Influence of planting date, harvest date, and maize (corn) hybrid on preharvest infestation of maize by *Sitotroga cerealella*

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Abstract

A field study was conducted during 1992–1993 in an effort to gauge the practicality of planting a higher yielding maize (corn) variety later in the growing season to avert preharvest infestation by *S. cerealella*. Infestation tended to decrease with planting date and increase with sampling ('harvest') date, in agreement with earlier studies. Yield of maize was unaffected by planting date or maize hybrid, suggesting that delayed planting may indeed be a viable cultural control method for *S. cerealella*. Infestation rate was somewhat higher in the higher yielding variety, but overall infestation rate was quite low during the study period compared with previous years. Although further study is required, the results suggest that late planting and early harvest alone are potentially useful methods for averting preharvest infestation of maize by *S. cerealella*, and that a higher yielding variety may not be necessary at the latitude of Kentucky, USA to compensate for potential loss of yield resulting from a shortened growing season.

Introduction

Sitotroga cerealella (Olivier), more commonly known as the Angoumois grain moth, is a worldwide pest of stored grains and the most abundant lepidopteran pest of stored maize in Kentucky (J. Sedlacek, unpublished data). Its pest potential is great owing to its high mobility, ability to colonise intact grain, and ability to infest grain both before and after harvest. Weston et al. (1993) reported that preharvest infestation of maize was strongly influenced by grain moisture content, with the likelihood of infestation increasing sharply once moisture content dropped below 31% (wt/wt). They suggested that cultural practices that minimised exposure of vulnerable maize to potential colonising moths, such as delayed planting or harvesting as soon as practicable, might be employed to reduce infestation of maize by this pest.

Delaying planting reduces preharvest infestation because the grain moisture content decreases to the threshold moisture content for infestation (31%) after peak moth activity in the field, which occurs around August (Barney and Weston 1994). Delayed planting, however, might reduce crop yield because of reduced time for maturation (Bitzer et al. 1979). The objectives of this study were to measure crop yield and infestation by *S. cerealella* of maize planted at normal and late planting dates for a maize hybrid commonly grown in central Kentucky and a higher yielding hybrid in an effort to measure the impact of cultural control methods on quality and quantity of harvested maize.

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Materials and Methods

The experiment was conducted in 1992 and 1993 at the ca. 85–ha Kentucky State University Research Farm in Franklin Co., Kentucky. Topography is rolling to hilly and the land surrounding the farm is used primarily for cattle grazing and small acreages of tobacco and field maize.

Maize was planted in four locations ca. 400 m from a cluster of galvanised grain storage bins located near the centre of the research farm. The sites were oriented approximately at the four cardinal compass directions with respect to the grain storage complex, which consisted of 12 300-bushel bins and 2 1000-bushel bins of maize containing various amounts of maize varying in duration of storage. Each site was planted with replicated plots (7.6 m × 12.2 m) of the three (1992) or four (1993) treatments. Two replicates were planted at each site, except for the north site in 1992, where three replicates were planted.

The treatments in 1992 were 'DeKalb (DK) 689' planted at the typical planting time of mid-May and at a late planting date (7 June), and 'DK 743' planted at the later date. Roughly 50% of maize is planted by the middle of May in a typical year, and 95% is planted by the end of the first week in June. In 1993, we used the same three treatments plus 'DK 743' planted at the normal planting date. 'DK 689' is commonly grown in central Kentucky, and 'DK 743' is a newer hybrid that has been found to produce higher yields than 'DK 689' in variety trials conducted around the state. Conventional tillage, fertilisation, and weed control practices were used.

Plots were sampled for *S. cerealella* on three dates at the end of the growing season, with three weeks between dates. In 1992, plots were sampled on 15 September, 13 October, and 13 November. In 1993, sampling dates were 22 September, 20 October, and 19 November. Adult emergence holes and 'windows' (transparent circular areas of cuticle created as last instar larvae hollow out their pupation chamber within kernels) were counted and marked at sampling time for the three sampling dates and again after five weeks' incubation in paper bags under laboratory conditions. Five weeks was chosen as the incubation time because it is sufficiently long to allow larvae to complete development but short enough to prevent eggs laid by emerging adults to complete development to adult. Four ears were sampled per subplot, one from three random locations in each plot and one from the centre. Emergence holes and windows were counted and recorded from the three randomly selected ears, and ca. 50 g of kernels were removed from the middle of the fourth ear and placed in air-tight vials for moisture determination at a later date. Total infestation was calculated by summing infestation measured at sampling time and that after incubation. Moisture content, expressed as the percentage of fresh kernel weight consisting of water, was determined by drying whole kernels at 103 °C for 72 hours (Watson 1984).

Yield of maize was measured by harvesting and weighing all ears in two 7.2-m rows from each plot.

Results and Discussion

As was found in our earlier study (Weston et al. 1993), infestation rate increased with sampling date, with the exception of late-planted 'DK 743' in 1992, where corn from the second sampling date had the highest infestation rate (Fig. 1). This was no doubt due to sampling error because total infestation cannot possibly decrease over time for a thoroughly sampled population. Infestation tended to decrease with planting date for both years, particularly at the first two sampling dates.

