The present results show that EMS acts as a sterilant and sterilizes both males and females of potato tuber moth.

25 April 1988; Revised 23 May 1988

1. Commonwealth Institute of Entomology, *Phthorimaea operculella* (Zeller), Distrib, Maps Insect Pests (A), No. 10, London, *Commonw. Agric. Bur.*, 1968.
2. Champ, B. R. and Shepherd, R. C. H., *Queensl J. Agric. Anim. Sci.*, 1965, **22,** 69.
3. Richardson, M. E. and Ross, D. J. W., *Bull. Entomol. Res.*, 1966, **57,** 271.
4. Harwalker, M. R., Khaire, S. N. and Rahalkar, G. W., *J. Econ. Entomol.*, 1971, **64,** 358.
5. Rahalkar, G. W., Harwalker, M. R. and Khaire, S. N., In: *Proceedings of panel, application of induced sterility for control of Lepidopterous populations*, IAEA, Vienna, 1971, p. 135.
6. Nabi, M. N., *Bull. Entomol. Res.*, 1983, **73,** 405.
7. Nabi, M. N. and Harrison, R. A., *Ann. Appl. Biol.*, 1984, **104,** 413.
8. Nabi, M. N. and Harrison, R. A., *Ann. Appl. Biol.*, 1984, **104,** 423.
9. Chamberlain, W. F., *J. Econ. Entomol.*, 1962, **55,** 240.
10. Thompson, T. and Rodrigues, P. H., *J. Med. Entomol.*, 1979, **15,** 115.
11. LaChance, L. E., Degrugillier, M. and Leverich, A. P., *Ann. Entomol. Soc. Am.*, 1970, **63,** 422.
12. Campion, D. G., *Cotton Grow. Rev.*, 1970, **47,** 135.
13. Jackson, H., In: *Antifertility compounds in male and female*, Charles C. Thomas Publishers, Springfield, 1966, p. 214.
14. Outram, I. and Campion, D. G., *Ann. Appl. Biol.*, 1967, **60,** 439.
15. Saxena, S. and Aditya, V., *Cytologia*, 1969, **34,** 405.
16. Shaw, J. G. and Riviello, M., *Ciencia*, 1962, **22,** 17.
17. Lindquist, D. A., Gorzycki, L. J., Mayer, M. S., Scales, A. L. and Davich, T. B., *J. Econ. Entomol.*, 1964, **57,** 745.
18. Schwartz Jr. P. H., *J. Invertebr. Pathol.*, 1965, **7,** 148.
19. Sprenkal, R. K. and Yendol, W. G., *J. Econ. Entomol.*, 1969, **62,** 122.
20. Jalaja, M. and Prabhu, V. K. K., *Entomon.*, 1976, **1,** 43.

EFFECT OF JUVENILE HORMONE ANALOGUE METHOPRENE (ZR-515) ON THE PREPUPAL AND PUPAL STAGES OF THE POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* ZELLER (LEPIDOPTERA: GELECHIIDAE)

G. V. PRASAD REDDY and K. C. DEVARAJ URS

Department of Entomology, University of Agricultural Sciences, GKVK Campus, Bangalore 560 065, India.

POTATO tuber moth, *Phthorimaea operculella* Zeller, is a major pest of potatoes both in the field and in stores. It causes 30–70% losses in the country stores in India[1]. Juvenile hormone anologues (JHA) have been reported to have high biological activity against insect pests, intermediate specificity, low mammalian toxicity and short environmental persistence[2]. The effect of the JHA, Methoprene (ZR-515), on development of eggs and larvae of *Corcyra cephalonica* has already been demonstrated[3]. This paper attempts to study the effect of different concentrations of Methoprene (ZR-515) on the prepupal and pupal stages of *P. operculella* Zeller.

The test insects were from a pure culture maintained in the laboratory on potato tubers. Concentrations of 0.25, 0.50, 0.75, 1 and 1.50% of the JHA were prepared in 1% acetone solution; for control only 1% acetone was used. Each of these concentrations was applied (5 μl per insect) to the prepupae individually on the dorsal surface using an automatic microapplicator. The same concentrations were applied to the pupae topically (1 μl per individual) on the dorsal surface. In each experiment (prepupae, pupae) and for each concentration, ten individual insects were used. Each set of experiments was replicated four times. The data are presented in tables 1 and 2.

