Incidence and Level of Aflatoxin in Preharvest Corn in South Georgia in 1978

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ABSTRACT

In 1978, an early and a late season survey of preharvest dent corn in 45 counties on the coastal plain of Georgia revealed 94 and 76% incidences of aflatoxin contamination, respectively. Aflatoxin levels in field samples of corn averaged 62 µg/kg and 51 µg/kg during the weeks of July 25 and September 5, respectively, and ranged from 0 to 620 µg/kg. Thus, the contamination level was considerably lower in the 1978 than in the 1977 survey, in which aflatoxin averaged 622 µg/kg and ranged from 0 to 4,708 µg/kg. Insect damage in 1978 increased significantly between the early and late surveys, but the average level of aflatoxin decreased. A positive correlation was found between ears with insect damage and ears with visible Aspergillus flavus Link, and between ears with visible A. flavus and those with aflatoxin level. However, the correlation between ears with insect damage and those with aflatoxin level was nonsignificant. These data suggest that environmental factors, in addition to kernel damage, may strongly influence the ultimate level of aflatoxin contamination in preharvest corn.

Considerable attention has been focused on the economic and health problems that are related to aflatoxin contamination in grain and other feed and food crops. Midwest surveys of corn (Zea mays L.) in 1964 and 1965 (Shotwell et al. 1969) and in 1967 (Shotwell et al. 1970) revealed low incidence and low levels of aflatoxin, a carcinogenic metabolite of Aspergillus flavus Link. Members of the A. flavus group of fungi are common on corn in Georgia (Doupinik 1972). Subsequent surveys (Shotwell et al. 1973) showed that grain infection and aflatoxin contamination are more serious problems in the southeastern than in the midwestern United States. In 1977, a survey (McMillian et al. 1978) of preharvest corn in 31 counties on the coastal plain of Georgia suggested that ears infected by Aspergillus spp. of the A. flavus group of fungi and ears contaminated with high levels of aflatoxin were widespread in about 810,000 ha (2 million acres) of corn. One of the most severe droughts in 20 years occurred during the early and middle parts of the 1977 growing season in Georgia, but rainfall was about normal during the latter part of the season. Insect populations, mostly corn earworms, Heliothis zea (Boddie), and fall armyworms, Spodoptera frugiperda (J. E. Smith), were severe throughout the season, and overall damage to foliage and ears was at one of the highest levels in the state’s history.

The 1978 survey of preharvest corn grown in southern Georgia is reported herein. Our main objectives were to monitor any differences between 1977 and 1978 in incidence and level of aflatoxin contamination in corn in south Georgia and to identify possible reasons for the differences.

MATERIALS AND METHODS

During the week of July 24, 1978 (early survey), and again during the week of September 4, 1978 (late survey), a dent corn field in each of 45 counties on the coastal plain of Georgia was surveyed (Fig. 1). Selection of fields and sampling within fields followed the procedures used in the 1977 survey (McMillian et al. 1978). Generally, we selected the first field we encountered after crossing the county line and traveling for about 6.4 km down a main highway if it apparently was typical for the area and the ears were at about 20–30% moisture. The top 10 ears on 10 plants at each of five locations in the field were husked and observed for visible greenish yellow fungal growth characteristic of Aspergillus spp. We recorded the number of infected ears and of ears damaged by insects and the amount of insect damage to ears, measured in depth penetration from the tip toward the butt of the ear. Two ears judged to be representative at each of the five sampling sites in a field were picked, bulked in a paper bag, brought to the laboratory within the day, and immediately shelled. Moisture content was read with a Steinlite moisture meter. Then grain samples were dried to 7% moisture in an oven at 60°C. Aflatoxin was determined on each sample by the AOAC official rapid modification for cotton seed products method. Correlation coefficients were calculated to determine relationships among the characteristics measured.

RESULTS AND DISCUSSION

The 1977 growing season, in which aflatoxin contamination was high in preharvest corn in Georgia, differed from the 1978 season in total precipitation. According to records at the Tifton station, total precipitation for April through July was 32.0 cm in 1977 and 43.2 cm in 1978.

Fig. 1. Outline of the counties in the Coastal Plain Region (C) of Georgia surveyed for corn with Aspergillus flavus, aflatoxin, and insect damage in 1978. A and B are the Mountain and Piedmont Regions, respectively.

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cm in 1978. In the latter part of the growing season, August through October, total rainfall was 32.5 cm in 1977 and 10.9 cm in 1978. Overall, insect population and resulting damage to foliage and ears were less severe in 1978 than in 1977.

In 1978, the incidence of aflatoxin in the July survey was 94%, compared with 76% in the September survey (Table I). Also, the average aflatoxin level was significantly lower in the late-season than in the early-season survey. Table II demonstrates the increase in the number of late-season survey samples falling into the low level aflatoxin category. Comparing years, the late-season survey in 1978 averaged 51 μg/kg (range, 0–620 μg/kg) compared with 622 μg/kg (range 0–4,708 μg/kg) of total aflatoxin for the late-season survey in 1977 (31 fields in the same area). Correlations were not significant between counties surveyed in 1977 and 1978 for insect damage (r = 0.14) or for percent of ears with visible A. flavus (r = 0.10) or aflatoxin (r = 0.03). In 1978, the average percent of grain moisture was significantly lower in the late-season than in the early-season survey, and average insect damage was significantly higher in the late-season survey. Insect damage for the late-season survey was lower in 1978 (2.1 cm average ear penetration) than in 1977 (4.9 cm average ear penetration). No significant association was found in either the early-season or late-season survey between percent grain moisture at harvest and corn earworm penetration (r = −0.02 early or r = 0.01 late), percent damaged ears (r = −0.06 or r = 0.11), or percent ears with visible A. flavus fungal growth (r = 0.01 or r = 0.11) or aflatoxin (r = −0.27 or r = 0.13). In addition, no significant association was found between aflatoxin level and corn earworm penetration (r = 0.21 or r = 0.21) or percent damaged ears (r = 0.18 or r = 0.24). Data for percent ears with visible A. flavus fungal growth were not reported because so few ears (about 2% for both surveys) were affected. In both 1978 surveys, however, correlation (r = 0.42 or r = 0.42) was found between earworm penetration and percent ears with visible A. flavus mold. Correlation also was found between percent ears with visible A. flavus mold and aflatoxin level (r = 0.43 and r = 0.67) in both 1978 surveys. Indications are that ear damage by insects or by other means is conducive to, but does not guarantee, A. flavus or aflatoxin production. Environmental factors other than kernel damage may influence the ultimate level of aflatoxin contamination.

**LITERATURE CITED**


