2070 and 2125 kg/ha respectively and were superior to other treatments.

Rathi *et al.* (1982) reported that fenvalerate 0.01 per cent spray was toxic to *S.litura* and was superior to other insecticides *viz.* phenthoate (0.05%), dimethoate (0.05%) and quinalphos (0.05%). The synthetic pyrethroids decamethrin (0.005%), cypermethrin (0.01%) and fenvalerate (0.01%) were found to be effective in checking *S.litura* on groundnut (Patel and Vyas, 1989). Mathirajan (1998) reported that 15 g ai./ha of lambdacyhalothrin was effective against *S.litura* on groundnut. In the present study also, betacyfluthrin 025 EC effectively checked the population of *S.litura* and a dose of 18.75 g a.i./ha is sufficient for control of the pest and to obtain an increased pod yield.

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References

Jaglan, R.S., Sircar, P. and Dhingra, S. (1997). Relative efficacy of solvents and emulsifiers in designing of the toxicity of decamethri emulsion to *Spodoptera litura*. *Indian Ent.* **58**: 226-230.

Mathirajan, V.G. (1998). Bioefficacy and dete mination of lambdacyhalothrin (Karathe EC) residues on brinjal, tomato and chillie *M.Sc.(Agri.) Thesis*, Tamil Nadu Agricultur University, Coimbatore-641 003.

Patel, R.L. and Vyas, H.N. (1989). Evaluation toxicity of some insecticides against tl eggs of *Spodoptera litura* infesting ground nut. *Agricultural Science Digest (Karnal)* **9**: 110-112.

Ramana, V.V., Reddy, G.P.V. and Krishnamurthy M.M. (1988). Synthetic pyrethroids and othe bait formulations in the control of *Spodopter litura* (Fab.) attacking *rabi* groundnut *Pesticides*, **1**: 13-16.

Rathi, R.K., Thakur, R.C., Kharthi, A.K. and Patitunda K.A. (1982). Relative efficacy of some moder insecticides against *Spodoptera litura* (Fab. on soybean. *Pestology*, **6**: 13.

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Research Notes

Acute toxicity of betacyfluthrin to *Helicoverpa armigera*

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Helicoverpa armigera (Hub.) is the most dreaded insect pest in agriculture, accounting for the consumption of over 30 per cent of the total insecticides used all over the world. An annual crop loss to *Helicoverpa* in India has been estimated to around Rs.2000 crores inspite of the use of insecticides worth about Rs.5000 crores (Pawar, 1998). The pest has assumed major status in crops like cotton, pigeonpea, chickpea, groundnut, sunflower, tomato and many other crops of economic importance. Synthetic pyrethroids are playing an important role in the control of *H.armigera* all over the world because of their quick action, high insecticidal efficacy and low mammalian toxicity (Sidhu *et al.* 1983). Betacyfluthrin 025 EC (Bulldock) is a new insecticide of the pyrethroid group developed by Bayer. In the present study the acute toxicity of betacyfluthrin was evaluated against *H.armigera*.

able 1. Acute toxicity of betacyfluthrin for *Helicoverpa armigera* larvae - Topical application method

l. lo.	Instars	Time (h)	LC_{50} (ppm)	95 per cent fiducial limits		y = a+bx	χ^2 at p=0.05
				Upper limit (ppm)	Lower limit (ppm)		
	Second	24	0.635	0.835	0.484	y = 3.779 + 1.52 x	2.239
		48	0.465	0.639	0.338	y = 4.027 + 1.459 x	3.095
	Third	24	2.009	2.927	1.379	y = 3.398 + 1.229 x	1.302
		48	1.292	1.883	0.887	y = 3.314 + 1.517 x	3.426
).	Fourth	24	2.418	2.838	2.059	y = 1.302 + 2.673 x	3.079
		48	4.277	5.793	3.157	y = 3.072 + 1.182 x	1.587
i.	Fifth	24	13.227	14.963	11.692	y = 4.225 + 4.349 x	3.846
		48	12.061	13.637	10.666	y = 5.079 + 4.843 x	10.564
5.	Sixth	24	16.966	18.885	15.242	y = 3.928 + 4.004 x	4.875
		48	15.249	17.065	13.627	y = 4.007 + 4.126 x	8.602

All lines ar good fit ($p<0.05$)

Table 2. Acute toxicity of betacyfluthrin for *Helicoverpa armigera* larvae - Larval dip method

