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Reproduction of *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae) on Different Host-grains

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Abstract: The ability of *Rhyzopertha dominica* (F.), to reproduce on different host-grains was studied. The number of F_1 adults emerged on wheat (551 per 5 pairs) was significantly higher than that emerged on maize (121 per 5 pairs). The beetles did not reproduce at all on groundnut. The mean weight of beetles emerged on maize (61.43 mg per 50 beetles) was significantly greater than those emerged on wheat (60.64 mg per beetles). It is suggested that amongst different host-grains used in these studies, wheat is the most productive host, maize is a suitable host and groundnut is a non-host for this particular strain of *R. dominica*.

Key words: *Rhyzopertha dominica*, reproduction, host grains

Introduction

The lesser grain borer, *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae) is a destructive insect pest of stored grains (Dowdy and McGaughey, 1992; Mayhew and Phillips, 1994). Both larvae and adults of this insect use their strong mandibles to attack whole, sound grains and cause extensive damage (Williams *et al*., 1981). The adults chew grains voraciously which not only causes weight loss (Brower and Tilton, 1973) but also reduces germination and vigour of the grains (Jilani *et al*., 1989). It can also facilitate infestation by secondary pests and fungi (Mukherjee and Nandi, 1993). Grains seriously attacked by the beetle may be hollowed out completely until only a thin shell remains. More than one beetle may be found in one grain. Being armed with powerful jaws the beetle can bore directly into wood that is regarded as its original food. As the beetle is small and generally feeds inside the grain, it is difficult to detect the attack at the initial stage. After the attack has been established it is difficult to control as *R. dominica* is one of the most resistant of the stored-product insect species to pesticides (Champ, 1979; Mills, 1983; Lorini and Galley, 1996; Alam *et al*., 1999).

R. dominica has been stated to infest and feed on a variety of stored food materials including grains of all kind, especially wheat, maize, rice and other cereals. The current investigation aims to study the ability of *R. dominica* to reproduce on different types of host grains. To determine whether it can reproduce and develop equally well on all kinds of grains, three contrasting hosts-grains, wheat [*Triticum vulgare* (L.)], maize [*Zea mays* (L.)] and groundnut (peanut) [*Arachis hypogaea* (L.)] were used.

Materials and Methods

Insects: The insects were obtained from stock cultures of *R. dominica* reared on organic wheat grain in a CTH room set at 27±1°C, 60±5% r.h. on a 12 hour light/dark cycle. For easy removal of the newly emerged adults, sub-cultures were prepared using a mixture of whole wheat flour and brewer's yeast (10:1). Parent adults were removed from the sub-culture after seven days. Thirty days after the removal of parent adults, the cultures were sieved daily through 710 μm sieves to remove all newly emerged adults.

Adults were sexed by examination of the tip of the abdomen using a binocular microscope. Adult males were recognized by the presence of a punctuate groove on the fifth abdominal sternite (Ghorpade and Thyagarajan, 1980). This groove is rather shallow and of variable development but is generally present on both sides or at least on one side of the mid-ventral line. At the end of the experiment sexing was confirmed by direct examination of genitalia (Crombie, 1941).

Host grains and experimental procedure: Three host-grains, wheat, maize and groundnut were used in these studies. Five pairs of 7 to 14 days old beetles were released into a jar containing 250g of wheat, maize or groundnut. The top of the jar was covered with muslin cloth. Each of the treatment was replicated five times. The host grains were equilibrated in a CTH room running on 27°C and 60% r.h. for one week before using them in the experiment and moisture content of the commodities was determined. Parent beetles were removed from the jars 7 days after their release. After 20 days of removal of parent beetles jars were observed every day till the adult beetles emerged in F_1 generation. It was made sure that the final observation was recorded after all the adults have emerged in F_1 generation but before the start the F_2 generation. For this, the beetles in any treatment were counted one day before the twice of the minimum number of days they took (after the removal of parent beetles) to emerge as F_1 adults in that treatment. Both alive and dead beetles were counted and percentage of adults survived was calculated. Weight (per 50 beetles) of the beetles in different treatments was recorded using a Mettler AE160 type balance (± 0.1 mg).

Statistical analysis: Results were considered statistically significant when the probability of their occurrence by chance was less than five percent ($p < 0.05$). As there were no adults emerged in groundnut, therefore, it was not included in statistical analysis. Student's t- test was used to analyze the data regarding number and weight of the beetles emerged in F_1 generation on wheat and maize.

Results

Moisture contents of all the grain commodities used in the experiment, i.e. wheat (11.84%), maize (12.23%) and groundnut (12.15%), were similar. Adult emergence in F_1 generation, in case of wheat, started 30 and 31 days after the removal of parent beetles in four and one replication, respectively. While in case of maize, adult emergence started after 32, 33 and 34 days of removal of parent beetles in 2, 2 and 1 replication, respectively. No adult emergence at all was observed in case of groundnut till the end of the experiment i.e. about two months after the removal of parent beetles.

