Competitiveness of Gamma Sterilized Moths to Normal Moths of Spotted Bollworm of Cotton, *Earias vittella* (F.)

One of the important requirements for an effective sterile insect release programme is the ability of sterilized insects to compete for mates with normal individuals.

The effects of gamma irradiation on the biology of *Earias vittella* (F.) (*E. fabia* Stoll) were reported by ANWAR and ARIF[1] and it was found that a dose of 35 kR to mature pupae produced completely sterile adults. The present studies were conducted to investigate the competitiveness of sterile adults with normal adults at different ratios in the laboratory cages.

Material and methods. Experimental insects were obtained by rearing larvae on okra, *Hibiscus esculentus* L., at 27 ± 2°C and 70–80% R.H. The pupae were kept individually in glass vials until emergence. One day before adult emergence the mature pupae were irradiated at 35 kR in a ^{60}Co panoramic irradiator (capacity 150 Ci, dose rate 80 Roentgens (R)/min, target distance 5 inches). The moths were caged in wire gauze cages (18 × 18 × 24″) in different ratios immediately after emergence. The adults were fed through cotton wicks soaked in 10% sucrose solution. The eggs were collected on muslin cloth provided in the cages after every 3rd day until the death of the female; the eggs incubated for hatch. Each ratio was replicated at least 5 times.

Per cent egg hatch when sterile males and females were caged with normal insects in different ratios

Ratios[a] I♂	I♀	N♂	N♀	Total cages tested	Cages with females producing fertile eggs	Total number of eggs observed	Hatch (%)
0	0	1	1	10	10	1072	92.9
1	0	1	1	10	6	879	37.1
5	0	1	1	8	3	1559	29.2
10	0	1	1	5	1	751	12.8
20	0	1	1	5	0	504	0.0
0	1	1	1	8	7	798	85.9
0	5	1	1	7	4	905	54.1
0	10	1	1	5	2	605	43.6
0	20	1	1	5	1	329	31.9
1	1	1	1	5	3	926	28.3
5	5	1	1	5	1	846	2.8
10	10	1	1	5	0	690	0.0
20	20	1	1	5	0	1124	0.0

[a] I, Irradiated; N, Non-irradiated.

Results and discussion. Data presented in the Table show that when a normal male was caged with a normal female, the females in all the cages produced fertile eggs and a hatch of 92.9% was recorded. The number of cages with females producing fertile eggs and the per cent hatch decreased as the ratio of sterile to normal insects was increased.

When sterile males were combined with normal insects in a ratio of 1 : 0 :1 :1 (sterile male, sterile female, normal male, normal female) the egg hatch was 37.1%. The egg hatch decreased to 29.2%, 12.8% and 0% when the ratio of sterile males was increased to 5, 10 and 20, respectively.

When sterile females were caged with normal insects, the egg hatch was 85.9% at a ratio of 0 :1 :1 :1 and decreased to 31.9% at the ratio of 0 : 20 :1 :1. When both sterile males and sterile females were confined with normal population at a ratio of 10 :10 :1 :1, none of the females produced fertile eggs.

PROVERBS and NEWTON[2] reported that the reproductive potential of the codling moth, *Carpocapsa pomonella* (L.) was reduced about 75% when 50 γ-irradiated male moths (exposed as mature pupae to 30 or 40 krad) were caged in the laboratory with 5 normal male and 5 normal female moths. The reduction in reproductive potential was less when 50 irradiated males and 50 irradiated females were added to the normal population. HATHAWAY[3] mentioned that population reduction of codling moth in the F_1 generation was 84% when adult males treated with 40 kR were confined in the field cages at a ratio of 20 : 0 :1 :1 (20 treated males, 0 treated female, 1 untreated male and 1 untreated female). ELBADRY[4] on the other hand found that sterile males of potato tuberworm, *Gnorimoschema operculella* (Zeller) do not compete satisfactorily with normal individuals. He recommended that sterile females should be used instead of sterile males in a release programme. HUSSEINY and MADSEN[5] found that sterile females were as effective as sterile males and sterile moths of both sexes were still more effective for the control of navel orangeworm, *Paramyelois transitella* (Walker).

Our results indicated that sterile males of *E. vittella* were more competitive than sterile females in laboratory tests. The addition of sterile males at a ratio of 20 : 0 :1 :1 or sterile males and sterile females at a ratio of 10 :10 :1 :1 to normal population gave similar results of 0% egg hatch. In view of the labour and cost of handling involved in sexing males for release, it is suggested that both sexes of the spotted bollworm should be used in a sterile insect release programme.

