

Fungi Associated with Cornstalks in Illinois in 1982 and 1983

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ABSTRACT

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Cornstalks from 40 and 45 cornfields throughout Illinois were sampled in 1982 and 1983, respectively. The samples were examined to determine the prevalence of stalk-rot fungi associated with both rotted and symptomless stalks. Of the rotted cornstalks collected in 1982, *Colletotrichum graminicola* was isolated from 46.3% and *Gibberella zeae* was found in 39.7%. In 1983, *Macrophomina phaseolina* and *C. graminicola* were isolated from 35.2 and 34.1% of all diseased stalks, respectively. Other fungi isolated from diseased stalks, in decreasing order of prevalence, included *Stenocarpella maydis*, *Fusarium moniliforme*, and *Bipolaris zeicola*. *G. zeae* and *F. moniliforme* were the pathogens most frequently isolated from symptomless stalks during both years of the survey.

Stalk rot is an important and destructive disease of corn (*Zea mays* L.) in Illinois (2,3,7). The disease varies in severity from year to year depending on the environment and the susceptibility of widely grown hybrids (2). Several fungi and bacteria are capable of causing this disease either alone or in combination.

Several studies have been conducted in Illinois over the past 60 yr to determine the prevalence of fungi associated with diseased stalks. Holbert et al (3) regarded *Stenocarpella maydis* (Berk.) Sutton (cited as *Diplodia maydis* (Berk.) Sacc.), *Gibberella zeae* (Schw.) Petch (anamorph: *Fusarium graminearum* Schwabe), and *F. moniliforme* Sheld. as the major stalk-rot pathogens in the 1920s. Koehler and Boewe (6) concluded that *S. maydis* and *G. zeae* were the most prevalent fungi associated with rotted cornstalks from 1946 to 1956. Hooker and White (5) isolated *Colletotrichum graminicola*

(Ces.) Wils. from rotted cornstalks in more than 78% of the fields surveyed in 1975. They also noted a decline in the prevalence of *S. maydis* compared with earlier studies.

Statewide disease surveys, such as the type that first identified *C. graminicola* as

a problem in Illinois, are useful for several reasons. The prevalence of different pathogens determined by these surveys can help identify where research is needed to minimize crop losses and if adjustments are needed in breeding programs to compensate for increases or decreases in certain diseases. This study was designed to detect any changes in the prevalence of organisms commonly associated with diseased cornstalks.

MATERIALS AND METHODS

In 1982 and 1983, 40 and 45 cornfields, respectively, were surveyed between 13 September and 6 October. To determine regional trends, the state was divided into northern, central, and southern sections and several widely scattered fields from each section were surveyed (Fig. 1). One hundred stalks per field were sampled from five random locations (20 consecu-

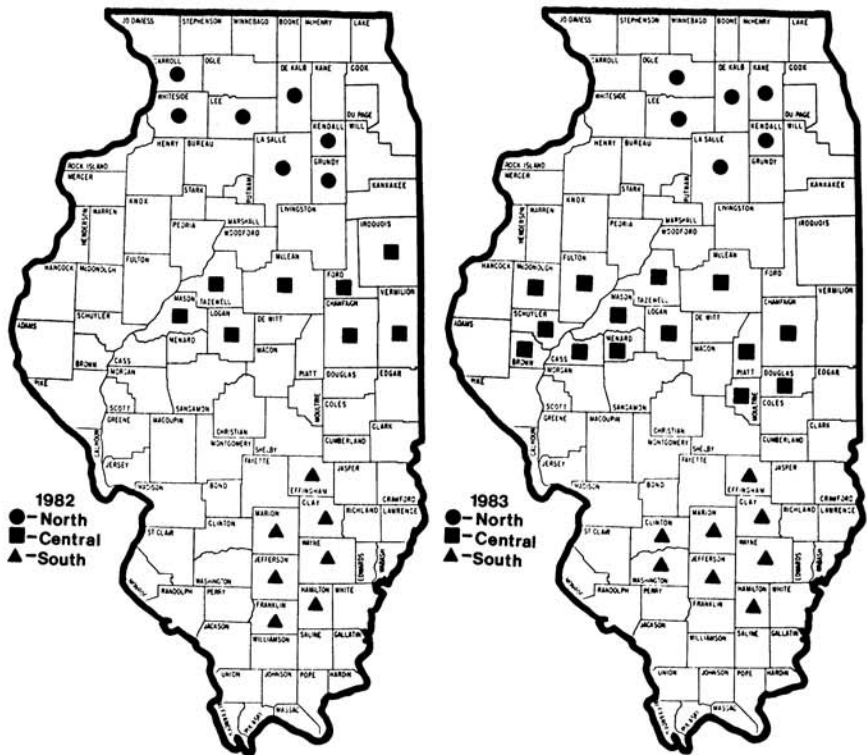


Fig. 1. Maps of Illinois showing counties in which cornfields were surveyed in 1982 and 1983.