There was a significant reduction in percentage of pupation with increase in the concentration of Methoprene (ZR-515) applied. Devaraj Urs and Byakod[4] reported that pupation percentage in *Spodoptera litura* decreased with increase in the concentration of JHA (Altozar).

In the present studies, adult emergence was 70% in control, 30% in pupae treated with 0.5 and 0.25% JHA and 20% in pupae treated with 0.75% JHA; there was no adult emergence at all in pupae treated with 1 and 1.5% JHA. The percentage of adult

Table 1 *Effect of Methoprene (ZR-515) on the prepupae of Phthorimaea operculella Zeller**

Conc. of Methoprene (%)	Percentage of		
	Prepupae that became normal pupae	Prepupae malformed or dead	Adult emergence
0.25	70	30	30
0.50	55	45	30
0.75	30	70	20
1.00	12	88	Nil
1.50	05	95	Nil
Control	95	05	70
CD(P=0 01)	1.92	1.20	1.03

*Averages of results from four replicate experiments.

emergence in the control group was significantly higher than in the JHA-treated groups. These findings are supported by those of Outram[5] who reported that adult emergence in *Prodenia litura* was affected at higher doses of a synthetic juvenile hormone (Roeller compound). Outram[5] also reported that there was a low percentage of emergence of deformed adults when spruce budworm pupae were treated with high doses of a synthetic JHA. In the present study also, it was found that the adults that emerged from the Methoprene (ZR-515) treated pupae were malformed. Such malformations were also reported earlier[4] in tobacco cutworm pupae treated with JHA (Altozar).

The authors are thankful to Ms H. N. Rama for supplying the potato tuber moth culture. The Juvenile hormone analogue, Methoprene (ZR-515), received from M/s Zoecon Corporation, Palo Alto, California, USA, is gratefully acknowledged.

Table 2 *Effect of Methoprene (ZR-515) on the pupae of Phthorimaea operculella Zeller**

Conc. of Methoprene (%)	Percentage of	
	Normal adults	Adults with malformed characters
0.25	30.0	Nil
0.50	23.3	08 2
0.75	15.0	12.5
1.00	15.0	18.3
1.50	05.0	32.0
Control	70.0	Nil
CD(P = 0.01)	2.04	2.30

*Averages of results from four replicate experiments.

22 April 1988

1. Lall, B. S., *Indian J. Entomol.*, 1964, 184. (Silver Jubilee Number).
2. Devaraj Urs, K. C. and Ramamurthy, R., *Curr. Sci.*, 1976, **45**, 600.
3. Ambika, B. and Abraham, C. C., *Agric. Res. J., Kerala*, 1982, **20**, 60.
4. Devaraj Urs, K. C. and Byakod, S. S., *Curr. Sci.*, 1976, **45**, 599.
5. Outram, I., *J. Econ. Entomol.*, 1973, **66**, 1033.

TOTAL DEVELOPMENTAL ARREST OF FOURTH INSTAR LARVAE OF *CULEX QUINQUEFASCIATUS* TREATED WITH PENFLURON

S. C. SAXENA and R. K. KAUSHIK
Department of Zoology, University of Rajasthan, Jaipur 302 004, India.

ALTHOUGH several workers[1-3] have observed the adverse effects leading to mortality of Penfluron, this is the first report pertaining to complete developmental arrest of fourth instar larvae of *Culex quinquefasciatus* treated with Penfluron. The duration of the 4th instar is abnormally prolonged and the larvae fail to pupate and finally die as 4th instar larvae.

A laboratory colony of *C. quinquefasciatus* was maintained under controlled conditions (temperature 28°C and humidity 70–80%). Penfluron was dissolved in acetone (1% w/v) to obtain a standard solution. Other concentrations (0.5, 1 and 5 ppm) were prepared by diluting the standard solution with distilled water. Tween-40 was used as an emulsifier. In the control experiment, acetone and emulsifier alone were used. Larvae in the 1st day of the 4th instar were used.

It is evident from the data (table 1) that Penfluron significantly prolongs the duration of the 4th instar and completely suppresses pupation. The maximum survival recorded for larvae treated with 0.5 ppm Penfluron was 35 days. For larvae treated with 1 and 5 ppm of Penfluron, the maximum survival recorded was 26 and 7 days respectively. In the case of treatments with 0.5 and 1 ppm of the insecticide, about 90% of the larvae survived for 10 days without pupating. None of the larvae pupated. In the control group all the larvae pupated on the 4th day of the 4th instar and on the 4th day after pupation adults emerged from all the pupae.