillage gives year-round forage. It may be the way to raise forages on grass sod in the South, say Louisiana State University agronomists Marvin Allen and Lee Mason. They're planting corn and forage sorghum in bermudagrass and bahiagrass sods after first suppressing grass growth with herbicides. Yields from tests have equalled those conventionally planted. They've also gotten good stands of ryegrass and clover the same way.

To suppress the grass for corn and sorghum, one qt/A of Roundup was broadcasted prior to planting. Two qts/A of AAtrex was banded.

To establish clover and ryegrass, researchers applied 1 pt. of Paraquat. The dried up plant residue was then burned before seeding the clover and rye with a minimum-till drill.

Ryegrass established on sod provides grazing from early December through May, when the bahiagrass starts providing forage again. Clover planted in October should be ready by March.

Tropical sorghums jump yields by 20%. And in some south Texas areas grain sorghum yields have doubled from tropically adapted varieties that were first introduced in 1974, explains Texas A&M sorghum breeder Fred Miller.

"In most of the world, sorghum is used as a human food and red color is a prejudice factor," he says. "That's why we're now breeding for white seeded sorghums which can be used for both human and animal consumption.

"By using best management practices and getting reasonable rainfall, some farmers are producing 5,000 lbs/A yields with white seeds, rather than the 3,000 lbs/A red seed average. Eventually, I'd like to see a total phase out of all red hybrids."

In the next few years, Miller expects more disease resistant and higher yielding white sorghums. Experimentally, Texas A&M now consistently produces white variety sorghums yielding 12,000 lbs/A.

Nematodes cut grass yield. *Yields of cool-season perennial forage grasses are severely reduced on light-textured soils when nematodes are present, advise Auburn University agronomists. When chemicals were applied to control the pests, second-year grass yields increased 50-90% during autumn and early winter periods.*

Stubby root, stunt and lance nematodes reduced root weight of tall fescue 60%, orchardgrass 47%. Infested grass fields, the agronomists note, are highly susceptible to autumn drought. Infested stands lack competitive vigor and eventually become infested with weeds and warm-season perennial grasses.

Although the Alabama tests clearly show greater yields are achieved by treating for nematodes, the researchers caution chemical control measures are not practical at this time.

New lodge resistant soybean. If you're experiencing lodging problems with Lee 74 soybeans, hang on, help's on the way.

The Oklahoma experiment station has released "Sohoma," a new variety reputed to be lodge resistant and high yielding based on tests in both Oklahoma and western Arkansas.

Sahoma falls in maturity Group VI, about 2-3 days earlier than Lee 74. It's a bit larger seeded than most of the varieties being grown in the region, tests higher in both protein and oil. Plants are shorter than Lee 74, have average drought tolerance.

Alfalfa benefits from killing frost. Grazing or cutting alfalfa for hay soon after the first freeze-down not only stretches winter feed supplies, but more importantly reduces weevil damage next spring.

"Harvesting after a freeze this fall will destroy some of the weevils going into the winter and reduce the number of places for them to lay eggs," explains University of Kentucky entomologist Chris Christensen.

—By **Charles E. Sommers** and **Greg Lamp,** Crops and Soils Editor

Help us help you. Get the best Successful Farming possible by filling out the red postcard in this issue telling us what kind of farming you're interested in.

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NEWSLETTER TO STATION STAFF

THE TEXAS AGRICULTURAL EXPERIMENT STATION / Neville P. Clarke, Director
Texas A&M University System / College Station, Texas September 1979 No. 9

DR. FRED MILLER INVITED TO STUDY SORGHUMS IN CHINA

Fred Miller, a leader in grain sorghum investigations, is one of seven U.S. scientists serving with an agricultural exchange team in the People's Republic of China for the next five weeks.

Miller, whose research with grain sorghums has received attention internationally, was invited to serve with the U.S. team, whose objective will be to study the acquisition of germplasm of soybeans, sorghum, millet and vegetables.

The U.S. recently entered into an agricultural exchange program with the People's Republic of China. The program involves reciprocal visits by scientists.