Both of these trends can be explained by changes in moisture content over the course of the sampling intervals. Moisture content at the first sampling date was at or above the infestation threshold of 31% for all treatments, and declined to well below this level by the third date (Fig. 2). In addition, moisture content was higher for later planted maize in virtually all cases. The later planted maize was particularly responsive to decreasing moisture content because the initial value was well above the threshold.

Infestation rate of the two hybrids was not consistent over the two years. Infestation of 'DK 743' was distinctly higher than that of 'DK 689' planted at the same time for three of the six sampling dates, and was roughly equal to that of 'DK 689' for the other three (Fig. 1). Thus, even though the infestation trends were not consistent over the two years, 'DK 743' seems to have a higher potential for sustaining damage from *S. cerealella*.

Yields averaged over hybrid and planting date were not appreciably different within years, and were similar between years (Fig. 3). Delayed planting, thus, had little adverse effect on maize yield, and resulted in slightly higher yields in 1993.

General Discussion

Delayed planting appears to be a viable strategy for reducing preharvest infestation of maize by *S. cerealella* where this pest is a threat and control options are limited. Using a higher yielding hybrid ('DK 743') had little apparent advantage, however, and 'DK 743' may in fact be more susceptible to infestation than 'DK 689'. It must be pointed out, however, that additional experimentation is required because the rate of infestation by *S. cerealella* was rather low during the study period compared to our earlier study. In 1991, for example, infestation rate for 'DK 689' planted at the normal time averaged 24–28 moths per three ears, roughly eight times higher that the maximum infestation rate observed here (Fig. 4).

Although moisture content may be a reliable indicator of susceptibility of maize to infestation by *S. cerealella*, it must be noted that this variable may merely be correlated with another characteristic of maize plants that more directly influences infestation. For example, *S. cerealella* might locate fields of maturing maize by orienting to volatiles produced by maize plants of the appropriate phenological state. Production of these putative semiochemicals might, in turn, be correlated with moisture content of the ripening grain. The likelihood of such a scenario is supported by the observations that moth abundance is greater in plots of maize compared to nearby open fields late in the growing season (Stockel 1971; Barney and Weston, unpublished data) and that survivorship of *S. cerealella* larvae increases as moisture content of maize kernels decreases as the grain ripens (Koone 1952).

The other strategy proposed by Weston et al. (1993) for avoiding infestation by *S. cerealella*, i.e. early harvesting, is

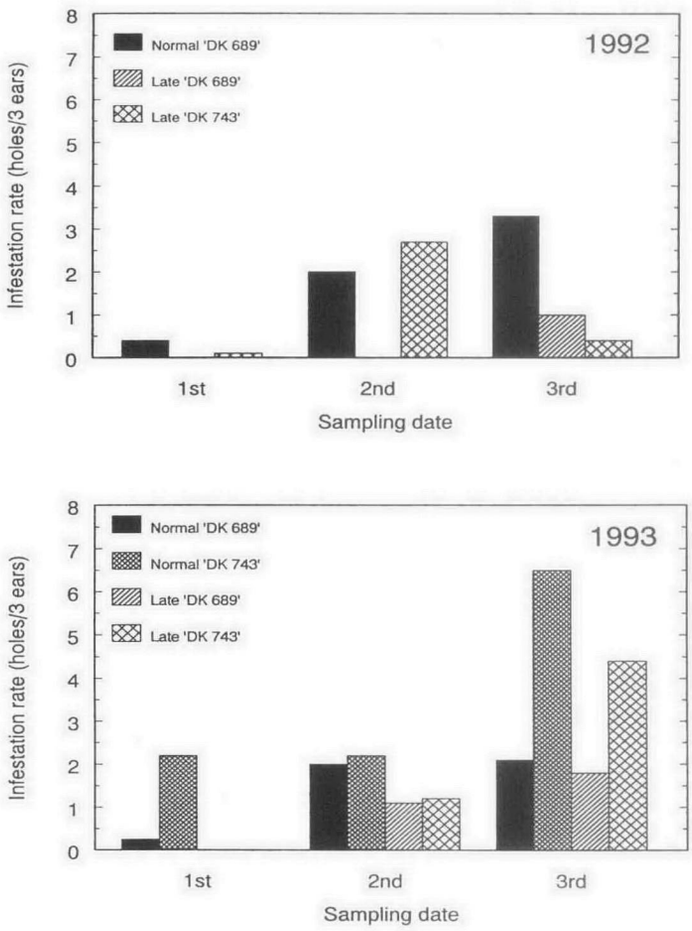

Fig. 1. Total infestation rate of maize by *S. cerealella* during the study period. See text for full details.

