ioefficacy and residues of betacyfluthrin used against *Helicoverpa rmigera* on groundnut

. CHELLADURAI, K. RAMESH BABU AND G. SANTHARAM
ept. of Agricultural Entomology, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu.

Abstract: Bioefficacy of betacyfluthrin 25 EC was evaluated against *Helicoverpa armigera* (Hub.) on irrigated groundnut (*Arachis hypogaea* L.) at doses 12.5, 18.75 and 25.0 g a.i. ha^{-1} with cypermethrin 10 EC at 60 g a.i. ha^{-1} and quinalphos 25 EC at 500 g a.i. ha^{-1} as standards. Betacyfluthrin at 18.75 g a.i. ha^{-1} effectively checked the larval population of *H. armigera* and the chemical had no phytotoxic effect on groundnut even at a higher dose of 50.0 g a.i. ha^{-1}. The residue of betacyfluthrin was detected only in haulm at higher doses (25 and 50 g a.i. ha^{-1}) when applied twice during *kharif*.

Key Words: Groundnut, Betacyfluthrin, Bioefficacy, Helicoverpa armigera, Phytotoxicity, Residue.

ıtroduction

In recent years, the gram pod borer *elicoverpa armigera* (Hubner) has assumed ajor status among the defoliators of groundnut *ıarachis hypogaea* L.). The pest is considered ıportant on groundnut in coastal Andhra Pradesh, ımil Nadu and Karnataka, particularly in areas here cotton is extensively grown and insec- :ide application is heavy. The larvae defoliate e leaves and also damage the flowers and ıds and reduce the pod yield significantly 3halerao *et al.* 1993).

Synthetic pyrethroids are playing an ıportant role in controlling *H. armigera* all ver the world because of their quick action, gh insecticidal efficacy and low mammalian xicity (Sidhu *et al.* 1983). Superiority of nthetic pyrethroids *viz.* fenvalerate, permethrin, rpermethrin and decamethrin over monocrotophos ıd carbaryl was proved against this pest under ıdian conditions by many workers (Shelke *al.* 1986, Mambiri and Amadalo, 1988). he present study was undertaken to evaluate e bioefficacy of betacyfluthrin, a new in- secticide of pyrethroid group against *H.armigera* in groundnut. Betacyfluthrin was found to effectively check the larvae of fruit borer *Leucinodes orbonalis* on brinjal at 12.5 g a.i ha^{-1} (Sinha and Gopal, 2002) and saw fly *Hoplocampa testudinea* on apple (Cigar and Baric, 2002).

Materials and Methods

Betacyfluthrin 025 EC (Bulldock(R)) [(SR)-alpha-cyano-4-fluoro-3 = phenoxyl benzyl (1 RS, 3 RS : 1 RS = 3 SR) -3-3 (2, 2-dichlorovinyl) -2,2 = dimethylcyclo-propanecarboxylate] supplied by Bayer (India) Ltd was used for the study. The formulation Bulldock 025 EC contained 25 g a.i. of betacyfluthrin per litre.

Bioefficacy

Two supervised field experiments were conducted to evaluate the bioefficacy of betacyfluthrin 025 EC against *H. armigera* on groundnut in irrigated condition.

First experiment was conducted in a farmer's field at Arasakuli in Cuddalore district of Tamil Nadu during summer, 1998 on cultivar TMV 7 in plots of 6 x 4 m with 30 x 10 cm spacing. The experiment was laidout in a randomized block design with treatment doses of betacyfluthrin 025 EC at 12.5, 18.75 and 25.0 g a.i.ha^{-1}. Cypermethrin 10 EC at 60.0 g a.i. ha^{-1} and quinalphos 25 EC at 500 g a.i. ha^{-1} were included as standards. Treatments were given only once on 45th day after sowing (DAS) when the pest outbreak was observed using a high volume sprayer with 500 l ha^{-1} spray fluid. Assessment of larval population was made before the treatment and at 1,3,7 and 14 days after treatment (DAT) in 10 randomly

Table 1. Effect of betacyfluthrin as foliar application against *H. armigera* on groundnut, summer 1998