"Our team will visit production units where a broad range of germplasm of major crops is under evaluation, including soybeans, sorghums, millets and vegetables. We will be permitted to select materials of interest to the U.S. from PRC selections," Miller explained.

The U.S. team will visit the Academy of Agricultural Sciences and nearby production units near Peking, Kirin, Shanghai, Shenyang and other provinces.

"Our team will discuss the future exchange of germplasm and relate other crop information covered in this first exchange program. Once the team arrives in China, members will be guests of the Republic of China," Miller added.

Miller will be concerned with collection of data and germplasm on sorghums and soybeans.

Also concerned with soybeans will be Dr. W. R. Fehr of Iowa State University, Dr. K. Hinson of the Agricultural Experiment Station at the University of Florida, and Dr. K. R. Bromfield of the Plant Disease Laboratory at Frederick, Md.

Exploring possibilities for vegetable germplasm exchange will be Dr. E. Z. Wann, director of the U.S. Vegetable Breeding Laboratory at Charleston, S.C., and Dr. John Bouwkamp, of the University of Maryland. Dr. W. W. Hanna of the Coastal Plains Experiment Station at Tifton, Ga., will be concerned with collecting germplasm of millet.

Miller met other team members in Washington, D.C., Aug. 13 and attended a briefing session conducted by the U.S. Department of Agriculture. The team then left for Tokyo and continued on to Peking.

Miller returned to College Station, Sept. 17.

Dr. Fred Miller

Researcher Miller Invited To Study Sorghums in China

A Texas Agricultural Experiment Station leader in grain sorghum investigations is one of seven U.S. scientists serving with an agricultural exchange team in the People's Republic of China for the next five weeks.

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Miller is scheduled to arrive back in College Station, Sept. 17.

FARM JOURNAL - Mid February 1979

Will sorghum feed and power the future? Despite many mixed reports on the economics of producing fuel from grains, Frederick R. Miller, Texas A&M geneticist (photo), thinks the answer may lie in changes that can be bred into the plant. The variety shown yielded 6,000 to 7,000 lb. of grain per acre and 37 tons of stover, he says. That stover yield would produce about 275 gal. of methanol for use as alternative fuels. "The sorghums under development now could allow an entire plant to supply energy for man, animals and mechanical vehicles," he says.

Photo: Texas A&M

MID-FEBRUARY 1979

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Dr. Jerry Johnson and Dr. Darrell Rosenow show new midge-resistant sorghum hybrids at Lubbock Texas Agriculture Experiment Station.

Midge Resistants Are Closer

One of the most significant advances for Texas grain sorghum producers this year is the release of midge resistant lines of sorghum. The sorghum midge has been one of the most devastating insects throughout the state for many years.

Dr. Jerry Johnson, Professor and plant breeder for the Texas Agricultural Experiment Station, located at Lubbock, Texas, has been a leader in midge resistant research. Dr. Johnson and other sorghum researchers have been working on this project for about 6 years.

Dr. Johnson stated that they have been able to transfer the midge resistance from the original lines to agronomically improved lines which are not brown (high tannin) varieties and are better suited to Texas conditions. The lines that have been released to seed companies for inclusion into commercial hybrids have been named TX2754 - TX2781.

Dr. Johnson points out that these varieties are not "totally resistant to the midge." If the midge population is large enough, there will be damage. So, more work is needed in this area, before enough information is available to use them adequately in a pest management program.

"When we have a light midge population adequate to destroy the normal susceptible varieties," said Johnson, "we get about 60-70% seed set on the resistant types. But if the population gets extremely high, approaching 150 or more per head, the resistant lines are destroyed the same as susceptible lines, so we still have spraying threshold numbers to work out, and we still have to look at these lines in combination with insecticides." Johnson said midge populations ran as high as 400 per head in South Texas this year.

Johnson is also involved in the continuing research involving problems of head smut and tolerance to Maize Dwarf Mosaic Diseases. He stated, "We have some promising lines coming along in this area as well." Dr. Darrell Rosenow, also of the Lubbock Station, is also directing much attention to research in sorghum diseases.

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THE FURROW
November/December 1979

BROADER ROLE FOR SORGHUM?

