Acremonium Wilt of Sorghum

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ABSTRACT

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Acremonium wilt, a new disease of sorghum (*Sorghum bicolor*) in the United States, is different from other diseases in sorghum. It is distinguished by the development of large patches of dead tissue along one axis of a leaf on either side of the midvein. As the disease progresses, whole leaves die and disease symptoms appear as the pathogen spreads into the younger leaves. The disease often results in discoloration of vascular tissue in leaves and stalks. *Acremonium strictum* was isolated consistently from stalks, leaf sheaths, and leaves of diseased plants. Several sorghum entries were resistant to the pathogen following natural infection or foliar clipping in the field. However, drenching around injured roots with inoculum and injecting a conidial suspension at the base of the plant increased their susceptibility. Grain production was reduced by 50% in affected plants.

During 1979, several mature plants of the sorghum hybrid BTx623 (*Sorghum bicolor* (L.) Moench) were observed to have a general wilted appearance at the Asgrow Sorghum Research Station near Plainview, TX. Later, wilted sorghum was observed at Lubbock and Chillicothe. Specimens collected from Celaya, Mexico, were subsequently positively identified to have the same disease. In 1980, plants at College Station, TX, and Griffin, GA, were observed with similar wilt symptoms.

Acremonium wilt is new and different from other disease problems in sorghum. The organism *Acremonium strictum* W. Gams causes vascular wilt of Shasta daisy (*Chrysanthemum maximum* Ram.) and affects a wide variety of monocotyledonous and dicotyledonous agricultural plants as well as some species of weeds (1). This fungus is believed to be similar if not identical to the pathogen described here as an organism causing wilt of sorghum in Egypt (2).

A naturally infected plant is first distinguished by foliar desiccation and discoloration of the midrib and leaf veins (Fig. 1). Initially, only a portion of a leaf is affected. Often large patches of dead tissue develop along one axis of a leaf on either side of the midrib. As the disease progresses, whole leaves die and disease symptoms appear in younger leaves as the pathogen spreads. Eventually the apical portion of the plant dies. In south Texas the basal crown tends to survive, permitting regrowth from lower nodes.

Cross sections of diseased stalks show discoloration of vascular bundles, particularly the xylem vessels (Fig. 2). Under the light microscope, these vessels were yellow or brown and appeared to be plugged.

This research was initiated to identify and demonstrate the pathogenicity of the causal agent, to test the reaction of some sorghum cultivars against *A. strictum*, and to determine the effect of the disease on yield of sorghum.

MATERIALS AND METHODS

Isolation of the causal agent. Tissue was selected from field-grown sorghum plants with symptoms that included wilting, vascular browning, and purple striping of midrib and leaf veins. Stalk, leaf sheath, and leaf pieces were washed in tap water, surface disinfected in 10.0% commercial bleach for 1–2 min, rinsed in sterile distilled water, and placed in plates containing potato-dextrose agar plus streptomycin at 200 ppm (PDAS). Plates were incubated at 28–30 C and examined periodically for growth of the organism.

Pure cultures were obtained by streaking a diluted conidial suspension on plated PDAS. Growth from isolated fungal colonies was transferred to fresh PDAS. A fungal disk was inoculated to potato-dextrose broth and incubated on a rotary shaker (150 rpm). This conidial suspension was used to test the pathogenicity of isolates obtained from plants with wilt.

Pathogenicity tests. Several methods of inoculation were used to test the pathogenicity of isolates obtained from wilted plants. The conidial suspension was adjusted to ca. 5×10^3 conidia per milliliter. Methods of inoculation included hypodermic injection of conidial suspension above the first node and at the base of the panicle; foliar spraying with or without an abrasive; introducing the inoculum between the leaf sheath and the stalk using a conidial suspension or an agar block; clipping leaves with a pair of scissors dipped in a conidial suspension, and drenching the soil around plants having injured roots. Root injury was done by inserting a spatula into the

Fig. 1. Foliar desiccation of wilted sorghum plant, with purple striping of leaf veins evident on dead leaf tissues.

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potting soil of sorghum plants, cutting aerial roots in the process. Plants injected at the base with sterile distilled water and untreated plants served as controls.

Reaction of selected sorghum lines to *A. strictum*. In 1980, 30 selected entries were inoculated in the greenhouse by drenching the soil around injured roots with conidial suspension. Similar entries were evaluated in the field following natural infection. In 1981, additional entries were evaluated in the field. The first set of plants in each plot was inoculated by clipping basal leaves with a scalpel freshly dipped in a conidial suspension. The second set was inoculated by clipping whorl leaves 4–5 in. from the tip with a pair of scissors also dipped in the inoculum. Plants were inoculated in the booting stage. The entries tested in 1981 were rated on a 1–5 scale where 1 = no wilt symptoms; 2 = some vascular discoloration, limited spread, and no leaf necrosis; 3 = vascular discoloration with large areas of necrotic leaf tissue; 4 = general leaf and leaf sheath wilting, spreading to several leaves; and 5 = very susceptible or total wilt. The number of inoculated plants with wilt was also recorded. An average of three to four plants per entry per replicate was inoculated and compared with the uninoculated control plants. Infection was verified by isolating the pathogen from diseased plants.