Sl. No.	Instars	Time (h)	LC_{50} (ppm)	95 per cent fiducial limits		y = a+bx	χ^2 at p=0.05
				Upper limit (ppm)	Lower limit (ppm)		
1.	Second	24	1.315	1.668	1.037	y = 3.241 + 1.563 x	5.534
		48	0.842	1.106	0.641	y = 3.694 + 1.411 x	5.534
2.	Third	24	3.447	4.788	2.481	y = 3.196 + 1.174 x	1.875
		48	2.820	3.763	2.114	y = 2.954 + 1.411 x	7.775
3.	Fourth	24	4.810	6.173	3.748	y = 2.537 + 1.464 x	7.752
		48	2.964	3.972	2.212	y = 3.036 + 1.334 x	3.463
4.	Fifth	24	16.346	18.808	14.206	y = 1.812 + 3.075 x	4.297
		48	14.092	16.443	12.076	y = 1.991 + 3.253 x	4.448
5.	Sixth	24	19.931	22.090	17.983	y = 3.698 + 3.782 x	1.092
		48	18.306	20.496	16.350	y = 3.213 + 3.629 x	1.326

All lines are good fit ($p<0.05$)

Acute toxicity of betacyfluthrin was assessed using two methods *viz.* larval dip and topical application on the laboratory cultured *H.armigera* larvae of different instars.

a) Topical assay method

Serial dilutions of technical grade betacyfluthrin with 98.7 per cent purity (obtained from Bayer (India) Ltd.) were prepared in analytical grade acetone. By dissolving 0.101 g of technical grade in 100 ml of acetone, 1000 ppm of betacyfluthrin was prepared. Different concentration of betacyfluthrin from 0.25 ppm to 40 ppm were prepared by serial dilution and used for the acute toxicity experiments. An aliquot of 1 µl of known dilution was delivered on the thoracic dorsum of larvae using a repeating dispenser (PB 600-1, Hamilton Co. Ltd.) fitted with Rheodyne needle. For untreated check, larvae were treated with acetone

alone. Not less than 40 larvae per dose were used per treatment. Mortality counts were taken at 24 and 48 hours after treatment. Bioassays were carried out at 26 ± 1°C under approximately 12 h: 12 h LD photoperiod.

b) Larval dip method

Aqueous dilution of betacyfluthrin 025 EC (25 g of betacyfluthrin in one litre) were prepared in distilled water. Betacyfluthrin 50 ppm was prepared by dissolving 2 ml of betacyfluthrin 025 EC in one litre of distilled water. By serially diluting this, different concentrations of betacyfluthrin from 1 ppm to 40 ppm were prepared. Batches of different instars of *H.armigera* larvae were submerged for 5 seconds as described by Watkinson *et al.* (1984). A group of 20 larvae were placed on a clean muslin cloth (10x10 cm size) and dipped in 100 ml of the appropriate dilution in a 500 ml beaker and gently swirled for 5 seconds to ensure complete wetting. Muslin cloth along with the group of larvae was removed and the excess liquid was removed by using a filter paper and shade-dried for 5 min. Then the treated larvae were transferred individually into semi-synthetic diet. For untreated check, insects were treated with distilled water alone. based on the Finney's (1971) method of probit analysis.

The results on acute toxicity of betacyfluthrin to *H.armigera* indicated that 50 per cent mortality of larvae was obtained at a very low concentration for early instars and high concentration for late instars.

a) Topical application method

The LC_{50} of betacyfluthrin for second, third, fourth, fifth and sixth instars of laboratory cultured *H.armigera* was 0.635, 2.009, 2.418, 13.227 and 16.966 ppm respectively at 24 h after treatment (HAT) and 0.465, 1.292, 4.277, 12.061 and 15.249 at 48 HAT respectively (Table 1).

b) Larval dip method

The LC_{50} value of betacyfluthrin assessed by larval dip method was 1.315, 3.477, 4.810, 16.346 and 19.931 ppm at 24 HAT and 0.842, 2.820, 2.964, 14.092 and 18.306 ppm at 48 HAT for second, third, fourth, fifth and sixth instars respectively (Table 2).

Gouthaman (1994) found that the LD_{50} of cypermethrin and fenvalerate for thrid instar larvae of *H.armigera* by larval dip was 0.75 and 1.40 ppm respectively. Lagadic and Bernard (1993) reported that the LC_{50} of cyfluthrin for fourth instar larvae of *Heliothis virescens* (F.) was 3.1 µg/g by using treated diet method. Srinivas (1987) found that LC_{50} of cypermethrin and fenvalerate for third instar larvae of *H.armigera* was 1.103 and 1.152 µg/g respectively. In present study also, more or less similar results were obtained for betacyfluthrin.