Researchers say there's potential for developing grain sorghum as a food crop

Sorghum, sorghum everywhere, but not a grain to eat—at least not for people in this country. It's no secret that among the major grain crops raised in the United States, none is used more exclusively for feed than grain sorghum is. Less than 1 percent finds its way into any type of product used for human consumption.

That doesn't necessarily have to be the case, however. Food scientists at several universities are using grain sorghum to make all sorts of tasty goodies, including bread, cookies, tortillas, noodles, a puffed cereal-like product, and a cheese-flavored snack that looks and tastes much like several made from corn that are now on the market.

Lloyd Rooney, a cereal chemist at Texas A & M University who's been working on sorghum quality for the past 12 years, says there's no question that sorghum is mainly a feed grain in the U.S., and will be for a long time to come. But he doesn't discount the possibility that some day it may become a food grain as well.

Used elsewhere. In many tropical areas—particularly in Asia and Africa—grain sorghum is a basic dietary staple for much of the population. In India, it's made into chapattis and rottis, which are similar to Mexican tortillas. Enjara and kissera, the basic breads of Ethiopia and the Sudan, are made from fermented grain sorghum flour.

Several African countries produce sorghum beer, which reportedly is less bitter than American brews but has a higher alcohol content. Other products made from sorghum include a cola-like soft drink, porridge, soups, baked goods prepared from a combination of sorghum and wheat flours, and even cosmetics.

Rooney says the red-and brown-seeded sorghums U.S. farmers grow aren't very satisfactory for these products. "Most of the sorghums raised overseas have nice white kernels, a bland flavor and better milling properties than the types we raise here," he explains.

New color. For a number of years, geneticist Fred Miller and others at Texas A & M have been working with some of the white-seeded types. Miller says most of the sorghums coming out of the Texas research program now are white-seeded. All have been analyzed for food grain quality and many have been selected in part for their human-food potential.

Miller is also working on some vegetable-type sorghums with sweet seeds that are harvested green and used much like garden peas. The grains are eaten in some parts of India and Africa, and Rooney says that when he took some to a Texas A & M faculty potluck, "people were coming back for seconds and asking what it was."

In addition to sorghums for food uses, the Texas scientists are developing types with more sugar in the stem. These, Miller says, could have real potential as raw material for fuel alcohol. "In Brazil," he explains, "some sweet sorghums have been found that yield more fuel per acre than sugarcane."

Another angle Miller is looking into is whether both grain yield and plant mass can be increased simultaneously in sorghum, or if one must be sacrificed to increase

Cereal chemist Lloyd Rooney displays food products made with grain sorghum, including a package of cereal sold in South Africa.

Mir Khan, a research scientist at Texas A & M University, checks loaves of bread made from a mixture of grain sorghum and wheat flours.

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THE FURROW
November/December 1979

Geneticist Fred Miller is developing sorghums that produce white, bland-flavored seed suitable for use in a variety of foods.

the other. He hopes eventually to develop selections that will produce large amounts of both grain and stover.

Scientists at other institutions are also looking at sorghum as a food crop. At Purdue University, for example, geneticist John Axtell is developing high-lysine varieties with twice the protein value of normal sorghums.

The federal government is getting into the act, too, by funding a major sorghum technology project to be conducted by researchers at eight universities.

Carl Hoseney, a cereal chemist at Kansas State University, explains that the main goals of the project are, first, to develop standards breeders can use to tailor new sorghums to specific food requirements and, second, to improve the primitive sorghum-processing methods now used in most developing nations.

Export potential. The sorghum technology project is primarily intended to help people in less developed countries get more out of the crop, but Hoseney says the work could benefit U.S. farmers as well. "I think sorghum has good export potential," he explains, "but in order to develop it, we'll have to pay much closer attention to what potential customers need."

Geneticist Fred Miller agrees. "Any sorghum that will work well in food products will also make a good feed grain, so there's really no reason not to develop and use food types," Miller says. "With sorghum being well established as a food grain in so much of the world, we should be able to export a great deal of it if suitable varieties are available and if American farmers will grow them."

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SOUTHWEST FARM PRESS

December 1979

Crops To Fuel New Enthusiasm Needs Caution

By Calvin Pigg, Editor

FORTH WORTH, Texas—Mushrooming enthusiasm over prospects for turning agricultural commodities into fuel energy can only be "cautiously justified" now.