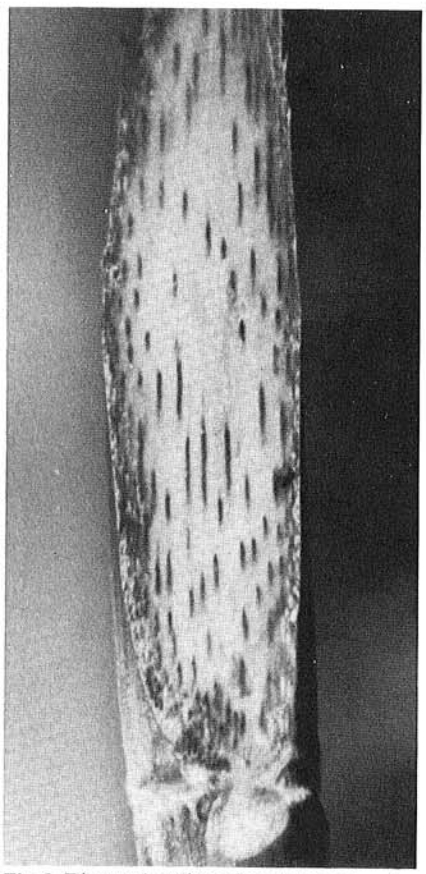

Fig. 2. Diagonal section of a sorghum showing vascular discoloration caused by invasion by *Acremonium strictum*.

Effect of *A. strictum* on yield of sorghum. The effect of *A. strictum* on yield of sorghum was determined by paired comparisons—ie, the yield of a healthy plant was compared with that of an adjacent wilted plant. Comparisons of the yields of 41 pairs were made from the grain sorghum hybrid ATx623 × 77CS1. Statistical differences were determined by the use of the *t* test.

RESULTS AND DISCUSSION

Isolation. Isolations made from wilted sorghum with red or purple striping on leaves, leaf sheaths, and stalks consistently yielded a fungus with growth characterized by the production of conidia in a slime drop, intertwining mycelia, and conidiophores occurring perpendicular to the mycelium bearing them. Mycelium was observed under the dissecting scope 24 hr after isolation, and conidia were produced in ca. 36–48 hr. Mycelial growth on PDAS ranged from cottony white to light orange. This fungus was identified as *A. strictum* by Walter Gams, Centraalbureau voon Shimmelcultures, Baarn, The Netherlands.

Pathogenicity tests. Plants inoculated with a hypodermic injection of conidia above the first node and those drenched around injured roots with inoculum resulted in rapid wilting. Disease developed very slowly following inoculation by foliar spraying with or without an abrasive. Introducing the inoculum between the leaf sheath and the stalk using a conidial suspension or an agar block resulted in a minor amount of leaf striping, even though the stalk and the leaf sheath adjacent to the inoculation point became discolored. Conidial injection at the base of the panicle resulted in pronounced red striping on leaves and leaf sheath and browning of the panicle. In time, this treatment resulted in breaking of the panicle at the point of inoculation. Infection occurred in most of the plants inoculated by foliar clipping, but it developed slowly. Plants injected with sterile distilled water had healthy leaf sheaths, but the leaf midrib occasionally exhibited purpling. *A. strictum* was recovered from discolored diseased tissues of inoculated plants. Other fungi, predominantly *Fusarium* spp., were also isolated from diseased tissues. No pathogenic fungus was isolated from the control plants.

Reaction of some sorghum lines to *Acremonium strictum*. Generally, wilt occurred when the soil around injured roots was drenched with the conidial suspension. Twenty-seven of the 30

Table 1. Reaction of selected sorghum lines to *Acremonium strictum* after root inoculation in the greenhouse and natural inoculation in test trials at College Station, TX, 1980

Entry designation	Variety, kind, group, or pedigree	Wilted plants (%)	
		Greenhouse	Field
SC748-5	Cau-Guin	80[a]	41
SC170-6-17	Zerazera	100[b]	4
QL3 (Texas)	C. Kaf. deriv.	100[b]	5
9L2818 (GP7430)	Tx430(Tx2746 × Tx430)	40[a]	2
CS3541	CSV-4	100	38
BTx623	(B3197 × SC170-6)	100	20
SC599-6 (9247)	Rio deriv.	60[a]	0
QL3 (India)	C. Kaf. deriv.	80[a]	2
BTx398	Martin	100[b]	4
Tx2775	TAM2566(B3197 × 170-6)20-8	100	11
SC110-14	Zerazera	100[a]	4
R3338	SC110 × SC748 deriv.	100	4
Tx7078	Combine 7078	80	21
SC35-6	Durra	75	2
SC599-11E	Cau-Nig (Rio deriv.)	0	0
SC103-12	Caudatum	40[a]	0
SC630-11E	Caffr.	0	0
1790 E	SC56 × SC33 deriv.	100[b]	12
SC414-12	Cau-Kaf.	100[b]	18
Tx430	(Tx2536 × SC170-6) deriv.	75[a]	0
SC326-6	Nigricans	40	11
BTx378	Redlan	100	5
TAM428	Zerazera	50[a]	0
MR (4613)	Tx2566 deriv.	40[a]	4
Tx2536	Y. E. Feterita deriv.	33	3
R5388	(SC599-6 × SC110-9)-24	80[a]	4
R1750	Tx3197 × SC170 deriv.	100[a]	61
SC173-12	Zerazera	100[a]	16
77CS1	(IS2935 × IS3922)	100	0
GPR-148	CSV-5	0	5

