Fecundity and percentage egg hatch of potato tuber moth F_1 progeny of 150-Gy irradiated parents crossed with irradiated moths

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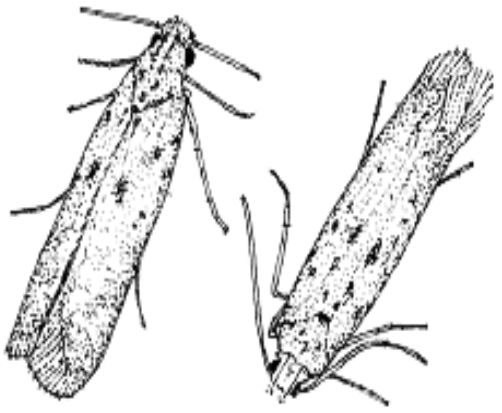
Introduction:

The potato tuber moth (PTM) *Phthorimaea operculella* (Zeller) is a major pest of stored potatoes. The inherited sterility (IS) technique is considered an important component of an area-wide approach to Lepidoptera control. This technique depends on rearing, irradiating moths with doses to produce partially sterile males and completely sterile females and release them to suppress the natural population of the insect pest. A radiation dose of 150 Gy was proposed to ensure the success of IS technique against PTM. However, during IS program several releases of irradiated moths will be performed. Thus, crosses between F_1 progeny, irradiated and wild moths could be occurred.

The objective of this research was to determine fecundity and percentage egg hatch when F_1 adults of 150-Gy irradiated male parents were crossed with irradiated and non-irradiated PTM moths (F_1 progeny follow-up).

Materials and methods:

Newly emerged PTM adults were irradiated with a dose of 150 Gy and either inbred or outcrossed with fertile counterparts. The deposit eggs were collected and allowed to hatch and sterility and fecundity in the F_1 generation were calculated. F_1 neonates from Irradiated ♂ x Normal ♀ were placed on wax-coated potato slices in plastic containers. Pupae were collected and separated by gender and all emerging adults were either inbred or paired singly with 150 Gy-irradiated or unirradiated counterparts of the opposite sex. Moths were allowed to mate and lay eggs. Eggs were collected and incubated. The sterility and fecundity in F_2 generation were calculated. Longevity for the F_1 and F_2 pairs were recorded.



PTM adults

Results:

Fecundity and percentage egg hatch of the PTM parental generation were significantly affected by the dose of radiation used (150 Gy) or by the gender irradiated. This dose effect was greater for crosses involving irradiated females than it was for crosses involving irradiated males. However, adult longevity was not affected by the applied dose. The fecundity and percentage egg hatch of F_1 male outcrossed to 150 Gy-irradiated female were the lowest. F_1 female crossed with 150 Gy-irradiated male had residual fertility comparable to that obtained form 150 Gy-irradiated male x normal ♀. A significant reduction in percentage egg hatch was observed when F_1 male crossed with F_1 female. The mean longevity of F_1 adults was significantly lower than their irradiated parents (Table 1).

Table 1. Percentages of egg hatch, mean number of eggs per female, and moth longevity when potato tuber moth adults were irradiated with 150 Gy and inbred or outcrossed with fertile counterparts (P1), and when F1 adults resulting from irradiated ♂ x normal ♀ were inbred or outcrossed with 150 Gy-irradiated and non-irradiated moths.

Crosses	Percentage egg hatch	Mean no. eggs/ female	Mean moth longevity (day) ♂	♀
Parental generation (P1)				
Irradiated ♂ x Irradiated ♀	5.8c	35.5b	12.4a	12.5a
Irradiated ♂ x Normal ♀	47.6b	60.8a	12.5a	12.9a
Normal ♂ x Irradiated ♀	12.1c	37.9b	12.8a	12.6a
Normal ♂ x Normal ♀	77.4a	64.7a	13.1a	12.8a
F1-generation				
F1 ♂ x 150 Gy-Irradiated ♀	0.1e	20.8c	10.0b	12.4a
F1 ♂ x Normal ♀	27.4c	62.1a	10.2b	10.3b
F1 ♂ x F1 ♀	14.1d	53.7b	10.1b	10.b1
150 Gy-Irradiated ♂ x F1 ♀	44.1b	61.7ab	12.3a	12.5a
Normal ♂ x F1 ♀	68.6a	58.8ab	12.8a	10.2b
Normal ♂ x Normal ♀	74.9a	67.5a	12.9a	12.8a

Percentages within a column for each generation followed by the same letter are not significantly different at 5% level (Analysis of Proportion). Means within a column for each generation followed by the same letter are not significantly different at 5% level (Fisher PLSD).

PTM damages on potato leaves and tubers

Discussion

One of the most important advantages of inherited sterility in *P. operculella* males, like other lepidopteran males, is that the males are more sterile than the irradiated parental generation and the females moths are more radiosensitive than the males. These finding agree with those reported for other lepidopteran species. From practical perspective, when irradiated males and females of *P. operculella* are released to control this species, our results reveal that the dose of radiation 150-200 Gy should be applied to insure: (i) zero adults emergence from crosses involving irradiated females to prevent an increase in the natural population of the pest; (ii) the advantages of inherited sterility phenomenon.