Between the two methods used *viz.* topical application method and larval dip method, variation in the LC_{50} of betacyfluthrin was observed. In topical application, insects required less toxicant than in larval dip method. The possible reasons may be, in the topical application method insect is exposed to the toxicant for longer time and further in this method technical grade material with purity of 99.7 per cent was used. While in larval dip method, the insects were exposed for 5 seconds only and formulated betacyfluthrin was used.

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References

Finney, D.J. (1971). Probit analysis and statistical treatment of the sigmoid response curve. Cambridge Univ. Press, London, 318p.

Gouthaman, S. (1994). Studies on monitoring techniques for detecting insecticide resistance in *Helicoverpa armigera. M.Sc.(Agri.) Thesis*, Tamil Nadu Agricultural University, Coimbatore-641 003.

Lagadic, L. and Bernard, L. (1993). Topical and oral activities of imidacloprid and cyfluthrin against susceptible laboratory strains of *Heliothis virescens* and *Spodoptera littoralis. Pestic. Sci.* 38: 323-328.

Pawar, C.S. (1998). *Helicoverpa*, A national problem which needs a national policy and commit-

ment for its management. *Pestology*, 22: 51-58.

Sidhu, A.S., Chahal, B.S. and Sukhija, S.S. (1983). Adaptive trials with synthetic pyrethroids for the control of cotton bollworm in Punjab. *Pesticides*, 17: 13-14.

Srinivas, P.R. (1987). Studies on the ecology and management of gram pod borer *Helicoverpa armigera*. *Ph.D. Thesis*, Tamil Nadu Agricultural University, Coimbatore-641 003.

Watkinson, I.A., Wireman, J. and Robinson, J. (1984). A simple test for field evaluation of the susceptibility of insect pests to pesticides. In: Proceedings of British Crop Protection Conference-Pests and Diseases. British Society of Chemical Industry. Brighton, UK. 559-564 pp.

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Research Notes

Life table studies for rice leaf folders

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Rice crop is vulnerable to attack by more than 800 insect species. In tropical Asia, 20 species are of major importance and of regular occurrence (Dale, 1994). The high magnitude of yield loss in rice is largely attributed to the lepidopterous stemborers, homopterous leaf- and plant hoppers and a complex of leaf feeding insects. In the later group, rice leaf folders are the main species (Reissig *et al.* 1986). Sabaratinam and Vennila (1996) had indentified that the research on the leaf folders is the most important technical need for the farmers of Tamil Nadu. Though reports are available on the rice leaf folders, the life table study for the rice leaf folder is wanting.

Leaf folders *viz. Cnaphalocrosis medinalis* Gueene and *Marasmia patnalis* Bradley were reared following the method of Waldbauer and Marciano (1979). Ten pairs of newly emerged adults were allowed to mate and the mated females were introduced into wooden oviposition cages (45x45x60 cm) having 45-day-old Taichung Native 1 (TN 1) plant for four days. One day after oviposition, the plants with eggs were removed and placed separately in wooden rearing cages (45x45x60 cm) for hatching. The larvae hatched from 100 eggs of each species (*C.medinalis* and *M.patnalis*) were individually reared on TN 1 plants. The larvae were maintained separately to study the developmental period, survival and longevity. The average temperature and relative humidity during the study period (August 1998 to April 2000) was 26.1°C to 32.9°C and 76.0 to 93.5 per cent respectively. The life table was constructed as per the method of Carey (1993).

The life table studies revealed that the egg period lasted for 7 days, larval period 25 days, pupal period 7 days and the adult longevity 9 days for *C.medinalis* while it was 8, 29 and 8 days respectively for *M.patnalis* (Table 1 and 2). *C.medinalis* suffered the highest mortality during the larval stage (12.00%) than during the egg stage (10.00%) and the pupal stages (5.00%), while *M.patnalis* suffered a heavy mortality during egg (18.00%) and larva (15.00%) when compared to the pupa (2.00%). Among the two cohorts *C.medinalis* reached adulthood of 73 per cent while in *M.patnalis* only 65 per cent reached adulthood. The expectation of life of a newly hatched larva was 32.29 days and the entropy value for *C.medinalis*