

Stalk Rot of Corn Caused by *Helminthosporium rostratum*

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ABSTRACT

Helminthosporium rostratum was frequently isolated from naturally infected, rotted corn stalks at several locations in Florida during the summer of 1971. Inoculations with two isolates on corn in the greenhouse and in the field resulted in rotted stalks. Culture reisolation from stalks inoculated in the greenhouse resulted in 100% recovery of *H. rostratum*; whereas,

culture reisolation from stalks inoculated in the field resulted in low frequencies of *H. rostratum* recovered and high isolation frequencies of *Fusarium* sp. and *Aspergillus niger*. Margins of rotted tissue yielded fewer cultures of *H. rostratum* and *Fusarium* sp. than did the centers of rotted tissue.

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Stalk rot of corn (*Zea mays* L.) is caused by many organisms, such as *Fusarium* spp., *Diplodia zaeae*, and bacteria (1). In Florida, during 1970, widespread stalk breakage was associated with field corn severely infected with southern corn leaf blight (*Helminthosporium maydis*). Sometimes, stalk breakage appeared to be the result of weakened, nonrotted, stalks (allegedly due to the reduction of photosynthetic tissue); at other times, microorganisms appeared to be the cause. Again, in August of 1971, stalk breakage below and above the ear and lodging originating at the crown of the stalk were present in 'McNair 440' field corn with either Normal (N) or Texas male sterile (T) cytoplasm planted in replicated plots near Jay, Marianna, Quincy, and Gainesville, Florida. This damage was more severe in the T- than in the N-cytoplasm source. At this time, according to the scale described by Miller et al. (4), southern corn leaf blight was rated at 5 on the T-cytoplasm source and at 1 on the N-cytoplasm source. Rotted nodal and internodal tissues of both N- and T-cytoplasm sources from all locations were placed on acidified potato-dextrose agar (APDA). Almost all tissue pieces yielded *Helminthosporium rostratum* Drechsl. but *Fusarium* spp. were also isolated. The purpose of this study was to determine whether *H. rostratum* alone, could cause stalk rot of field corn when it was introduced into healthy-appearing stalks.

MATERIALS AND METHODS.—Corn plants inoculated in the greenhouse were planted in a floor-level bed consisting of soil (Arrendondo series) amended with 0.17 m³ of compressed sphagnum peat moss of an area 7.5 m² and 0.3 m deep. Fertilizer (soluble NPK=20-20-20) with minor elements was applied to the soil several times during the experiment. Two seeds per hill were planted and later thinned to one plant per hill. The hills were spaced 0.3 m apart in the row and the rows were spaced 0.5 m apart. At inoculation, the plants were 1.8 - 2.1 m tall and stalks were 2.5 - 3.2 cm in diam at the third internode above ground. In the greenhouse, two varieties, 'McCurdy 67-14' and 'Florida 200A', were inoculated. Both N- and T-cytoplasm types were used

for each variety. Each plant was inoculated in the third, fifth, and seventh internode above ground with one of the two isolates. Each isolate was inoculated into six internodes at the same level for each cytoplasm type of each variety.

Helminthosporium rostratum growing on APDA was identified by use of the key by Luttrell (3). In addition, a culture was verified by Luttrell. Isolate 200 was originally isolated from corn stalks near Jay, Florida, and isolate 201 originated from corn stalks near Marianna, Florida.

Corn plants inoculated in the field were located on the Agronomy farm in Gainesville, Florida, and maintained according to standard field procedure for this area. Plants were spaced 0.3 m apart in the row and the rows were 1 m apart. N cytoplasm of three hybrids were inoculated: Pioneer Synthetic X LA 0110, Pioneer Synthetic X LA W8113, and Pioneer Synthetic CBTX X Mart. 11,1-D-Mex.5. Sixteen to 24 plants of each hybrid were inoculated with each isolate and the noninfested toothpick check.

Corn stalks were inoculated using the toothpick method (8). Plants in the greenhouse were inoculated during the ninth stage of growth (anthesis) according to the scheme used by Dixie Early Warning Line cooperators, in 1971, as modified by Hanway (2), and those in the field were inoculated during stage 10 (early dough).

The stalk rot rating scheme used was on a 1-4 scale as suggested by Christensen & Wilcoxson (1).

Stalk tissue from nodes and internodes with the rind tissue removed was used for all isolations. Tissues were immersed in 0.525% NaOCl for 1-2 minutes, rinsed in sterile distilled water, and then placed on the culture plates containing APDA.

RESULTS AND DISCUSSION.—Both isolates of *H. rostratum* caused stalk rot on N- and T-cytoplasm types of two corn varieties grown in the greenhouse (Table 1). Ratings were made 28 days after inoculation. The severity of stalk rot was greater in the fifth, than in the third, internode above the ground in all comparisons. In turn, the amount of stalk rot was greater in the seventh than in the fifth internode above the ground in six of eight

comparisons. Similar increased severity at higher internodes has been shown by others with other organisms (1). No consistent difference in severity was observed between N- or T-cytoplasm sources of

either variety with either isolate. The variety Florida 200A was slightly more susceptible than McCurdy 67-14.

