9. REARING, BIOLOGY AND STERILIZATION OF THE PINK RICE BORER, *SESAMIA INFERENS* WLK.

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Introduction

The rice stem borers are one of the groups of most destructive pests of rice throughout Asia. In West Pakistan *Tryporyza incertulas* (Wlk.) and *Sesamia inferens* Wlk. have been reported to cause severe damage to rice crop. The severity of the damage caused by these borers to rice crop can be judged from the fact that in the year of borer epidemic 30–70% of the crop may be lost while in certain cases the borers cause total destruction of the crop (Moiz 1967). *Sesamia inferens* is particularly very serious on thick stem varieties of rice in the province of Sind. This species of borer has also been found damaging the recently introduced variety of wheat "Mexi Pak" in this region.

The control measures adopted against rice stem borers are insecticidal treatments and cultural practices. Although these methods give a good borer control but the complete eradication has not been achieved. Moreover, the life cycle of the pest is such that the eggs are laid deep into leaf sheath and the larvae feed and pupate inside the stem, which make the control of this pest difficult by insecticidal treatment. The continuous use of insecticides also create undesirable toxicity and residual problems. Therefore, other safer methods with wider application must be sought. The use of sterile-male technique offers a way of one such possibility. This technique has successfully been applied for the eradication of screw worm fly (Baumhover *et al.* 1955) from Curacao and south eastern United States of America. Since then this technique has been successfully used in the control or eradication of at least eight species of insects in either experimental or field trials. An experiment already completed in Rota, the Mariana island with sterile melon flies *Dacus cucurbitae* Coq. has led to the eradication of this important vegetable pest (Steiner *et al.* 1965a). In a pilot scale test conducted on the island of Hawaii in a semi-isolated area it was shown that Medfly *Ceratitis capitata* (Wied.) population could be reduced by the sustained release of sterile males.

With a view to study the feasibility of the application of sterile-male technique for the eradication of *S. inferens* the present work was undertaken. This paper therefore, deals with the rearing of the pest on an artificial semisynthetic diet, biology and the determination of sterilizing dose.

Development of Rearing Medium

In order to achieve the goal of utilizing sterile-male technique as a control measure, it is imperative to develop a suitable diet for a mass production of the pest under captivity. The first attempt to rear a phytophagous insect on an artificial diet was carried out by Bottger (1942) who formulated a diet for the European corn borer,

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Pyrausta nubilalis (Hubner). Beck *et al.* (1949) reported successful diet for rearing of the European corn borer. Subsequently, many investgators formulated their experimental diets based on the media formulated by Beck *et al.* Shorey and Hale (1965) reported their success in rearing of the larvae of nine noctuid species on a simple artificial media. *Chilo (zonallus) partellus* Swinhoe was successfully bred on artificial diet by Pant *et al.* (1960), Chatterji *et al.* (1966) and Ashraf *et al.* (1969). The first attempt to rear *Chilo suppressalis* Walker on artificial media was reported by Koyama *et al.* (1951) and Ishii (1952). Fukaya and Kamano (1964) claimed their success in rearing *C. suppressalis* on the artificial diet consisting of agar, cellulose, glucose, sucrose, casein, dry yeast, salt mixture, cholesterol, choline chloride, ascorbic acid, sorbic acid and rice stem powder.

In the present studies different diet combinations were tried for the rearing of *S. inferens* larvae. The artificial diet which produced the best insects in respect of size, uniformity, vigour, fertility, fecundity and general appearance of the adults has the following composition:

Material	Amount
Rice stem powder	10.0 g
Agar	5.0 g
Casein	7.0 g
Sucrose	7.0 g
Brewers' yeast	6.0 g
Vitamin fortification mixture in dextrose	4.0 g
Ascorbic acid	2.0 g
Cholesterol	0.6 g
Wesson's salt	2.0 g
Nipagin	0.2 g
Linseed oil	0.6 ml
Distilled water	170.0 ml

Preparation of the Medium

Each of the diet ingredients, with the exception of agar and distilled water, were thoroughly mixed in a mixer for 2–3 minutes. The agar was separately dissolved by continuous stirring in the distilled water, heated to boiling point and then cooled to 56°C before being added to other mixed ingredients in the blender. The medium was then thoroughly blended for 2 minutes. While still hot the liquid was poured into the rearing vials and allowed to stand for 24 hours. This allows most of the free moisture to evaporate which usually condenses on the sides of the vials. The vials were then stored in a refrigerator until used.