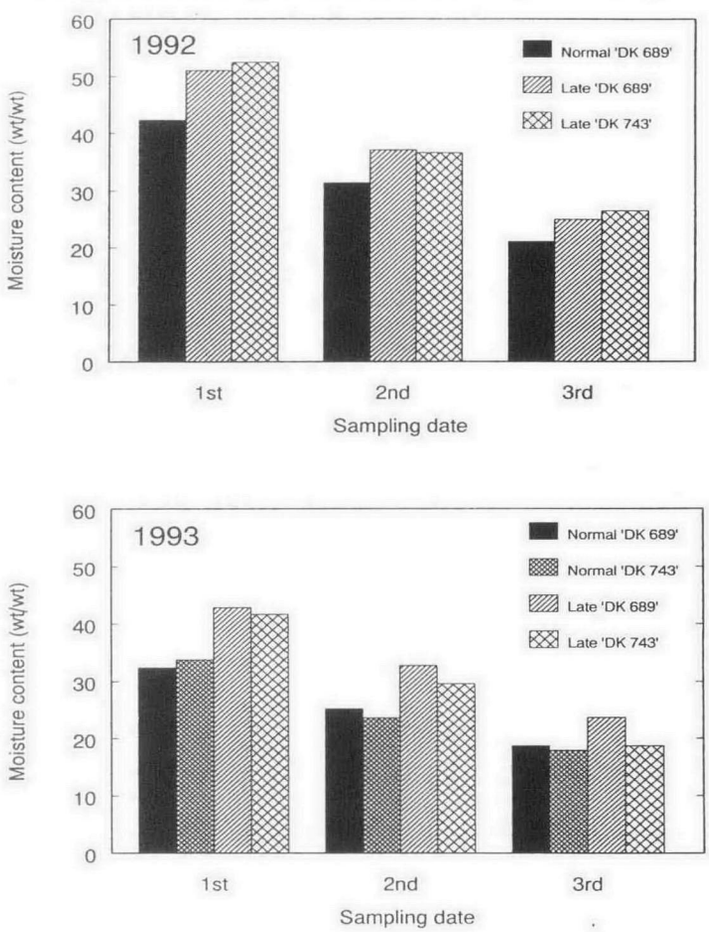

Fig. 2. Moisture content of maize during the study period.

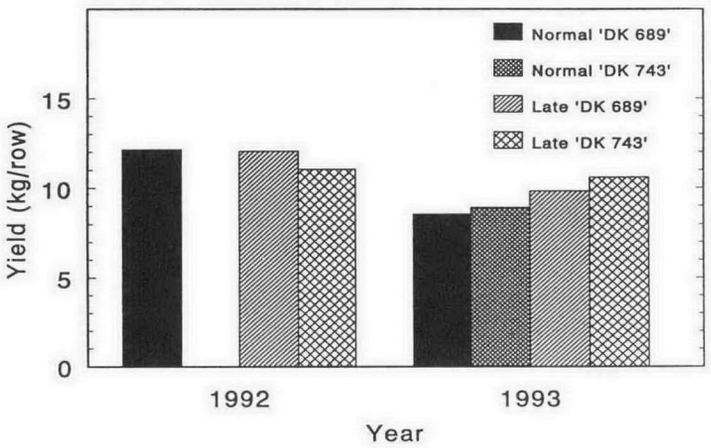

Fig. 3. Yield of maize harvested during the study period. Yield was weight of maize (including cobs) harvested from 7.2-m rows. Note that 'DK 743' was not planted at the earlier date in 1992.

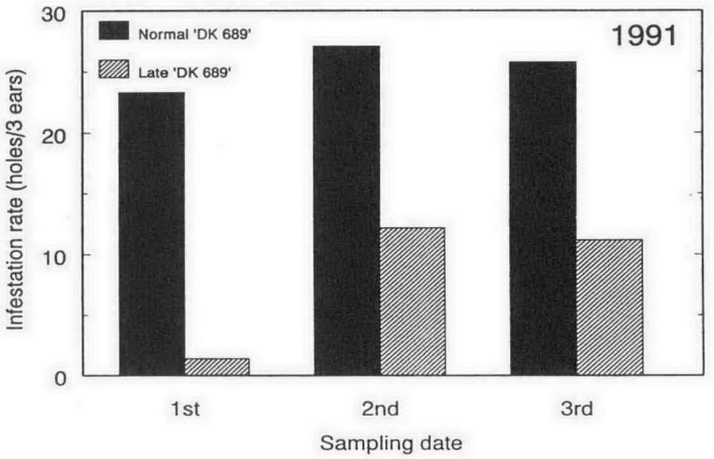

Fig. 4. Total infestation rate of maize grown in 1991 at the Kentucky State University Research Farm. See Weston et al. (1993) for full details.

also supported by the current study. Harvesting maize as soon as practicable minimises the window of exposure to potential colonising moths. Limitations imposed by harvesting and grain-drying capacities, however, need also to be considered when choosing the optimal time for harvest.

Acknowledgments

I thank R. Barney, X. Ge, S. Hill, W. Owens, B. Price, P. Rattlingourd, J. Sedlacek, and W. Tietjen (Community Research Service, Kentucky State University) for assistance in conducting this research. This investigation was supported by a grant from USDA-Cooperative States Research Service to Kentucky State University under agreement KYX-10-90-15P.

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