The 1977 Corn-Aflatoxin Epiphytotic in Alabama

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ABSTRACT

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A prolonged drought and severe fall armyworm infestation were probable factors resulting in the high level of aflatoxin B_1 contamination in the 1977 Alabama corn crop. Of 2,489 samples tested from 1 August to 31 December 1977, 63% exceeded the guideline for aflatoxin of 20 parts per billion set by the U.S. Food and Drug Administration. The percentages of samples exceeding 20 parts per billion in south, central, and north Alabama were 82, 54, and 48%, respectively. The corresponding percentages below normal rainfall for the three geographical regions were 45, 22, and 16%, respectively. Losses directly attributed to aflatoxin during 1977 exceeded $2 million.

Infection by *Aspergillus flavus* (Link) and the resulting production of the toxic metabolite aflatoxin B_1 in preharvested corn have been reported by several researchers (1,3,9). The presence of aflatoxin at quantities exceeding the guideline of 20 parts per billion (ppb) set by the U.S. Food and Drug Administration has been reported to occur more frequently in the southern United States than in other corn growing regions (10,12,13). Jones (6) suggested that high relative humidity (>85%) and high temperature (>30 C), which favor fungal infection by *A. flavus* and aflatoxin production, may explain this increased incidence of aflatoxin in the southern United States. More recently, Thompson et al (15) have shown that aflatoxin concentrations are likely to be high when corn is infected at the hard-dough stage and when postinfection temperatures are high. The association of drought stress with the early appearance and increased incidence of aflatoxin in preharvested corn was reported in South Carolina in 1977 (14).

Although insect damage is not essential for corn ear infection by *A. flavus* (7), a positive association of corn earworm damage and aflatoxin contamination is well documented (4,8,14,17).

During the 1977 growing season in Alabama, below average rainfall occurred throughout the state. Most cornfields showed symptoms of severe drought stress by early June. This was particularly true in the sandy soils of the southern Coastal Plains region, which occupies the lower third of the state. By early summer, populations of the fall armyworm (*Spodoptera frugiperda* J. E. Smith) had reached extremely high levels and were causing severe damage to corn in the state (2). All these conditions were conducive to a corn-aflatoxin epiphytotic. Spot checks of field corn made by U.S. Department of Agriculture personnel in early July indicated a growing aflatoxin problem in the southeastern United States, including Alabama (16).

The purpose of this paper is to report the corn-aflatoxin problem that occurred in Alabama during 1977, probable factors relating to the epiphytotic, and its economic impact on the state's economy. A preliminary report has been made (5).

MATERIALS AND METHODS

Aflatoxin analyses of corn samples tested between 1 August and 31 December 1977 were obtained from the U.S. Department of Agriculture Food Safety and Quality Services Laboratory in Dothan and the Deep South Laboratory in Montgomery, AL. Samples were categorized as to their point of origin within the state (south, central, or north). They were analyzed by the official method of the Association of Official Analytical Chemists and listed as having aflatoxin B_1 at <20 or >20 ppb. Samples having >20 ppb were further subdivided into those having 21–100 ppb and those having >100 ppb.

Because aflatoxin levels appeared to be more severe in the drought-stressed areas of southern Alabama, monthly climatological data were obtained from the National Oceanic and Atmospheric Administration, Environmental Data Service, Asheville, NC (11), to see whether an association could be established. Estimated losses due to aflatoxin contamination were determined by using the following formula: percentage of contaminated corn with aflatoxin exceeding 20 ppb × total corn production × average discount (dollars) per bushel for aflatoxin contamination. The average discount (dockage) for contaminated corn in south, central, and north Alabama was obtained by contacting several grain elevator operators within the three regions.

RESULTS AND DISCUSSION

Results of the aflatoxin analyses from the two testing laboratories are given in Table 1. Of the 2,489 corn samples tested during the 5-mo period beginning 1 August and ending 31 December 1977, 1,556 (62.5%) exceeded the 20-ppb guideline for aflatoxin. Of the samples exceeding 20 ppb, 924 (59.4%) exceeded 100 ppb.

When aflatoxin analyses of corn samples submitted from south, central, and north Alabama were compared, a higher number of samples exceeding the 20-ppb level occurred in the southern than in the central or northern regions (Table 2). Samples exceeding 20 ppb in south, central, and north Alabama were 81.5, 54.5, and 47.7%, respectively. Of the samples that exceeded the 20-ppb level in south, central, and north Alabama, 583 (71.0%), 107 (46.9%), and 234 (46.2%)

Table 1. Aflatoxin level of corn samples submitted to two testing laboratories during the period 1 August to 31 December 1977

Aflatoxin B_1 level (ppb)	Lab 1[a] samples		Lab 2[b] samples		Total	
	No.	%	No.	%	No.	%
<20	630	37.7	303	37.1	933	37.5
>20	1,043	62.3	513	62.9	1,556	62.5
21–100	361	34.6	271	52.8	632	
>100	682	65.4	242	47.2	924	
Total	1,673		816		2,489	

[a] U.S. Department of Agriculture Food Safety and Quality Services Laboratory, Dothan, AL.
[b] Deep South Laboratory, Montgomery, AL.

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Table 2. Comparison of aflatoxin levels of corn samples from three geographical regions in Alabama

Aflatoxin B_1 level (ppb)[a]	South		Central		North		Total	
	No. of samples	%	No. of samples	%	No. of samples	%	No. of samples	%
<20	186	18.5	191	45.6	556	52.3	933	37.5
>20	821	81.5	228	54.4	507	47.7	1,556	62.5
21-100	238	29.0	121	53.1	273	53.9	632	
>100	583	71.0	107	46.9	234	46.2	924	
Total	1,007		419		1,063		2,489	

[a]Corn sample analyses were obtained from the U.S. Department of Agriculture Food Safety and Quality Services Laboratory and the Deep South Laboratory located in Dothan and Montgomery, AL, respectively.

exceeded 100 ppb, respectively.

When the average monthly rainfall data for April, May, June, and July for the three geographic regions were analyzed, below normal levels of rainfall occurred in all three regions. The percentages below normal rainfall for the 4-mo period for south, central, and north Alabama were 44.8, 21.6, and 15.7, respectively. Above normal rainfall was reported only in the months of April and July in north and central Alabama, respectively.

When the rainfall data were compared with the aflatoxin analyses for the three geographic regions (Table 2), a positive association was observed.

Average monthly temperatures for April, May, June, and July were near normal in all three regions. Mean temperatures for south, central, and north Alabama were 24.56, 23.83, and 23.04 C, respectively.

An additional factor that undoubtedly added to the drought-stressed condition of the corn plant was the different soil types that occurred in the three geographic regions. This was particularly true of the predominately sandy upper subsoils of the Coastal Plains of south Alabama, compared with the loamy upper subsoils of north Alabama.

Estimated dollar losses in the 1977 corn crop for south, central, and north Alabama were $1,378,000, $136,000, and $730,000, respectively. These values include losses both in sales and in feed value of contaminated corn. The total loss directly attributed to aflatoxin contamination was $2,244,000.

Below normal rainfall throughout most of the growing season combined with an uncommonly high population of fall armyworms in the early part of the growing season were dominant factors resulting in the high incidence of aflatoxin in preharvested field corn in 1977. Occurrence of a similar epiphytotic can be expected if and when these two factors again coincide.

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