Rearing Procedure

Five neonate larvae were placed in each vial. The diet was changed 3–4 times during the total period of 25–40 days. The rearing vials were kept in a room maintained at a temperature of 80 ±2°F and R.H. 80%. Artificial illumination from day light fluorescent tubes was provided for 16 hours daily in order to inhibit diapause. When the larvae were bred on the above mentioned diet 50–80% transformed into adults. The adults were healthy and vigourous. The emerging adults were transferred to glass chimneys with fresh tillers of rice plant for egg laying. These chimneys were kept at a temperature of 80 ±2°F and R.H. 80%. In order to increase the humidity a sponge soaked in water was also placed inside the chimneys. Cotton wicks soaked in 10% sucrose solution was provided as food for adults.

Biology

The life history of the *S. inferens* was also investigated on an artificial diet under laboratory conditions. The spherical eggs were laid singly in rows between the leaf sheath and stem. There were normally 3–6 rows of eggs in a batch. Females laid 194–700 eggs each. Each egg stage lasted for 6–10 days. The total larval period was 25–40 days, the pupal period 8–11 days, and adult life span was 3–6 days. The total life cycle was completed in 42–67 days at temperature of 80 ±2°F and R.H. 80%.

Sterilization

In order to determine the sterilizing dose for *S. inferens*, 7–8 day old male pupae and one day old male adults were subjected to gamma radiation at dosages of 0, 10, 15, 20, 22.5, 25 and 30 Kr. The irradiation was done with a Co^{60} panoramic type irradiator. The dose rate was 88.6 R per minute. The irradiated adults were crossed with normal females of the same age. Glass chimney were used as test cages. The adults were fed on 10% sucrose solution and fresh tillers of rice plant were provided in each cage for egg laying. Mating frequency was determined by the presence of spermatophores in the bursa copulatrix of the female. The collection of eggs was made every 3–4 days till the death of the female and total eggs laid were counted to determine the fecundity. Out of the total eggs collected a certain portion was kept for checking their fertility (Table 1).

Table 1. Effects of gamma radiation on the fecundity, fertility and mating behaviour following irradiation of 7-8 day old male pupae and one day old male adults of *Sesamia inferens*.

Dose (kr)	No. of pairs tested	Mating %	Ave. no. of eggs laid per mated female	Egg hatch %
		Treated as 7–8 day old pupae		
0	25	24.0	237	86.0
10	20	20.0	269	75.0
15	25	16.0	211	34.5
20	24	20.8	305	5.5
22.5	39	20.5	203	3.0
25	41	22.0	211	—
		Treated as one day old adults		
0	72	18.0	232	88.0
10	64	15.6	217	74.8
15	42	19.0	244	31.0
20	51	21.6	211	6.0
22.5	44	11.4	251	4.0
25	69	16.0	195	—
30	20	20.0	194	—

The data showed that there was a progressive increase in sterility with increasing dose. With pupal treatments the percent of eggs hatched was 5.5 and 3 at 20 and 22.5 Kr, respectively, whereas in the control, 86% of the eggs hatched. None of the eggs hatched following irradiation of 25 Kr.

With adult treatments egg hatch at 20 and 22.5 Kr was 6% and 4%, respectively, whereas no egg hatch was recorded at 25 and 30 Kr. In control 88% of the eggs hatched.

At 25 Kr the fertile eggs from the irradiated male parents showed partial to complete embryonic development (black head stage). It was also observed that there was no effect of radiation on the mating frequency, fecundity and emergence of the moths treated as 7–8 day old pupae upto a sterilizing dose of 25 Kr. Our studies also indicated that under laboratory condition the maximum mating was 24%. The low mating was recorded both in irradiated and control pairs.

From the studies conducted it was concluded that a dose of 25 Kr was found quite satisfactory for the complete sterilization of male *S. inferens* whether irradiated as 7–day old pupae or one day old adults.

To determine the sterilizing dose for female moths, one day old adults were irradiated at 0, 10 and 15 Kr. After irradiation the females were crossed with normal males of the same age. The data so far collected revealed that at 10 Kr there was no egg hatch. This suggests that as with other lepidoptera the females of *S. inferens* are more radio-sensitive than the males.

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Abstract

An artificial medium and laboratory rearing techniques are described on which larvae and adults of *Sesamia inferens* have been successfully reared. Biology of the pest has also been worked out. Radiation studies on the fecundity, fertility and mating behaviour following irradiation of 7–8 day old pupae and one day old male adults revealed that a dose of 25 Kr was enough to achieve the complete sterilization in males. For females a dose of 10 Kr was sufficient to render them sterile. No adverse effect was noticed on the vigour and mating behaviour of the males at the sterilizing dose.

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Discussion

Kalode: Have you tried the diet as mentioned by Shorey *et al.*

Z. A. Qureshi: No, we have tried wheat germ diet as developed by Vanderzant and Adkisson with slight modification.

M. Sakai: Have you noticed any mortality of the larvae in the first instar?

Z. A. Qureshi: Yes, it was about 20 to 30%.