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Abundance of *Plodia interpunctella* (Hübner) and *Cadra cautella* (Walker) infesting maize stored on South Carolina farms: seasonal and non-seasonal variation[☆]

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Abstract

Seasonal trends and short-term fluctuations in abundance of *Plodia interpunctella* (Hübner) and *Cadra cautella* (Walker) infesting maize stored on two South Carolina farms were studied during three storage seasons (September 1990–June 1993). Coils of corrugated paper placed on the grain surface were used to trap mature larvae seeking pupation sites. Temperatures in the grain (18-cm-deep) and in the bin headspace were recorded hourly, and grain moisture content was measured weekly. Weekly mean numbers of moth larvae, and adults of two natural enemies, trapped in the coils were used for tracking changes in their abundance over time. The most significant findings were: (1) a seasonal pattern of abundance in both moth species that persisted from farm to farm and year to year, and (2) the coincidence of the highest population levels with the lowest temperatures. With few exceptions, the moth populations increased in the fall, reached their highest levels in winter, and then declined to low levels by early spring. The persistence of this pattern suggests a seasonal regulatory mechanism, with onset of low temperature as the primary initiator of population decline and adversely high temperature as a contributor to its protraction through spring into early summer. This view is supported by our observations of temperature and moth abundance, in conjunction with published information on the biological limitations of the two species. However, other factors, such as predators, parasitoids, and viral infection, may have contributed to the final population

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collapse. Superimposed upon the seasonal trends were short-term, non-seasonal cycles of abundance with variable periods. Population theory suggests that predation, parasitism, disease, and competition may have produced these cycles.

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1. Introduction

Plodia interpunctella (Hübner) and *Cadra cautella* (Walker) (Lepidoptera: Pyralidae) are cosmopolitan species known to infest a wide range of dried plant materials, including grain and cereal products (Cox and Bell, 1991). Both species occur frequently in farm-stored maize in South Carolina, but *Plodia* occurs more frequently than *Cadra* and is usually more abundant (Arbogast and Throne, 1997).

Plodia interpunctella, *C. cautella*, and various other species of stored-product pyralids have frequently been studied in the laboratory and occasionally in warehouses or other commercial settings (Cox and Bell, 1991). Both approaches are important to understanding their population dynamics and developing integrated strategies for managing infestations in commercial facilities. Benson (1973) reviewed the biology of *P. interpunctella* and *C. cautella* and examined various mortality factors that may be of importance in their population dynamics. Warehouse studies have examined population trends of pyralid moths infesting bulk grain (Richards and Waloff, 1946), bagged maize (Graham, 1970), citrus pulp (Hagstrum and Sharp, 1975), and groundnuts (Keever et al., 1985), but the dynamics of populations in storage environments remain poorly understood.

The nature of the grain storage habitat on South Carolina farms and the diversity of insect populations that occur there were described by Horton (1982) and by Arbogast and Throne (1997). The present paper reports an extension of these studies, which examined temporal variation in abundance of *P. interpunctella* and *C. cautella* infesting stored maize. The principle objective was to identify seasonal trends in the moth populations and to seek underlying mechanisms, with emphasis on temperature and grain moisture content. However, short-term variation in abundance was also given consideration, and any factor that could affect population growth was at least noted.

2. Materials and methods

2.1. The storage situation

The data examined in the present study are from observations of shelled maize stored in galvanized steel bins on two South Carolina farms; the observations spanned three storage seasons or nearly 3 years, September 1990–June 1993. The two farms were located about 35 km apart, one in Bamberg County and the other in Barnwell County. On the Bamberg farm, the same bin, which was 5.5 m in diameter by 5.5 m high (capacity of about 85 t), was used for all three

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