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).

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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.

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

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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.

Table 1 *Effect of Penfluron on 4th instar larvae of Culex quinquefasciatus*

Conc. (ppm)	Replicates	No. of larvae treated	Days of 4th instar and no. of surviving larvae*													
0.5	1	27	1–2 / 27	3–8 / 26	9–10 / 24	11–12 / 23	13–16 / 18	17 / 16	18–20 / 14	21–23 / 13	24 / 10	25–26 / 8	27–28 / 7	29 / 5	30–32 / 4	33–35 / 0
	2	19	1–2 / 19	3–9 / 17	10–11 / 16	12–13 / 14	14–18 / 11	19–20 / 8	21–23 / 7	24–27 / 5	28–29 / 4	30–32 / 2	33 / 0			
	3	23	1–2 / 23	3–8 / 22	9–10 / 19	11–13 / 17	14–16 / 14	17–19 / 12	20–24 / 10	25–28 / 7	29–31 / 5	32 / 4	33 / 2	34–35 / 1	36 / 0	
1.0	1	15	1–3 / 15	4–9 / 13	10–11 / 10	12–13 / 9	14 / 7	15–16 / 6	17–18 / 5	19–20 / 4	21–22 / 2	23–25 / 1	26 / 0			
	2	18	1–3 / 18	4–10 / 17	11–13 / 15	14 / 12	15–16 / 9	17–18 / 7	19–21 / 5	22–23 / 2	24 / 0					
	3	15	1–3 / 15	4–9 / 13	10–12 / 12	13–15 / 9	16 / 7	17–19 / 6	20–22 / 4	23–25 / 3	26 / 0					
5.0	1	20	1 / 15	2 / 14	3 / 11	4 / 9	5 / 4	6 / 1	7 / 0							
	2	20	1 / 16	2 / 12	3 / 7	4 / 4	5 / 2	6 / 2	7 / 0							
	3	20	1 / 12	2 / 7	3 / 5	4 / 2	5 / 2	7 / 0								
			Larval 4th instar				Pupa									
Control	1	25	1 / 25	2 / 25	3 / 24	4 / 24	5 / 24	6 / 24	7 / 24	8 / 24						
			All pupated				All adults emerged									

(*Contd. . . . next page*)

(*Table 1 contd. . . .*)

Conc. (ppm)	Replicates	No. of larvae treated	Days of 4th instar and no. of surviving larvae*							
	2	25	$\frac{1}{25}$	$\frac{2}{25}$	$\frac{3}{25}$	$\frac{4}{25}$	$\frac{5}{25}$	$\frac{6}{25}$	$\frac{7}{25}$	$\frac{8}{25}$
						All pupated				All adults emerged
	2	25	$\frac{1}{25}$	$\frac{2}{24}$	$\frac{3}{24}$	$\frac{4}{24}$	$\frac{5}{23}$	$\frac{6}{23}$	$\frac{7}{23}$	$\frac{8}{23}$
						All pupated				All adults emerged

*Figures in upper row are days of 4th instar and figures in lower row are no. of larvae surviving.

The results show that Penfluron disrupts the growth and development of 4th instar larvae of *C. quinquefasciatus*. The significant observations are prolongation of larval period and complete suppression of pupation. All the concentrations tested blocked development; with higher concentrations the effect was quicker.

Prolongation of larval period and suppression of pupation may be due to imbalance caused by the insecticide in growth-stimulation and growth-inhibition hormone levels as suggested by Novak[4]. The juvenilizing activity of chitin inhibitor compounds against mosquito larvae has been reported earlier[5–8]. Gujar and Mehrotra[9] recorded the juvenilizing effect of plant extracts on the last larval instar of *Spodoptera litura* and related the juvenilizing action to disruption in the insect's endocrine system. It is quite possible that complete arrest of development induced by Penfluron in *C. quinquefasciatus* is a juvenilizing effect of a disrupted neuroendocrine system. Whether such an effect is insect-specific is to be investigated.

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EFFECT OF VARIOUS INSECTICIDES ON HONEY BEE, *APIS FLOREA* FABRICIUS IN 'BER' (*ZIZYPHUS MAURITIANA* LAMK)

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'BER' (*Zizyphus mauritiana* Lamk) is a cross-pollinated fruit crop, where pollinators play a vital role in fruit setting. It is reported that 85% of the cross pollinated flowers depend on insect pollinators[1]. In India, the activities of honey bees on different crops were reported earlier[2,3]. Ber is an important fruit crop in the semi-arid zones of North Gujarat, where *Apis florea* is an important pollinator. However, scanty information is available on the adverse effects of various insecticides (to *A. florea*) which are commonly used in 'ber' for insect pest management. The present study was carried out to determine the effect of insecticidal spraying on the population of *A. florea*.

The popular ber variety 'Umran' was used for this study and the experiment was set in a split-plot design with nine insecticidal treatments and one untreated control. The details of insectides used are given in table 1. Spraying was done with a knapsack sprayer using 5 l mixture per tree. The first spraying was immediately after flowering and subsequent sprayings were done at a three week interval. Initial observations on the honey bees were recorded 24 h before each spraying and there after observations were taken at 24, 48, 72 h and one week after spraying. For recording the honey bee population, four branches (50 cm each) each from south, north, east and west direction were tagged. The observations on honey bee population were recorded by four persons at a time standing in four different directions, observing the tagged branches at 5 min interval. The results subjected to statistical analysis are presented in table 1.

The data on the population of the noney bee recorded before and after spraying (table 1) revealed a significant difference in the honey bee population due to insecticide, spray, period, insecticide × period and spray period. The control recorded the highest bee population (3.17/0.5 m branch) which was statistically at par with 0.07% endosulfan (3.05/0.5 m branch), 0.03% thiometon (2.82/0.5 m branch) and 0.03% demeton-*o*-methyl (2.81/0.5 m branch) whereas the rest of the insecticidal treatment remained at par and showed lower