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MATING COMPETITIVENESS OF RADIO-STERILIZED MALES OF THE GRAIN WEEVIL, SITOPHILUS GRANARIUS L. (COL: CURCULIONIDAE)

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Abstract. Virgin males of *Sitophilus granarius* L. were irradiated with two sterilizing doses of gamma-radiation and their mating competitiveness studied. The sterilized males competed equally with normal males during their life time, but 100% 16 krad irradiated males and 94%, 8.1 krad-treated males died in the second week after treatment.

The grain weevil, *Sitophilus granarius* L. which is a major pest of stored grain, has been studied by various workers for radiation susceptibility. Considerable information is now available on the radiation susceptibility, environmental factors which modify the radiation susceptibility and the effectiveness of different doses. This information has been compiled by Cornwell.[1] The dose recommended for sterilizing this species is 8.1 krad and the dose recommended for commercial exploitation of grain disinfestation is 16 krad. At these doses the survival is not affected immediately, but some weeks after treatment there is mortality in a certain percentage of the population. The surviving sterile population can give protection against the further build up of pest population from residual and reinfesting population if the mating competitiveness and longevity are not affected by radiation treatment. In stored-grain insects, the mating competitiveness of radiosterilized males of *Tribolium castaneum* Hbst., *Tribolium confusum* Duvall[2] and of *Trogoderma granarium* Everst[3] has been investigated. In *T. confusum*, the males irradiated with 7.1 krad competed equally with normal males, but 16 krad-treated failed to compete with normal males. The irradiated males of *T. castaneum* were partially competitive whereas those of *T. granarium* were equally competitive with normal males. The present investigations were undertaken to investigate the mating competitiveness of radiosterilized males of the grain weevil.

Materials and Methods

The culture of grain weevils *S. granarius* L. was maintained on sterilized whole wheat at 29°C and 55% R.H. The sexes were separated on the first day of adult eclosion. The sexed adults were transferred to fresh wheat in plastic cups and were left undisturbed for the next 8 days. These 9 day-old virgin males were irradiated with 16 krad and 8.1 krad of gamma radiation from Co^{60} source at a dose rate of 3.87×10^5 krads/hr. The irradiated males were paired with untreated males and females in the combinations given in Table 1.

The paired weevils for each replicate were placed in a 3×1 in glass vial with 3 g of wheat for oviposition. On alternate days for the next 20 days the weevils were sieved from the wheat and transferred to new vials; the wheat was returned to the original vial and held for observation of progeny development. Thirty-five days after oviposition, the vials were screened for adult progeny for ten days on every second day. These records of 10 days screening of individual replicate were pooled.

To determine the effect of radiation on survival, three replicates (45 weevils per replicate) at each level were set up in glass jars with 25 g wheat per jar. The survival was checked on every alternate day for 20 days. These figures were pooled with the figures from main experiment and were corrected for control mortalities using Abbot's correction.

Results and Discussion

Effect of Radiation on Survival. The survival of weevils was adversely affected by irradiation (Fig. 1). No mortality was observed for 6 days after irradiation, but there followed a period of acute mortality extending for a further 7 days, when most of the weevils died. In weevils irradiated with 16 and 8.1 krad respectively, 100 and 94% died within 14 days after irradiation. There was no mortality after this period of acute lethality during the experimental period. These observations are in agreement with those obtained by Cornwell, *et al.*[4]

Radiation Induced Sterility in Males. The females paired with 16 krad irradiated males, did not produce any offspring indicating that the males were completely sterile. The females paired with 8.1 krad

TABLE 1

Combination		Replicates
Unirradiated		
5 N males × 5 N females	5	Control
8.1 krad irradiation		
5 T males × 5 N females	5	Treated control
5 T males × 5 N females × 5 N males	5	Competition test
16 krad irradiation		
5 T males × 5 N females	5	Treated control
5 T males × 5 N females × 5 N males	5	Competition test

N, normal; T, irradiated.

