SHORT COMMUNICATIONS

Competitive Ability of Two Moths, *Sitotroga cerealella* (Oliv.) and *Ephesia cautella* (WLK) in Sorghum

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The Angoumois grain moth *Sitotroga cerealella* (Oliv.) and warehouse moth *Ephesia cautella* (WLK) are serious pests of stored grains, especially in the tropics. Infestation of *E. cautella* and *S. cerealella* has also been associated with stored products imported from warmer countries to temperate regions (Freeman, 1976). In Nigeria, the moths attack sorghum and maize both in the fields and in storage (Caswell, 1979; Osuji, 1985; Ayvert and Iarroye, 1987). A common characteristic associated with larval development in both species is the production of webbing. In large populations, the larvae may enter a migratory phase which aggravates the problems associated with the production of silk (Winks, 1975a; Richards and Davis, 1977).

Interspecific competition can be studied using a number of species than inhabit the same environment, and these interactions have been suggested as a possible explanation for the observed distribution of pests (Crombie, 1945; Smith and Howard, 1983). In various experiments, de Wit's replacement series concept has been used to investigate competition between animal species (Sigurjonsdottir and Reynolds, 1977; Pajunen 1979 and Snell, 1979) and competition in stored products of coleopteran pests (Shazali, 1982; Howard, 1983). According to Smith and Howard (1983), the replacement series approach predicts the long-term outcome of competition from a relatively quick and easy experiment with one generation.

In this study, the replacement series approach was used to investigate the competitive development of two moths, *S. cerealella* and *E. cautella*, in the sorghum.

MATERIALS AND METHODS

The stock cultures for the moths were set up in kilner jars (3 l) with wheat and wheatfeed plus glycerine (5% by weight) (Winks, 1975 b; Navarro and Gonen, 1970). The cultures were maintained at ambient laboratory conditions of 26±2°C and 65–70% r.h. with a 12L:12D cycle. To obtain a large quantity of eggs for experimental purposes, 20 adults of each moth species were placed in separate kilner jars (1 l) which were covered with a wire mesh screen and inverted over a Petri dish containing 2 g of powdered wheat. The jars were left in this position for egg collection. Eggs were viewed under a stereo-microscope, Wild M8, and uncollapsed eggs were used for experimental purposes.

Three sets of 25 kilner jars (1 l), each containing 250 g of sorghum (*Sorghum vulgare* Pers.) seeds, were prepared. Eggs in ratios of 25 Sc/25 Ec, 15 Sc/35 Ec, 35 Sc/15 Ec were introduced into the respective jar sets. Also, 50 eggs of *S. cerealella* and *E. cautella* were introduced separately into the jars for intraspecific competition. Five replicates were presented for each experiment. A set of 25 jars was maintained separately in incubators at temperatures of 20°C, 25°C and 32°C.

In all cultures, a test-tube (40 mm×10 mm) containing cotton soaked in water was supplied as a drinking tube for *S. cerealella*. A thermohygrometer was used to record the ambient temperature and humidity of the laboratory.

RESULTS AND DISCUSSION

Figure 1 shows the replacement diagrams for each of the temperatures with the relative frequencies of eggs introduced plotted against the ratio of the number of adult progeny per 50 eggs. A comparison of the lines drawn for each species reveals the effect of interspecific competition. At the lowest temperature of 20°C, the number of adult progeny for *S. cerealella* is depressed so that, at the equiproporitional mixture, it has diminished to 8.20, while that of the *E. cautella* remained at 16.25. At 25°C, the numbers of the adult progeny of both

species are almost equal at the equiproportional mixture. However, at 32°C, the adult progeny for S. cerealella is 20.30, while that for E. cautella is 7.30. This shows that E. cautella undergoes a depression as a result of interspecific competition.

The competition exclusion principle states that two species of the same ecological niche cannot exist together or, by virtue of being different, cannot occupy the same niche (DeBach, 1966). The moths S. cerealella and E. cautella belong to the families Gelechiidae and Phycitidae, respectively. According to Winks (1975a), both are cosmopolitan in distribution, their life histories being fundamentally quite similar with little difference in behavior. Comparative sizes of the larvae of S. cerealella and E. cautella in a mixed culture are 6 × 1.5 mm and 11 × 2.0 mm, respectively. In the present study, the mechanism of larval competition is not only by simple exploitation, but also involves some component of interference. There is the influence of temperature and the fact that the aggression of the larvae is a function of the initial input numbers of either species.

The outcome of prolonged competition between the two species at various temperatures can be deduced by using data from replacement diagram to plot a ratio diagram (Fig. 2). At a temperature of 20°C, S. cerealella suffers interspecific competition to a much greater extent than E. cautella and eventually becomes extinct. However at 25°C, there is an unstable equilibrium point which predicts that one species outcompetes the other de-
depending on the initial input numbers of both species. At 32°C, S. cerealella dominates the culture and E. cautella suffers interspecific competition to a greater extent than S. cerealella and eventually the unstable equilibrium point shifted according to the temperature.

A similar comparative life history study showed that C. rhodesianus is quite capable of rapid population growth in tropical conditions (Giga and Smith, 1983), but replacement series experiments demonstrated that C. maculatus would rapidly compete with, eliminate and outlive C. rhodesianus at 25°C and 30°C; only at 20°C would C. rhodesianus outlive C. maculatus, suggesting a possible reason for the restricted distribution of C. rhodesianus.

The major ecological finding from this study is that S. cerealella will outcompete and eliminate E. cautella at 32°C, while E. cautella will outcompete S. cerealella at 20°C. This possibly accounts for the coexistence of both species in the southern part of Nigeria where temperature ranges from 25°C to 30°C. In the northern Nigeria, which has a temperature range of 30–40°C, Avertyey and Ibitoye (1987) reported high incidence of S. cerealella in maize and sorghum. Our present study predicts the survival of S. cerealella and eventual extinction of E. cautella at 32°C.

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REFERENCES