There was no distinctive macroscopic characteristic that could be used to differentiate stalk rot caused by *H. rostratum* from rot caused by other fungi. Culture isolation should be used. The internal stalk lesions have a chocolate brown color.

Four pieces of rotted tissue from each of six inoculated internodes placed on APDA yielded *H. rostratum*. *Fusarium* spp. also grew from some tissue pieces.

Because the amount of stalk rot in the lowest internode was not severe, inoculations were made again at a low internode in the field. Stalks of three varieties of N cytoplasm corn in the field were inoculated with two isolates of *H. rostratum*. Only the second internode above the ground was inoculated, and ratings were made 28 days later. The amount of stalk rot with both isolates was severe while the amount of rot resulting from blank (organism-free) toothpicks was considerably less (Table 2).

Four pieces of rotted tissue from each of 12-14 internodes from stalks inoculated with one of the isolates and those inoculated with blank toothpicks were placed on APDA and assayed for recovery of *H. rostratum*. The first attempt was done by excising tissue at the advancing margin of the rotted tissue, but recovery of *H. rostratum* was only 23% from internodes inoculated with this same fungus (Table 3). Recovery of *H. rostratum* from inoculated internodes was increased to 71%, when tissue was excised near the center of the rotted area. This same change in recovery of *H. rostratum* resulted with those internodes inoculated with blank toothpicks. The source of *H. rostratum* in stalks inoculated with blank toothpicks was apparently from naturally occurring inoculum.

Fusarium spp. and *Aspergillus niger* were also isolated from tissue pieces. The frequency of *Fusarium* spp. isolated from advancing margins (compared to centers) of rotted tissue was comparable to that of *H. rostratum*, and its over-all

TABLE 1. Corn stalk rot ratings from two varieties inoculated in the greenhouse with two isolates of *Helminthosporium rostratum*

Cultivar	Cytoplasm	Isolate	Disease scale ^a			
			Internode (above ground)			Total
			3	5	7	
'McCurdy 67-14'	N	200	1.0 ^b	1.7	2.7	5.4
		201	0.5	2.0	4.0	6.5
	T	200	0.8	1.8	3.5	6.1
'Fla. 200A'	N	201	0.7	1.5	2.8	5.0
		200	1.2	2.0	3.0	6.2
	T	201	1.5	2.2	3.2	6.9
		200	1.8	3.2	3.2	8.2
		201	1.5	2.7	2.3	6.5

^a Rating scale was: 1 = 0-25% of internode necrotic; 2 = 26-50% of internode necrotic; 3 = 51-75% of internode necrotic; 4 = 76-100% of internode necrotic.

^b Each figure is the mean of six inoculated internodes.

TABLE 2. Corn stalk rot ratings of three hybrids inoculated in the field with two isolates of *Helminthosporium rostratum* in the second internode above the ground

Hybrid	Disease scale ^a		
	Isolate 201	Isolate 200	Blank toothpick
Pion. Syn. × LA 0110	3.5 ^b	3.8	1.8
Pion. Syn. × LA W8113	2.8	3.1	1.7
Pion. Syn. CBTX × Mart. 11,1-D-Mex.5	3.2	3.2	1.8
Average	3.2	3.4	1.8

^a Rating scale was: 1 = 0-25% of second internode necrotic; 2 = 26-50% of internode necrotic; 3 = 51-75% of internode necrotic; 4 = 76-100% of internode necrotic.

^b Each figure represents the mean of 16-24 internodes.

TABLE 3. Reisolation of *Helminthosporium rostratum* and other fungi from corn internodes inoculated with *H. rostratum* in the field

Fungus	Percent internodes ^a yielding fungi				Percent tissue ^b pieces yielding fungi			
	Inoculated		Check ^c		Inoculated		Check ^c	
	Margin of rot	Center of rot	Margin of rot	Center of rot	Margin of rot	Center of rot	Margin of rot	Center of rot
<i>Helminthosporium rostratum</i>	23	71	33	56	10	44	21	37
<i>Fusarium</i> spp.	23	79	58	78	6	53	35	47
<i>Aspergillus niger</i>	62	43	42	44	48	27	32	17

^a Each figure is based upon 12-14 internodes.

^b Each figure represents 48-56 tissue pieces from 12-14 internodes.

^c Check = noninfested toothpicks.

frequency of isolation was as high or higher than that of *H. rostratum* in most plants.

Healthy, noninoculated, contiguous internodes were also assayed for fungi; out of 96 tissue pieces, representing 24 internodes, only one colony of *H. rostratum* resulted. *Fusarium* spp., *A. niger*, *Nigrospora* spp., *Alternaria* spp., *Chaetomium* spp., *Sclerotium bataticola* and unknowns were isolated from 10, 12, 1, 41, 2, 4, and 6 tissue pieces, respectively.

H. rostratum has been shown to cause leaf spotting and ear rotting of corn (5, 6, 7), but this author knows of no previous report of *H. rostratum* causing stalk rot of corn. These data indicate that corn stalk rot in Florida is a syndrome caused by *H. rostratum* as well as several other species of fungi in other genera.

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