Any major-scale conversion of biomass into alcohol fuels must come as part of a larger integrated feed, food, fiber and fuel complex to be anywhere near economically worthwhile—at least for now, speakers appearing before Texas seedsmen generally agreed here recently.

Gasohol will play only a "trivial" role in solving the nation's energy dilemma, the 200 gathered members of the Texas Seed Trade Association were told.

However, among southwestern-grown crops, corn, sorghum and sugarcane are leading candidates for fuel alcohol making.

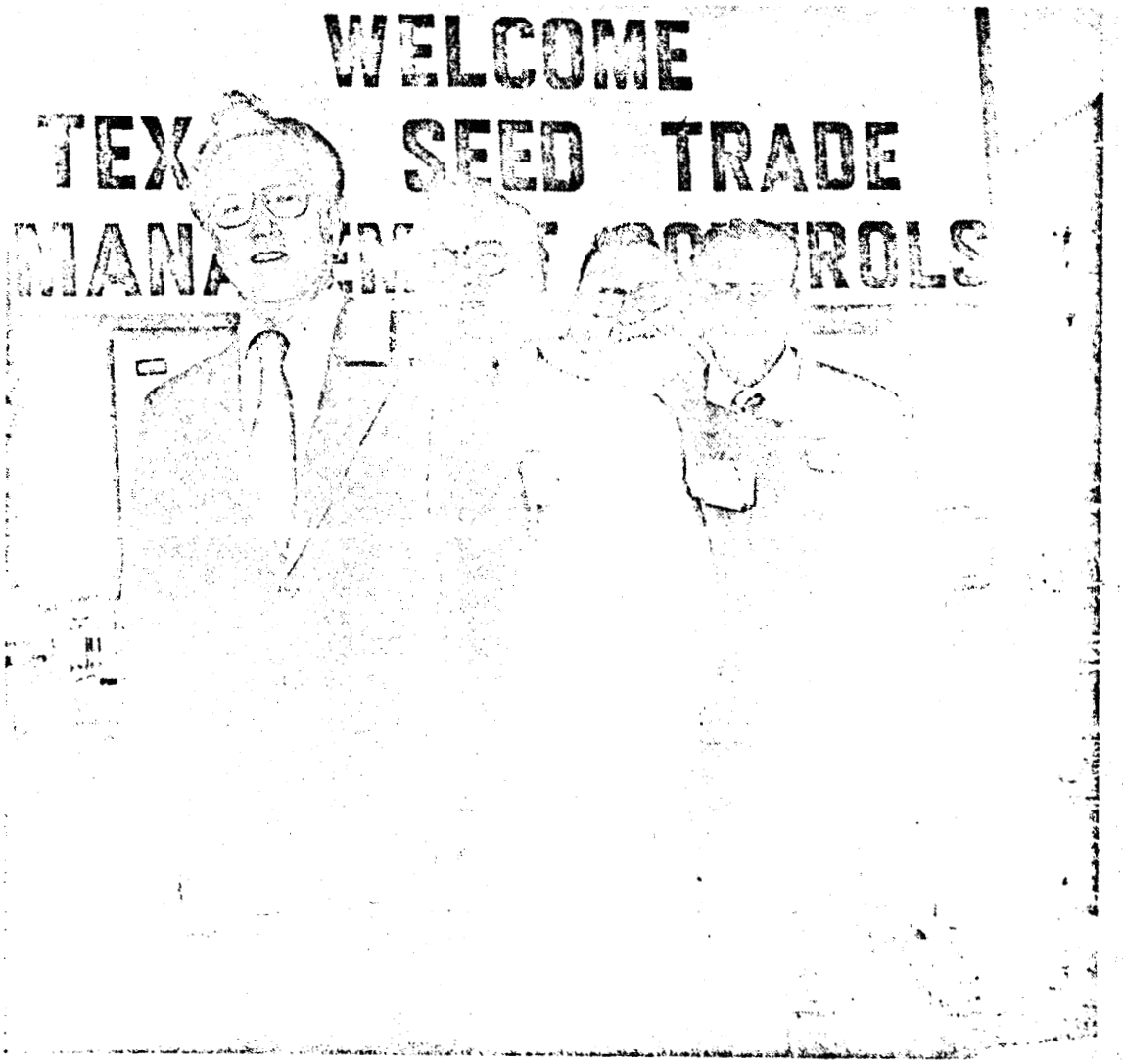
Dual-Purpose?