Résumé. Quelques essais de mélanges des papillon d'*Earias vittella* (F.) irradiés (à la dose de 35 kR appliquée à des chrysalides en fin de développement) ou non en

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proportions variable ont été réalisées dans les conditions du laboratoire. Les résultats montrent que l'introduction de mâles stériles réduit fortement la viabilité des œufs; mais une réduction encore plus importante est obtenue en introduisant à la fois des mâles et des femelles stériles. Nous constatons que mélangés dans la proportion de 10:10:1:1 d'insectes (mâles, femelles stériles; mâles, femelles normaux) provoque une stérilité absolue.

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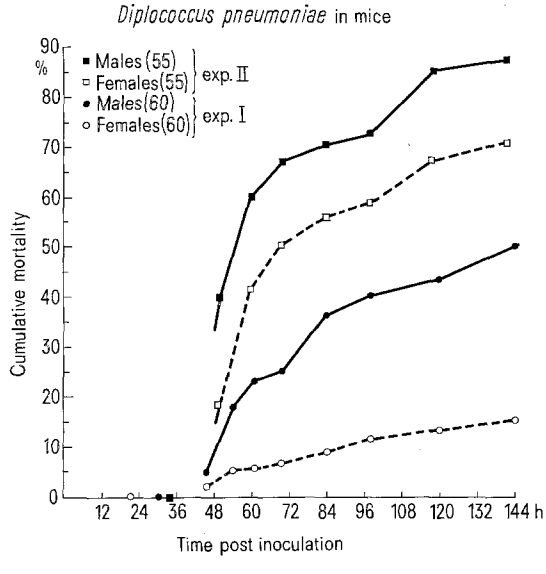
Sex Difference in Susceptibility of Mice to Pneumococcus

Clinically and experimentally, males appear to have less resistance to infectious diseases than females[1–3]. With pneumococcus, a sex difference in susceptibility has been reported for man [3,4] and rachitic rats[5]; in mice, altered resistance has been noted only after the treatment of the animals with estrogen[6]. We show here that mortality is distinctly higher in males than females following i.p. inoculation of normal mice with *Diplococcus pneumoniae*.

Materials and methods. We used a strain of *D. pneumoniae*, type 12, which had been isolated from man. Alternate broth-mouse-broth passages were made to adapt the organism for infection of mice. The organism was grown for 20–24 h in brain heart infusion (BHI) broth containing 10% horse serum. Several mice were then inoculated i.p. with 0.1–0.5 ml of the culture. When a mouse appeared to be terminally ill, heart blood was removed and 1 drop added to 10 ml of broth medium. After 20–24 h incubation, the pure culture of pneumococcus type 12 obtained was used for another round of animal inoculations. Under this procedure, the strain became highly virulent for mice and an inoculum of 70–100 microorganisms gave an LT_{50} in less than 48 h. When we diluted the inoculum, animals tended to survive the infection.



Cumulative % mortality of male and female albino mice (29 g av.) inoculated i.p. with *D. pneumoniae*, type 12. The sex difference is stastically significant by Chi Square contingency tests.

Since a rapidly attained LT_{50} could obscure any sex difference[1], we 'attenuated' the organism by 24 serial passages through BHI in the absence of horse serum. The undiluted culture from the 24th passage was divided into 0.3 ml portions and stored at –60°C. For the experiments with sex segregated animals described here, inoculum was thawed and diluted with BHI containing 10% horse serum.

Albino mice, 6–8 weeks old and averaging 29 g were used to test the effect of sex on resistance to pneumococcus. They were bred in our laboratory from Charles River CD-1 stock. At weaning, males and females were separated and held on litter in colony cages, food (Purina Laboratory Chow) and water being supplied ad libitum. Just prior to an experiment, the mice were sorted into wire bottomed cages, 15×30 cm, holding 10 each of one sex. Wire bottomed cages were used to aid in observing and removing dead animals.

Using a plastic 1 ml syringe with a 27 gauge needle, each treated mouse was injected i.p. with 0.1 ml of a diluted suspension estimated to contain about 1700 organisms by the most probable number method[7]. A total of 115 male and 115 female mice were infected in the two experiments reported here. Approximately half that number of control animals were injected i.p. with 0.1 ml of sterile broth.

Heart blood from a random sample of terminally ill animals was streaked on blood agar plates for reisolation and identification of organisms. Pneumococci were invariably recovered in pure culture. We used specific typing serum purchased from the Statens Serum Institut, Copenhagen, Denmark, to identify the isolates as type 12 pneumococci.

Results and discussion. Cumulative % mortality is plotted by sex, separately for the 2 experiments, in the Figure. In both experiments, mortality began between 36 and 48 h. In Experiment I, the LT_{50} for male mice was reached at 144 h, while females at that time showed less than 20% mortality. In Experiment II, the LT_{50} for males was reached between 48 and 60 h, and for females, at

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