Maize Seed Predisposed to Fungal Invasion and Aflatoxin Contamination by Helminthosporium maydis Ear Rot

Ben Doupnik, Jr.

Assistant Professor, Department of Plant Pathology, University of Georgia College of Agriculture Experiment Stations, Coastal Plain Station, Tifton, Georgia 31794. Present address: University of Nebraska South Central Station, Box 66, Clay Center 68933.

ABSTRACT

Data from seed samples of maize grown in Georgia in 1970 and 1971 suggest that *Helminthosporium maydis* ear rot predisposed the seed to fungal invasion and aflatoxin contamination.

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Helminthosporium maydis ear rot was associated with the southern corn leaf blight (SCLB) epidemic in Georgia in 1970. Although research in Georgia and other states (1) suggested that *Helminthosporium maydis* Nisik. & Miyake (*Cochliobolus heterostrophus* Drechs.), the causal agent of SCLB, was not toxic per se to animals, there was the possibility that seed damaged by *H. maydis* would be more susceptible to invasion by secondary fungi, many of which have the potential to produce mycotoxins. Many farmers, then, submitted samples of maize seed for mycoflora and aflatoxin analyses in an attempt to evaluate the risks involved in feeding this seed to livestock.

The purpose of this paper is to evaluate the relationship of *H. maydis* ear rot to the presence of secondary fungi and aflatoxins in maize seed.

MATERIALS AND METHODS.—*Maize seed samples.*—Over 100 samples of maize seed from the 1970 and 1971 harvests were received from Georgia farmers through the University of Georgia Cooperative Extension Service and the College of Veterinary Medicine Diagnostic and Research Laboratories. Little or no background history was submitted with many of the samples. The samples were examined visually for shrivelled and/or blackened kernels, then classified as being either "SCLB-damaged" or "non-blight-damaged". Data from 80 of these samples (the first 40 received of each classification) were subsequently selected for this report. It is assumed that all the samples classified as SCLB-damaged contained some or all Texas male-sterile cytoplasm (T) seed. The nonblight-damaged samples, on the other hand, may have contained either or both T or normal (N)

cytoplasm seed, since early plantings of T seed were not appreciably affected by SCLB.

Mycofloral and aflatoxin analyses.—Upon receiving a given maize sample, I randomly selected 25 seeds for mycofloral analyses, and took duplicate 25-g subsamples for aflatoxin analyses. I determined the mycoflora by soaking the seeds for 3 min in a 0.5% (w/v) solution of sodium hypochlorite, then plating them, five/petri dish, on rose bengal-streptomycin agar. After 5 days of incubation at 28 C, the fungal colonies growing from the seeds were enumerated and identified. Aflatoxin analyses were made by the aqueous-acetone method using thin-layer chromatography (2).

RESULTS.—The mycoflora of the SCLB-damaged seed samples included primarily *Fusarium moniliforme* Sheldon (79.2% of the total seeds infected), *Aspergillus flavus* Link (47.2%), *H. maydis* (32.4%), *Penicillium* spp. (13.6%), other *Aspergillus* spp. (12.4%), and other fungi (8.8%) including *Mucor* spp., *Rhizopus* spp., *Trichoderma* sp., *Alternaria* spp., *Fusarium* spp., and several unidentified fungi (Table 1). The same fungi occurred in the nonblight-damaged samples, but their incidence was lower. In addition, more of the seeds in the nonblight-damaged samples were free of fungi.

TABLE 1. Mycoflora of maize seed samples from *Helminthosporium maydis*-invaded and -noninvaded ears grown in Georgia in 1970 and 1971

Fungus	Incidence of seeds infected (% of total seeds)[a]	
	Blight-damaged	Nonblight-damaged
Fusarium moniliforme	79.2	38.2
Aspergillus flavus	47.2	9.6
H. maydis	32.4	5.4
Penicillium spp.	13.6	3.8
Aspergillus spp.	12.4	3.5
Other fungi[b]	8.8	2.6

[a]Twenty-five seeds from each of 40 samples were analyzed for mycoflora, giving a total of 1,000 seeds which were analyzed for each classification.

[b]Other fungi included *Mucor* spp., *Rhizopus* spp., *Trichoderma* sp., *Alternaria* spp., *Fusarium* spp., and unidentified fungi.

The aflatoxin analyses revealed that 25% of the SCLB-damaged samples contained aflatoxins, whereas only 5% of the nonblight-damaged samples were contaminated. In addition, the average concentration of aflatoxins in the positive samples was higher in the SCLB-damaged samples than in the nonblight-damaged samples, 728 μg/kg and 19 μg/kg, respectively.

DISCUSSION.—It is apparent that SCLB-damaged ears are more susceptible to infection by fungi and aflatoxin contamination than nonblight-damaged ears in Georgia. This may be a reflection of the higher susceptibility of T cytoplasm maize to ear invasion by *H. maydis,* thus predisposing the seed.

Several other studies have been carried out on the effect of T and N cytoplasm, *H. maydis* ear invasion, and high-lysine content on seed and ear rots of maize. Warmke & Schenck (5) suggested that a higher incidence of *F. moniliforme* occurred in T cytoplasm than in N. Tuite & Caldwell (3) however, reported that invasion of ears by *H. maydis* did not increase fungal infection of the seeds. Ullstrup (4), on the other hand, has reported that high-lysine maize, which is mostly in N cytoplasm, is extremely susceptible to seed and ear-rotting fungi. It is apparent, then, that many factors are involved in the susceptibility of various types of maize to seed and ear-rotting fungi. These studies (3, 4, 5) and our study all show, however, that *F. moniliforme* is the predominant fungus on damaged seeds.

The hazard of mycotoxins from feeding maize heavily infected with *F. moniliforme* is not known. Data from our laboratory (J. Peckham & B. Doupnik, *unpublished data*) suggest, however, that *F. moniliforme* infection could represent a serious mycotoxin problem. Using methods previously described for screening fungal isolates for toxicity to chicks (1), I found that 6 of 15 isolates of *F. moniliforme* obtained from SCLB-damaged maize were toxic to chicks. Ullstrup (4) has also pointed out potential mycotoxin hazards of using severely infected high-lysine corn for livestock feed or human food. The precautions suggested by Ullstrup in the feeding of severely infected high-lysine corn should also be observed in the feeding of corn severely damaged by SCLB.

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