Noting fever-pitched farmer interest in an obvious "energy from farm crops" drive, state seedsmen considered at their 1979 Hilton Inn meeting here whether their plant breeders should go to work "reconstructing" certain crops for dual-purpose roles.

Theme of the meeting was "Different Approaches to Alcohol Production in Texas."

Featuring top-flight experts in the energy field, the session focused on just how fragile the fuels from agriculture question actually is today.

In organization business matters, a South Texan, C.H. Warnken Jr., was named TSTA president. Warnken is with Wilco Seed Company of Pleasanton, a peanut seed producing firm. He succeeds Armon Lauderback of Hereford in the post.



NEWLY ELECTED OFFICERS OF the Texas Seed Trade Association are C.H. Warnken Jr. of Pleasanton, president, left, Gerald Proctor of Stamford, first vice president, and Wayne Richardson of Vega, renamed second vice president. TSTA executive vice president Othel Neely of Waco is at right, rear. Seedsmen devoted Fort Worth session to whether breeders should forge ahead with development of fuel crops -- and they got several different answers.

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Breeder Says Crops Easily Altered

Forages Important

"We also feel that in the very near future, forages for fuel-making are going to become more important," said Kresovich, noting new processing and conversion techniques.

He detailed two newly developed, cost-cutting conversion processes, one called the MIT process, devised at Massachusetts Institute of Technology and another popularly called the Chem System, developed by a private firm.

He said whereas older methods of making ethanol once required 150,000 Btus to produce, the figure with the newer procedures is no greater than 20,000 Btus.

"In the next year or so, I believe they'll have it down to only 5,000 Btus of energy–so we're not talking negative energy balance anymore," said Kresovich. Ethanol has an equivalent 80,000 Btus.

In a later interview, Kresovich told SOUTHWEST FARM PRESS that some of the current enthusiasm among land operators over the fuels potential, including investments a few are making, is only "cautiously justified."

"There is a large amount of potential in biomass energy in Texas. However, people must take caution in all the various aspects, not the least is safety on on-farm distillation of alcohol and the legal ramifications."

He said any successful alcohol system will need to consider use of all fermentation by-products for the fuels scheme to be profitable.

"Don't go overboard," he suggested.

"Energy systems for agriculture are multidisciplinary, you have to know about commodity production, chemical engineering and a good bit about economics."

Another speaker was Texas A&M sorghum breeder, Dr. Fred R. Miller of College Station.

Easily Altered

Dr. Miller said commercial grain sorghums can be altered fairly easily for an additional role as an energy crop. He envisioned a grain sorghum plant five to six feet tall giving high grain yields and having a large stem area providing increased sweetness (sugars) for conversion into fuels.

"Many new methods are available to plant breeders to genetically engineer specific types of plants," he said. He said a similar type of genetic rebuilding applies to corn, sugarcane, wheat, peanuts, soybeans, sunflowers and other high carbohydrate crops as well as to sorghum.

The plant breeder said sorghum might be reconstructed for fuel purposes easier than other commercial farm crops. "The main reason such reconstruction is possible, we believe, in sorghum," said Dr. Miller, "is that we know so much about sorghum through our work with the world collection of sorghums, where specific traits have been singled out and drawn into present day hybrids."

He said now with the fuel possibility, crops such as sorghum, could be altered to serve as multi-purpose crops such as for feed, food and for fuel.

He said building materials can be manufactured from cellulose fibers left from the sorghum plant.

Maximize Grain

"We need the grain to produce both food and feed from sorghums–we cannot change that part of our reconstructed plant," Dr. Miller told the seedsmen. "In fact, if we could produce more grain that would be to our advantage. Any excess grain over market needs for feed or food could go to produce alcohol."