[a] Abnormal tillering caused by *Acremonium strictum*.
[b] Tillers infected.

Table 2. Reaction of selected sorghum lines to *Acremonium strictum* inoculated by foliar clipping in the field at College Station, TX, 1981

Entry designation	Variety, kind, group, or pedigree	Wilted plants (%)	Disease rating[a]
SC103-12	Caudatum	0.0	1.0
SC748-5	Cau-Guin	71.4	2.8
SC599-6 (9247)	Cau-Nig (Rio deriv.)	0.0	1.0
SC599-11E	Cau-Nig (Rio deriv.)	0.0	1.0
SC414-12	Cau-Kaf.	42.9	2.0
SC170-6-17	Zerazera	100.0	3.4
SC170-6(77Cs2)	Zerazera	100.0	3.6
TAM428	Zerazera	0.0	1.0
SC325-12	Nigricans	0.0	1.0
SC326-6	Nigricans	0.0	1.0
SC630-11E	Caffr.	0.0	1.0
IS9530	Caffr.	0.0	1.0
77CS1	(IS2935 × IS3922)	0.0	1.0
Tx2536	Y. E. Feterita deriv.	0.0	1.0
Tx430	(Tx2536 × SC170-6) deriv.	100.0	2.7
9L-2818	Tx430 (Tx2746 × Tx430)	0.0	1.0
9L-28/22	Tx2746 × Tx430	57.1	2.9
9L-26/14	Tx2746 × Tx430	57.1	2.3
SC35-6	Durra	0.0	1.0
QL3 (India)	C. Kaf. deriv.	0.0	1.0
GPR-148	CSV-5	0.0	1.0
8BH6956	(SC326-6 × SC103-12)F_8	0.0	1.0
BTx623	(B3197 × SC170-6)	100.0	3.4
BRx625	(B3197 × SC170-6)	100.0	3.9
Tx2775	TAM2566(B3197 × 170-6)20-8	0.0	1.0
MR4 (4606)	TAM2566(B3197 × 170-6)7-2-1	100.0	3.8
Tx2737	TAM2554	60.0	2.8
R5388	(SC599-6 × SC110-9)-24	66.6	2.7
BRx378	Redlan	0.0	1.0
Tx7078	Combine 7078	0.0	1.0

[a] Based on 1–5 scale, where 1 = no wilt; 2 = some vascular discoloration, limited spread, and no leaf necrosis; 3 = vascular discoloration with large areas of necrotic leaf tissue; 4 = general leaf and leaf sheath wilting, spreading to several leaves; and 5 = very susceptible, or total wilt.

selected entries tested in 1980 in the greenhouse were susceptible to *A. strictum*, often wilting (Table 1). Three entries—SC599-11E, SC630-11E, and GPR-148—were resistant to the pathogen. Tillering was at first thought to be a mechanism of overcoming the disease. However, tillers of 1790E, SC414-12, BTx398, and Tx430 later became infected, further indicating the systemic nature of the pathogen. Control plants remained healthy.

Drenching around injured roots with inoculum seemed to bypass or overcome field resistance. Injury increased the susceptibility to the disease as indicated by the results obtained from naturally infected plants in the field at College Station in 1980.

In 1981, more sorghum entries were tested. Foliar clipping of either basal or whorl leaves gave similar results. Several entries were found to be resistant to *A. strictum* after foliar clipping (Table 2). This test confirmed the reaction of some sorghum lines evaluated in the field in 1980. Entries like SC748-5, SC170-6-17, BTx623, BTx625, Tx2737, and MR4 (4606) were very susceptible to the pathogen. Tillers of some wilted plants were again observed to be systemically infected.

Effect of *A. strictum* on yield of sorghum. *A. strictum* caused a highly significant reduction of yield of sorghum hybrid ATx623 × 77CS1. The average yield of healthy plants was 71.7 g per plant, whereas that of wilted plants was only 30.9 g per plant, a reduction of more than 50%. Some severely wilted plants yielded less than 10 g. We believe that these data are reliable because the paired plants came from a carefully designed, hybrid grain sorghum yield trial. Tillering, plant density, and other agronomic factors were carefully controlled.

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