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tive plants per location) in each field. A single tissue core 4 mm in diameter by 20 mm long was taken from the second elongated internode of each green, symptomless stalk with a bark increment hammer (8). Prematurely killed and rotted stalks were sampled by removing a portion of the diseased stalk with a knife. All samples were placed in individual plastic bags, placed in a cooler, and returned to the laboratory.

To isolate and identify fungi associated with the cornstalks, tissue samples were surface-disinfected in 0.5% sodium hypochlorite for 2 min, placed on acidified Difco potato-dextrose agar (11), and incubated at room temperature (20 ± 3 C) under fluorescent light with a 12-hr photoperiod. Resulting fungal colonies were identified and recorded 7–10 days later (1,9). Numerous saprophytic fungi were also isolated, but these were not recorded. The presence of fungal fruiting bodies and internal and external stalk symptoms were also used to identify fungi associated with diseased stalks. Both *G. zeae* and its anamorph, *F. graminearum*, were isolated during the survey but are collectively referred to as *G. zeae* throughout the paper.

The following data were compiled: 1) percentage of fields from which individual stalk-rot pathogens were isolated; 2) percentage of prematurely killed and rotted stalks from which various stalk rot

pathogens were isolated; and 3) percentage of healthy, symptomless stalks from which various stalk-rot pathogens were isolated.

RESULTS

The prevalence of stalk-rotting fungi isolated from diseased cornstalks in this survey is compared with those reported in past surveys in Table 1. *G. zeae* and *C. graminicola* continued to be prevalent; both organisms were commonly isolated from rotted cornstalks during both years of the survey. *Macrophomina phaseolina* (Tassi) Goid. was isolated from stalks in only 10.3% of the fields sampled in 1982 but increased to 62.2% in 1983. Other fungi isolated less frequently included *S. maydis*, *F. moniliforme*, and *Bipolaris zeicola* (Stout) Shoem. (syn. *Helminthosporium carbonum* Ullstrup). The number of isolations of *S. maydis* represents an increase in prevalence from 1975 (5).

A summary of stalk-rotting fungi associated with diseased stalks is presented in Table 2. Because more than one organism was occasionally isolated from a single sample, the total percentage of isolations is greater than 100.

C. graminicola was the most frequently isolated pathogen from diseased stalks during the survey; it was isolated from 46.3 and 34.1% of rotted stalks in 1982 and 1983, respectively. *G. zeae* was

isolated from 39.7 and 25.9% of rotted stalks during the same 2-yr period, making it the second most prevalent stalk pathogen found in 1982 and the third in 1983. *M. phaseolina* was isolated from only 1.9% of diseased stalks in 1982 but increased to 35.2% in 1983. Other fungi isolated from diseased stalks in decreasing order of prevalence included *S. maydis*, *F. moniliforme*, and *B. zeicola*.

The occurrence of fungal stalk pathogens isolated from symptomless stalks also is listed in Table 2. *G. zeae* was the most common pathogen and was isolated from 9.0 and 13.4% of symptomless stalks in 1982 and 1983, respectively. *F. moniliforme* also was isolated consistently from symptomless cornstalks. Other fungal pathogens were rarely isolated from symptomless stalks in either year of the survey.

DISCUSSION

C. graminicola continues to be a major cause of stalk rot in Illinois as indicated by the numerous isolations from diseased stalks. These findings confirm a trend first reported by Hooker and White in 1975 (5). This pathogen was frequently found in the northern area of Illinois, signifying that the fungus has increased its geographic range and can be found throughout the state. The range and annual amount of damage caused by *C. graminicola* makes screening for resistance to this pathogen a priority when developing new corn hybrids.

Gibberella stalk rot continues to be important in Illinois. The prevalence of *G. zeae* is expected to continue because of its wide host range, which includes wheat, another commonly grown crop in Illinois (10). This fungus was also the stalk-rotting organism most frequently isolated from symptomless stalks, which may be due to the organism's ubiquitous nature in Illinois soils or to some advantage related to its competitive saprophytic nature.