He said the different need is for added sugar, or the amount of total fermentables, in the stem of plants as a source of energy for alcohol and as sugar for food.

The breeder's final prediction:

"We will see much more awareness of total plant utilization from our major agricultural crops as we move into this era of harvesting both food and fuel from our fields. This will bring the need to develop new plants with multiple uses rather than just sorghum or corn for grain." He called it a system of "more total utilization of green plant materials."

The Texas A&M expert said he is active in one research project to devise a high energy system with sorghum.

"From all we know about economics of farm fuel production today," concluded Dr. Miller, "producers are well advised to leave fuel making alone unless they can use all the by-products. He said dried distillers grain, a left-over from fermentation, is commonly utilized in cattle feedlots and on dairy farms in some areas.

A commercial seedsman, Jim Lindsey of Plainview, president of Pioneer Hi-Bred International, Incorporated and president, Southern Seedsmen's Association, was next speaker on the program. He spoke on "The Seed Industry Challenge" to fuel crops development.

He challenged his fellow seed merchants to stay alert to all fuel crop possibilities, as a "new economics of energy" emerges.

Suspects Doubts

"I suspect that many people in this room harbor some doubts about the likelihood of farm crops becoming a serious source of energy–or that the production of fuel will be a serious market for farm crops," said Lindsey.

The seed official pointed out that the economy of the U.S. is based on energy and the cost of that energy will increase. "In other words," said Lindsey, "there'll be a new economics of energy. And, it's not just a matter of rewriting the old rules. The whole rule book has to be thrown out and a new one is to be written.

"If we feel we're sticking our neck out in getting serious about gasohol," continued the speaker, "think of the guy who puts his money on the status quo today–he won't make it."

Lindsey told his fellow seed industrymen that the "portability" fo gasohol, the 9-to-1 blend of gasoline and ethanol (alcohol), is a key part of the alternate fuels question.

Gasohol Advantage

"None of the other alternate energy sources can be moved around so easily–not nuclear, not solar, not really coal," stressed Lindsey. "Gasohol is the one easily available fuel for extending our fast-dwindling supply of motor fuels."

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He said it will be exciting to see what the seed industry can contribute "to this exciting chapter in man's experience."

The three-day conference concluded with luncheon remarks by David E. Gushee, chief of environmental and natural resources policy for the Library of Congress in Washington, D.C.

In his assignment, Gushee provides congressional members with data on the nation's energy matters. He was less enthusiastic about gasohol serving the national interest. He said Congress has been reluctant to do much in "uneconomic energy areas" such as gasohol represents currently.

Congress Moving

Gushee's tact was that the U.S. Congress appears not to be moving forward on energy policy development but that actually it is. "Congress recognizes that many specific legislative actions on energy can be highly counter productive to our citizens.

He told the luncheon audience that gasohol "in the national policy scene is actually a trivial matter."