Sl. No.	Treatments	Larvae / 10 plants (mean of four observations) Before #treatment	1 DAT**	3 DAT**	7 DAT**	14 DAT #	Pod yield** kg ha^{-1}
1.	Betacyfluthrin 025 EC @ 12.5 g a.i./ha^{-1}	7.75 (2.861)	4.25 (2.177)^{b}	2.50 (1.726)^{b}	2.50 (1.709)^{cd}	0.5 (0.966)	1764^{b}
2.	Betacyfluthrin 025 EC @ 18.75 g a.i./ha^{-1}	6.25 (2.581)	3.25 (1.924)^{ab}	1.50 (1.403)^{a}	0.75 (1.095)^{b}	0.75 (1.055)	1812^{b}
3.	Betacyfluthrin 025 EC @ 25.0 g a.i./ha^{-1}	7.50 (2.809)	1.75 (1.418)^{a}	1.00 (1.184)^{a}	0.00 (0.709)^{a}	0.50 (0.966)	1906^{a}
4.	Cypermethrin 10 EC @ 60 g a.i./ha^{-1}	6.25 (2.581)	4.75 (2.284)^{b}	3.75 (2.052)^{c}	2.00 (1.565)^{c}	0.75 (1.055)	1760^{b}
5.	Quinalphos 25 EC @ 500 g a.i./ha^{-1}	9.00 (3.017)	5.50 (2.402)^{bc}	3.50 (1.986)^{c}	2.00 (1.565)^{c}	0.50 (0.966)	1772^{b}
6.	Untreated check	7.25 (2.774)	7.75 (2.864)^{c}	7.75 (2.861)^{d}	3.50 (1.996)^{d}	1.25 (1.313)	1606^{c}

In a column, means followed by a common letter are not significantly different by DMRT (P=0.05)
Values in parenthesis are transformed values $\sqrt{X + 0.5}$

- Non significant; ** - Significant at P = 0.01; DAT - Days after treatment

selected plants per plot, leaving the border rows. Yield was recorded at harvest.

Second field experiment was conducted during *kharif* 1998 at Regional Research Station, Vridhachalam on cultivar VRI 2, in plots of 5 x 4 m with 30 x 10 cm spacing. Two rounds of treatments were imposed based on the pest incidence using high volume sprayer on 45 and 60 DAS and the pest assessment was made as in the first experiment.

Phytotoxicity and residues analysis

Two separate field experiments were conducted simultaneously, during summer and *kharif* 1998 to study the phytotoxic effect and to estimate the residue. The treatments were, betacyfluthrin at 12.5, 25.0 and 50.0 g a.i. ha^{-1} along with untreated check. The treatments were given along with the bioefficacy experiment, once at 45 DAS during summer 1998 in a high volume sprayer with 500 l ha^{-1} of spray fluid and twice in the *kharif* 1998 experiment, first at 45th day and second at 60th day after sowing.

Phytotoxicity

Observations were made for phytotoxic symptoms like injury to leaf tip and leaf surface, wilting, vein clearing, necrosis and epinasty and hyponasty on 1,3,5,7,10 and 20 days after application. The symptoms were recorded in a 0-10 rating scale.

Residue analysis

Samples of haulm, shell and kernel were collected at the time of harvest and the residue of betacyfluthrin was analysed using Gas Chromatography (GC), model Chemito 3865, fitted with Electron Capture Detector (ECD). Glass

Table 2. Effect of betacyfluthrin as foliar application against *H. armigera* on groundnut