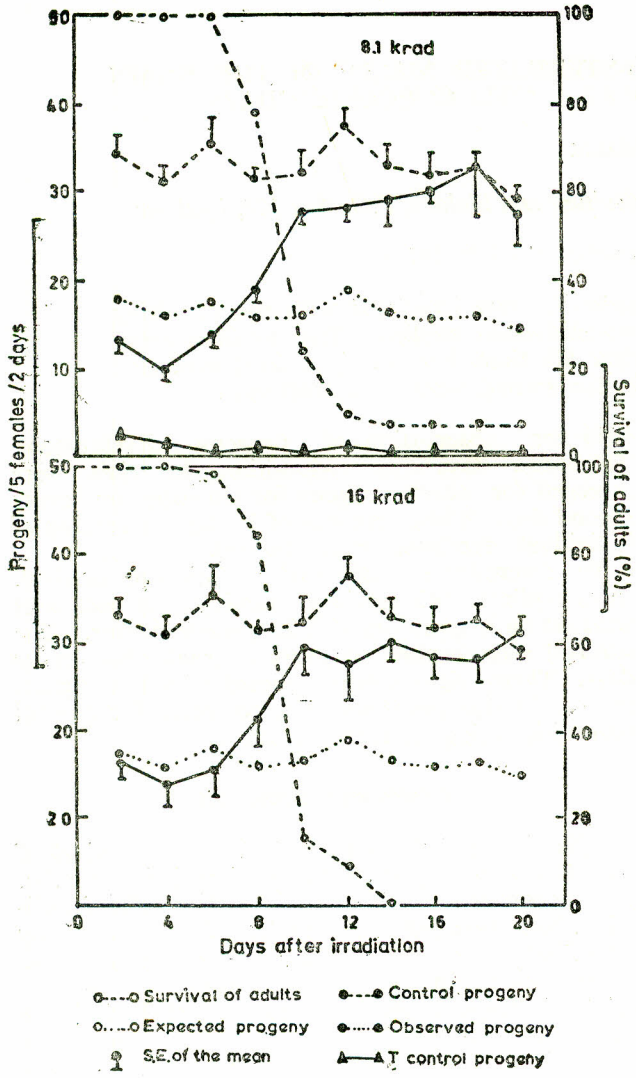

Fig. 1. Mating competitiveness and survival of irradiated males of *Sitophilus granarius* L.

irradiated males, however, produced some progeny at a very low level, 1.34% of control, for 12 days after which they were completely sterile. This observation reveals that the mature sperms are more tolerant of the irradiation than the genetic cells and developing sperm. A phenomenon which has been found to occur also in *T. castaneum*[2] and *T. confusum*.[5] These results further suggest that the male weevils are more sensitive to sterilizing and lethal doses of radiation than males of flour beetles.

Competitiveness of Sterilized Males. Figure 1 shows that, for the period when survival is not affected, the irradiated males at both levels of radiation dose are fully competitive with the control males. This competitiveness was revealed by the suppression of the reproductive potential of normal females confined with both normal and sterile males. It can further be deduced from the figure that as the percentage mortality increases with time, the suppression attributable to irradiated males decreases and from the 14th day onward it is hardly noticeable. At this time, the females paired with the test males produced approximately the same progeny as did normal females paired with normal males ('t' test differences not significant at 5% level).

From these studies it can be suggested that if the irradiated grains are stored for any length of time and a small insect population should survive, the further build-up of the pest population could occur.

These observations further suggest that, in this species, multiple matings take place and utilization of sperm is based on displacement of sperms from earlier matings by the later matings, as well as on mixing of two types of sperm from different matings. A similar mixing and displacement of sperm have been reported in the boll weevil, *Anthonomus grandis* Boheman,[6] in *Drosophila melanogaster* Meigen[7] and in *Tribolium castaneum*.[2]

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