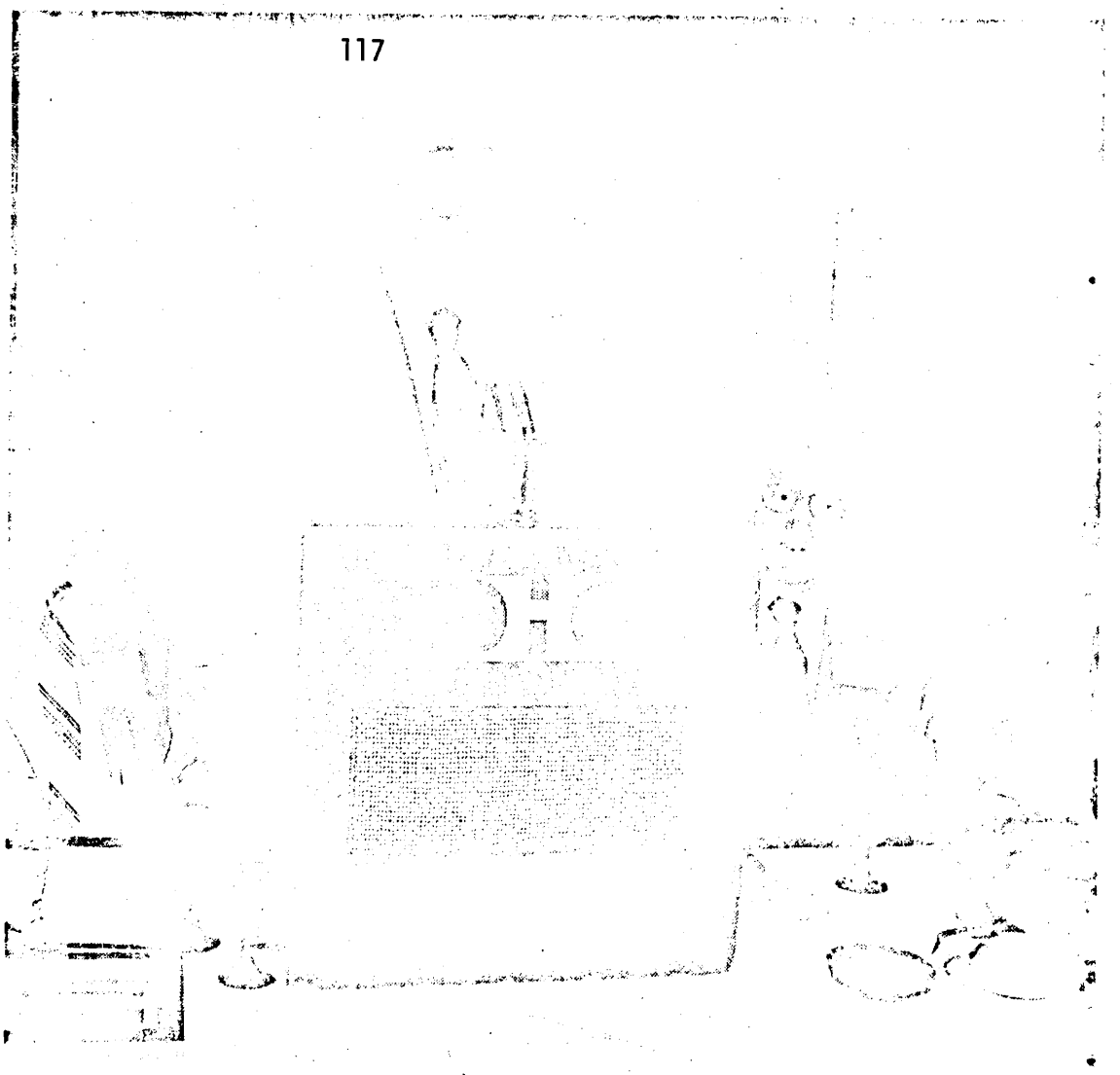
"It is a trivial matter," he explained, "because as things stand today you must write off four cents a gallon in national highway tax funds in order for gasohol to compete in the open market place." He said for gasohol to be viable, it has to be subsidized by either direct or indirect means through the tax system.

"In the final analysis," said Gushee, "gasohol is more expensive the gasoline."

Cites Examples

He said Iowa and Nebraska are in trouble with their state highway maintenance programs due to diminishing funds for repair. Gasohol with a four-cent a gallon state tax exemption, he said, has penetrated 10 percent of the total motor fuels market in those states.

"As we view it," continued the Library of Congress official, "there is an opportunity for gasohol if you do it yourself, and consider it as a secondary enterprise to a farming operation." He said economics do not permit an operator to fully charge his land and labor costs to fuel energy production.



LIBRARY OF CONGRESS energy specialist David Gushee tells seedsmen gasohol is a trivial part of national energy question and that gasoline is still cheaper than the alternative fuel.

"You cannot afford the cost of harvesting and stockpiling biomass materials for its energy purposes alone today," added Gushee. He said Congress is considering $700 million in incentives to promote gasohol production but that the bill as originally proposed will be altered considerably.

Concluding, Gushee suggested that for gasohol to be feasible as a general motor fuel, prices for fuels must rise considerably or federal policy must be changed to subsidized gasohol and then to spread the increased costs to citizens through the taxing system.

During the TSTA business meeting, in addition to new officers chosen, three additional directors were designated to serve the organization. They are Delbert Hess of Plainview, Curtis Tally of Justin and Roy Holland of Loraine, Texas.