The amount of *S. maydis* found in this survey represents an increase from 1975

Table 1. Comparison of surveys identifying stalk-rotting fungi from corn plants in Illinois

Fungus	Survey period				
	1948–1952 ^a	1959 ^b	1975 ^c	1982 ^d	1983 ^d
<i>Stenocarpella maydis</i>	71.3	86.3	5.0	38.5	11.1
<i>Gibberella zeae</i>	38.8	...	95.0	87.2	73.3
<i>Colletotrichum graminicola</i>	78.3	72.5	88.9
<i>Fusarium moniliforme</i>	32.4	...	31.7	7.6	22.2
<i>Macrophomina phaseolina</i>	3.2	...	11.7	10.3	62.2
<i>Bipolaris zeicola</i>	7.5	...	41.7	42.5	33.4

^aPercentage of plants examined (6).

^bPercentage of fields examined; other fungi not identified (4).

^cPercentage of fields examined (5).

^dPercentage of fields examined.

Table 2. Percentage of cornstalks from which various fungi were isolated in Illinois during 1982 and 1983

Region	No. of fields sampled		Fungus											
			<i>Colletotrichum graminicola</i>		<i>Gibberella zeae</i>		<i>Stenocarpella maydis</i>		<i>Fusarium moniliforme</i>		<i>Macrophomina phaseolina</i>		<i>Bipolaris zeicola</i>	
	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
Rotted stalks^a														
North	14	10	63.6	58.4	36.7	29.9	0	2.3	0	9.2	0	0	4.0	2.9
Central	16	24	46.2	28.2	45.3	29.8	14.4	3.8	2.8	5.2	0	42.8	5.2	4.1
South	10	11	22.7	24.7	34.9	13.7	24.2	2.7	7.1	8.2	7.6	50.7	4.5	3.4
Total	40	45	46.3	34.1	39.7	25.9	11.8	3.2	2.9	6.8	1.9	35.2	4.6	3.4
Symptomless stalks^b														
North	14	10	0.4	0.2	7.3	21.6	0	0.5	6.9	11.5	0	0	5.2	8.7
Central	16	24	2.4	0.4	11.4	12.5	0.2	0.4	8.0	11.8	0.2	4.6	1.3	1.6
South	10	11	0	0.2	7.6	8.0	0.5	0.4	8.7	14.3	0.5	3.1	2.6	2.7
Total	40	45	1.1	0.3	9.0	13.4	0.2	0.4	7.8	12.1	0.2	3.2	3.0	3.4

^aValues are from 828 and 864 stalk samples collected in 1982 and 1983, respectively.

^bValues are from 3,172 and 3,636 stalk samples collected in 1982 and 1983, respectively.

(5). This may be due to the increased use of reduced tillage in Illinois. Conventional tillage, which reduces inoculum by burying debris and exposing it to decomposition, has been recommended as a means of minimizing *Diplodia* stalk rot development (2,7). Because corn is the only known host of *S. maydis* (2,10), the survival of this pathogen in fields is dependent on infected debris. The debris left on the soil surface with reduced tillage may increase the opportunity for long-term survival of *S. maydis* until corn is grown again. Koehler and Holbert (7) stated that by covering infected debris with soil, conventional tillage reduced the spread and infection by *S. maydis* on ensuing corn crops. Less stalk rot has been found to develop when reduced tillage is used, possibly because of moisture conservation or cooler soil temperatures (12), but from a standpoint of survival and dissemination of inoculum, it may be beneficial to *S. maydis*.

F. moniliforme was frequently isolated from cornstalks during this survey, but in most cases, it was isolated from symptomless cornstalks. Reports in the literature refer to this fungus as an important cause of stalk rot in some areas

but only a secondary stalk invader in others (2,3). In Illinois, the latter seems likely because *F. moniliforme* was rarely found in association with prematurely killed and rotted stalks.

The prevalence of *M. phaseolina* in Illinois can vary from year to year. The increase in the number of isolations of this pathogen from diseased stalks in 1983 followed a hot, dry summer. This phenomenon has also been described by others (2). When such weather conditions occur, as in 1983, *M. phaseolina* can be an important cause of stalk rot in Illinois.

The importance of *B. zeicola* as a stalk pathogen is not known. This fungus has been isolated from cornstalks before but does not appear to be causing much damage.

The data reported here indicate that *C. graminicola* and *G. zea* are prevalent stalk pathogens in Illinois. The increased presence of *S. maydis* is also noted. Our observations indicate that periodic surveys of prevailing stalk-rot diseases are essential to monitor the continuing changes related to cultural practices, weather, and corn hybrids planted.

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