Sl. No.	Treatments	Larvae / 10 plants (mean of four observations)									Pod yield** Kg ha^{-1}
		Before treatment#	First spray				Second Spray				
			1 DAT**	3 DAT**	7 DAT**	14 DAT**	1 DAT**	3 DAT**	7 DAT**	14 DAT**	
1.	Betacyfluthrin 025 EC @ 12.5 g a.i./ha^{-1}	6.75 (2.688)	4.75 (2.278)^{b}	2.25 (1.637)^{ab}	3.25 (1.934)^{b}	6.50 (2.625)^{b}	4.75 (2.269)^{b}	4.25 (2.171)^{c}	1.75 (1.475)^{bc}	1.75 (1.475)^{b}	1872^{b}
2.	Betacyfluthrin 025 EC @ 18.75 g a.i./ha^{-1}	8.50 (2.948)	3.75 (2.042)^{b}	3.00 (1.851)^{ab}	3.50 (1.996)^{b}	7.25 (2.763)^{b}	2.75 (1.798)^{a}	2.50 (1.716)^{bc}	1.25 (1.274)^{bc}	1.25 (1.314)^{b}	2070^{a}
3.	Betacyfluthrin 025 EC @ 25.0 g a.i./ha^{-1}	8.25 (2.947)	1.50 (1.403)^{a}	1.50 (1.403)^{a}	1.75 (1.492)^{a}	3.00 (1.861)^{a}	2.50 (1.726)^{a}	0.75 (1.055)^{a}	0.00 (0.709)^{a}	0.00 (0.709)^{a}	2125^{a}
4.	Cypermethrin 10 EC @ 60 g a.i./ha^{-1}	8.25 (2.947)	4.50 (2.197)^{b}	3.50 (1.958)^{ab}	7.00 (2.736)^{c}	6.00 (2.530)^{b}	3.00 (1.861)^{ab}	2.00 (1.565)^{b}	0.75 (1.095)^{ab}	1.25 (1.274)^{b}	1890^{b}
5.	Quinalphos 25 EC @ 500 g a.i./ha^{-1}	7.25 (2.770)	3.25 (1.934)^{b}	4.00 (1.982)^{b}	7.25 (2.765)^{c}	7.75 (2.869)^{b}	3.25 (1.907)^{ab}	2.75 (1.798)^{bc}	2.25 (1.627)^{c}	2.25 (1.637)^{b}	1850^{b}
6.	Untreated check	8.00 (2.893)	8.50 (2.975)^{c}	10.00 (3.235)^{c}	9.25 (3.108)^{c}	11.75 (3.490)^{c}	8.75 (3.041)^{c}	8.75 (3.024)^{d}	10.50 (3.316)^{d}	7.00 (2.729)^{c}	1735^{c}

In a column, means followed by a common letter are not significantly different by DMRT (P=0.05)
Values in parenthesis are transformed values $\sqrt{X + 0.5}$

- Non significant; ** - Significant at P = 0.01; DAT - Days after treatment

column, 2 mm i.d., 120 cm length filled with 4 per cent SE 30 was used. Temperature settings for injector, column and detector were 250, 240 and 260°C respectively. Nitrogen was used as a carrier gas with a flow rate of 60 ml/min. Injection volume of the sample was 2 μl and the retention time was 2.5 minutes.

For residue analysis, 10 g of sample (haulm/shell/kernel) was extracted with 200 ml acetonitrile (saturated with n-hexane) and partitioned with n-hexane. Then the residue was extracted with dichloromethane and clean up was performed with column chromatography using 5 g deactivated Florisil. Finally the residue was taken in 5 ml cyclohexane for determination in GC.

For oil sample, 20 g of seed was blended and tumbled and ran in a soxhlet apparatus for 6 h in petroleumn ether and oil was extracted. Five gram oil was weighed and added with 100 ml mixture of dichloromethane: hexane (9:1 v/v) and digested by concentrated H_2SO_4. To this 100 ml of saturated NaCl solution was added and the dichloromethane: hexane portion was separated and evaporated to near dryness. The aqueous remainder was dissolved in 5 ml of cyclohexane for final determination. Recovery studies were conducted using beta- cyfluthrin technical grade (99 per cent purity) by the fortification of groundnut samples at 0.5, 1 and 2 ppm levels.

Results and Discussion

Bioefficacy

In the first field experiment conducted during summer 1998, the pretreatment population of *H. armigera* ranged from 6.25 to 9.0/10 plants. Betacyfluthrin 025 EC at 12.5, 18.75 and 25.0 g a.i. ha^{-1} significantly reduced the larval population to 4.25, 3.25 and 1.75/10 plants respectively at one DAT while it was 4.75, 5.50 and 7.45 in cypermethrin 10 EC at 60 g a.i. ha^{-1}, quinalphos 25 EC at 500 g a.i.ha^{-1} and untreated check respectively (Table 1). Similar trend was observed at 3 and 7 DAT. At 14 DAT there was a general decline in larval population in all the treatments and the differnces were not significant.

The results on pod yield indicated that, betacyfluthrin at 25.0 and 18.75 g a.i. ha^{-1} recorded 1906 and 1812 kg ha^{-1} respectively and were superior to other treatments.