When the beetles were allowed to remain on groundnut kernels for one month, in another set of five replications of this treatment, even then there was no increase in the number of the beetles. However, nearly all of the beetles were alive after one month. In all the replications, holes in groundnut kernels due to *R. dominica*'s boring and dust produced in its result were observed.

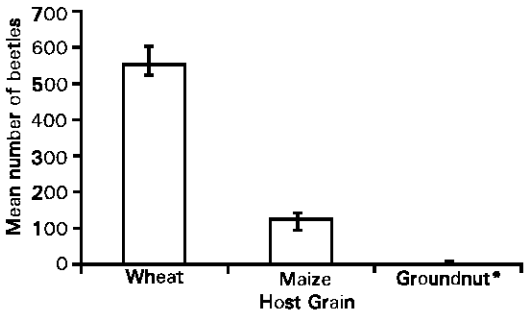

Fig. 1: Mean number of *Rhyzopertha dominica* (F.) adults emerged per five pairs in F_1 generation on different host grains (bars represent standard deviation)
* No F_1 adults emerged at all on groundnut

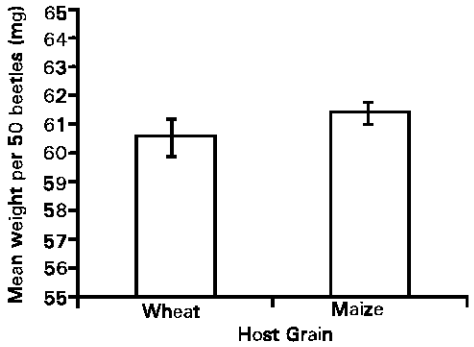

Fig. 2: Mean weight per 50 adults of *Rhyzopertha dominica* (F.) emerged in F_1 generation on different host grains (bars represent standard deviation)

The percentage of the adults survived in both the treatments (i.e. wheat and maize) was nearly one hundred percent as only one beetle each in two replications of wheat and one replication of maize was found dead. The mean number of adults emerged (Fig. 1) on wheat was about 4.5 times higher than that emerged on maize. Analysis confirmed that the difference in the number of adults emerged on wheat and maize was statistically significant ($t = 17.36$, $df = 8$, $p < 0.001$).

In general observation of the beetles in the two treatments, beetles emerged on maize seemed to be heavier than those emerged on wheat. When the beetles were weighed, a difference in the mean weight (per 50 beetles) was observed (Fig. 2). Statistical analysis showed that this difference was significant ($t = -3.69$, $df = 8$, $p = 0.003$) i.e. beetles emerged on maize were significantly heavier than those on wheat.

Discussion

Adult emergence of *R. dominica* in F_1 generation, started 30 to 34 days after the removal of parent beetles in different replications of the treatments wheat and maize. The present results are not completely in agreement with those of Potter (1935), who in his comprehensive paper on the biology of *R. dominica* reported that the total developmental period of this insect, from egg hatch to adult eclosion, on an average is 58 days. However, number of days taken to emerge as adults by *R. dominica* in present studies fall within the range described by Elek (1994). He stated that developmental period of *R. dominica* may vary considerably depending upon temperature and humidity, ranging from 29 to 81 days (Elek, 1994). The relatively short developmental period taken by the beetle in the present studies is understandable as the optimum conditions of temperature and humidity were maintained throughout the experimental period.

R. dominica did not reproduce at all on groundnut. They were able to bore into the kernels and possibly also feed on them as they survived on groundnut for about one month. The present results are opposite to those of Mukherjee and Nandi (1993). They reported that *R. dominica* population increased more quickly on groundnut (8 to 48) than on maize (8 to 19) in a twelve-weeks period. The difference in the results may be due to the difference in the strain of the *R. dominica* and variety of the groundnut used. It is worth mentioning here that generally *R. dominica* is not considered as a pest of stored groundnut, while maize is its established host (Osuji, 1982). It is not clear from the present investigations whether *R. dominica* did not lay eggs on groundnut, eggs were not hatched or larvae were not able to survive (no dead larvae were found in any of the replications). However, it has been clearly demonstrated that groundnut is not a suitable host for the strain of *R. dominica* used in the present studies.

A very high rate of reproduction (551 per 5 pairs) on wheat suggests that wheat is the most productive host for this particular strain of *R. dominica*. Maize does not seem to be as productive host for this strain of *R. dominica* as wheat. However, emergence of 121 beetles from five pairs suggests that it is also a suitable host for *R. dominica* especially as beetles feed on maize were significantly heavier than those feed on wheat. The difference in the rate of reproduction on both the host grains does not seem to be due to the moisture contents of the grains as both the commodities have similar moisture contents.

In conclusions it may be suggested that wheat is the most productive host for this particular strain of *R. dominica* that was used in these studies. Maize is also a reasonably suitable host, however, groundnut is an unsuitable or non-host for this strain of *R. dominica*.

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