With headquarters in Waco, the TSTA's executive secretary is Othel M. Neely.

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"We will see much more awareness of total plant utilization from our major agricultural crops as we move into this era of harvesting both food and fuel from our fields."

Other newly elected officials include Gerald Proctor, Bronco Seed Company, Stamford, first vice president, and Wayne Richardson of Vega who was rechosen second vice president. He heads up Richardson Seeds, Incorporated.

"You have here in Texas systems that can produce both food and energy on the same land and at the same time," one speaker, Steven Kresovich of the Battelle Columbus (Ohio) Laboratories, told the gathering.

No Trade-Off

"There is no trade-off. We can get food and we can get energy from the same land," said Kresovich, who is agricultural coordinator for biomass production systems for the 1929-founded non-profit research organization, active in biomass energy development for the past five years.

Kresovich explained as an example that with either corn or sorghum grain, the carbohydrate to make the alcohol can be removed while protein for food is left intact in the kernel of grain.

"In the short term, ethanol (anhydrous ethanol) produced from starches and sugars through fermentation," continued Kresovich, "is the easiest and most cost-effective way to go. This could be done under a number of different skill levels," said the Battelle specialist. "Alcohol from biomass can be produced with farm skills, with co-operative skills or on a multi-million dollar r finery basis."

Kresovich said that with new methods it appears the conversion to alcohol can eventually be cost-effective at all three levels. He said, however, on-farm alcohol making via a modernized still device is highly confining to the operator.

Carbon Materials

In the long-run, methanol (alcohol) will be produced commercially from all carbon containing materials, he said.

"Just give me total biomass at the cheapest possible cost and the chemical engineers will do the rest," said Kresovich, adding: "Farmers can be fuel self-sufficient themselves but the technology and marketing will determine the overall feasibility of going public with massive fuel alcohol production."

Suggesting the U.S. needs "perspective" into its energy situation, Kresovich said Texas farmers consume an equivalent 210,000 barrels of crude oil in their operation daily.

He said agriculture's energy requirement is expected to increase at a rate of 9 percent a year until 1985 and increase by 17.4 percent annual gain by the year 2000.

Fuels Not Same

As to the alternate fuels possibility, the Battelle energy coordinator reminded the seedsmen that methanol and ethanol are not the same, in terms of energy equivalents. Methanol has only one-half the Btu equivalents of gasoline. Ethanol, used in gasohol, contains two-thirds as much working energy as gasoline.

He said the U.S. Department of Energy has projections calling for methanol to be produced commercially by the year 2000 for 50 to 60 cents a gallon and ethanol for $1 a gallon. "But we can't wait that long."

He said the only plant producing ethanol today with corn as a fermentation feedstock, located in Decatur, Illinois, is producing anhydrous ethanol for $1.28 to $1.58 per gallon today.

The sugar in biomass materials, such as in sugarcane, is fermented to make the alcohol.

Leading Crops

"When energy production through biomass in Texas is spoken of," explained Kresovich, "the three leading candidates are corn, sugarcane and sorghum, specifically sweet sorghum." He said Battelle has conducted research on the latter two.

Much information has been brought out about "energy balance", whether you draw more net energy from the conversion than you put into the manufacturing process, Kresovech continued.

"A lot of critics say it takes more energy than you get out of the final product and that's true if you use information from 1954," he added.

"We have at hand today breakthroughs in technology that will give us a more positive energy balance." He said that as examples, with latest know-how, corn converted into alcohol fuel can give a 1.05-times net energy gain, a 2.43-times gain is possible through sugarcane and a two-times energy balance is found when sweet sorghum is converted.

Noting other considerations, he reminded his audience that "net energy balance" doesn't have anything to do with the cost of making the conversion from raw material into any final fuel product.

Kresovich said with the latest conversion methods it is now possible to convert sweet sorghum or sorghum grain into alcohols for a "positive energy balance" at around $1.10 to $1.15 a gallon, "and hopefully this will come down some more."

He said one advantage in the fermentation of corn or sorghum is that a protein-rich by-product has potential for either human food or as livestock feeds is readily available.

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