The results on the second field experiment conducted during *kharif* 1998 are presented in Table 2. The pretreatment population of *H.armigera* ranged from 6.75 to 8.50/10 plants. At one DAT, all the treatments significantly reduced the larval population. A minimum larval population of 1.5/10 plants was observed in betacyfluthrin at 25.0 g a.i. ha^{-1} and the maximum (8.50) was observed in untreated check. At 3 and 7 DAT also a similar trend was noticed. A significant increase in larval population was noticed at 14 DAT which necessitated a second round of treatments. Significant reduction in larval population was observed in betacyfluthr at 18.75 and 25 g a.i. ha^{-1} after the secor round of treatments and were superior to oth treatments.

Betacyfluthrin at 25.0 and 18.75 g a ha^{-1} recorded a pod yield of 2125 and 20 kg ha^{-1} respectively and were superior to oth treatments.

Effectiveness of synthetic pyrethroio over other group of insecticides has been prove by many workers under Indian condition Bhamburkar and Kathane (1984) reported th decamethrin 25 g a.i. ha^{-1}, flucythrinate 2 g a.i. ha^{-1} and cyfloxilate 50 g a.i. ha^{-1} wer significantly superior to endosulfan an monocrotophos against *H. armigera* on groun nut. Sharma *et al.* (1989) indicated that th synthetic pyrethroids like decamethrin (0.002% flucythrinate (0.02%), fenvalerate (0.015%) a cypermethrin (0.01%) were effective in reduci population of *H.armigera* on cotton. The pres findings on the efficacy of betacyfluthrin we in conformity with these findings.

Phytotoxicity and residues analysis

Phytotoxicity

Results of the two experiments indicate that, foliar application of betacyfluthrin 02 EC at 12.5, 25.0 and 50.0 g a.i. ha^{-1} ha no phytotoxic effect on groundnut.

Residue analysis

The mean recovery of betacyfluthrin wa 88.58 per cent from fortified oil, 87.43 pe

Table 3. Harvest time residues of betacyfluthrin on groundnut, *Kharif* 1998

(Mean of 5 observations

S.No.	Treatment	Haulm (mg/g)	Oil (mg/g)	Kernel (mg/g)	Shell (mg/g)
1.	Betacyfluthrin 025 EC @ 12.5 g a.i./ha^{-1}	BDL	BDL	BDL	BDL
2.	Betacyfluthrin 025 EC @ 25.0 g a.i./ha^{-1}	0.07	BDL	BDL	BDL
3.	Betacyfluthrin 025 EC @ 50.0 g a.i./ha^{-1}	0.14	BDL	BDL	BDL

BDL - Below detectable limit
Number of sprays - 2, on 45th and 60th day after sowing
Sampling - 40 days after second spray

cnt from kernel, 87.58 per cent from shell nd 86.25 per cent from haulm samples at 5, 1 and 2 µg level. The minimum de-rminability level was 0.1, 0.025, 0.05 and 05 µg in oil (5 g), kernel (20 g), shell 0 g) and haulm (10 g) respectively for the mple extract of 5 ml.

For the first field experiment (summer, 998) samples were collected 40 days after eatment. Results of the analysis in GC revealed at the residue of betacyfluthrin was at below tectable limit (BDL) in samples of shell, rnel and oil at all the three doses tested. the second field experiment, betacyfluthrin as applied twice at 45 and 60 DAS and mples were collected at 40 days after second und of treatment. The results revealed that residue of betacyfluthrin was at BDL in samples of shell, kernel and oil at all three doses tested. However, in haulms sidue of 0.07 and 0.14 µg/g was detected 25.0 g and 50.0 g a.i. ha^{-1} respectively able 3). The maximum residue limit (MRL) r betacyfluthrin on groundnut has not been orked out so far.

Chopra *et al.* (1973) reported that the liometon residues were found to persist on roundnut leaves even after 75 days after plication. Similar results were also obtained groundnut samples (haulms) by Rajukannu *al.* (1980) for monocrotophos residues and Upadhyay and Vyas (1989) for phosphomidon sidues. In the present study the residues of etacyfluthrin were detected only in haulm at 5.0 and 50.0 g a.i. ha^{-1}, when sprayed twice n 45 and 60 DAS.

Results of the bioefficacy studies indicated at betacyfluthrin at 18.75 g a.i. ha^{-1} is effective reducing the larval population of *H. armigera* gnificantly with significant increase in pod eld. The chemical had no phytotoxic effect groundnut even at a higher dose of 50.0 a.i. ha^{-1}. Residue of betacyfluthrin was detected ly in haulm at a higher dose of 25.0 and 0.0 g a.i. ha^{-1}.

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