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Bio-efficacy and dissipation of Beta-cyfluthrin against white fly in okra

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ABSTRACT

Beta-cyfluthrin at 18 g a.i. ha^{-1} applied twice as foliar spray was found to be most effective in controlling the whitefly and dissipation pattern was studied by collecting okra fruits at 0, 1, 3, 5, 7, 10 and 15 days after last spray and analyzed at AINP on Pesticide Residues, Hyderabad. The initial deposits of beta-cyfluthrin (18.75 g a.i. ha^{-1}) in okra fruits was 0.11 mg kg^{-1} dissipated to below detectable level (BDL) on 5^{th} day.

Introduction

Among the vegetable crop grown in India, okra (*Abelomoschus esculentus* L. Moench.) is an important crop grown throughout the year, occupies an area of 4.51 lakh hectare with an annual production of 47.96 lakh tons and productivity of 10.62 ton per hectare "[1]". The major okra growing states includes Assam, Uttar Pradesh, Bihar, Orissa, West Bengal, Maharashtra, Andhra Pradesh and Karnataka. Okra is a major economically important vegetable crop which alone accounts for 21 per cent of total exchange earnings from export of vegetables from India. Insect pests pose major constraint to production of this important export oriented crop. The major pests are leafhopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius) which is known to be the vector of vein clearing disease and shoot and fruit borer (*Earias vittella* Fabricius) "[9]". In order to tackle these pests, several insecticides are recommended for the control of these pests.

Beta-cyfluthrin, cyano(4-fluoro-3-phenoxyphenyl) methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclo propane carboxylate belonging to pyrethroid group, acts as a contact and stomach poison. The residues of Beta-cyfluthrin have been estimated on various crops such as eggplant "[12]", okra "[11]", tomato "[2]" and chickpea "[3]". The synthetic pyrethroids represent the most popular class of insecticides today. The presence of pesticides residues in vegetables, fruits, and green leaves above the maximum limit is of concern to human health because of the toxic nature of the pesticides. Hence studies were conducted to evaluate the efficacy of different insecticides used commonly and also to establish the dissipation pattern of effective insecticide to fit in pest management strategy.

Materials and Methods

Okra crop was raised in randomized block design with seven treatments replicated thrice using "Arka Anamika" variety at spacing of 45×15 cm and the insecticides Bifenthrin 10 EC at 80g a.i. ha^{-1}, fipronil 5 SC at 500 g a.i. ha^{-1}, flubendiamide 480 SC at 60 g a.i. ha^{-1}, quinalphos 25 EC at 350 g a.i. ha^{-1}, profenofos 50 EC at 400 g a.i. ha^{-1} and beta-cyfluthrin 25 SC at 18.75 g a.i. ha^{-1} were sprayed on okra plants at 50 per cent of flowering and thereafter, repeated at 15 days interval using knapsack sprayer.

For the efficacy studies the population of whitefly was recorded on five randomly selected plants per plot leaving the border rows. The population counts were recorded from top, middle and bottom leaf in each of the five selected plants in every plot and mean number of whiteflies per five plants was calculated. Then data was analyzed with arc sine values and mean treatments were compared using Duncan's Multiple Range Test"[5]". The percentage reductions of whitefly in all treatments over control were calculated using modified Abbot's formula"[4]".

$$\text{Population Reduction Percentage} = \left[1 - \left\{\frac{\text{Post treatment population in treatment}}{\text{Pre treatment population in treatment}} \times \frac{\text{pre treatment population in check}}{\text{post treatment population in check}}\right\}\right] \times 100$$

The percentage reduction at one, three, five, seven and ten days after each spraying were pooled and transformed into arc sine values which were further subjected to Randomized Block Design Analysis. The overall effect of the treatments by combining these five observations were also assessed by analyzing the data thorough ANOVA.

Dissipation

The most effective insecticidal treatment from the efficacy study *i.e*, beta-cyfluthrin at 18 g a.i. ha^{-1} was utilized for residue analysis. The okra fruits samples of 250 g were collected randomly from each plot at 0, 1, 3, 5, 7, 10 and 15th day after last spray in polythene bags and brought to the laboratory immediately for sample processing and further procedures were adopted for dissipation studies.

Extraction and Clean-up for Beta-cyfluthrin

Representative fruit sample of 25 g was homogenized with 50 ml acetone:hexane (1:9) and was filtered. The filtrate was partitioned after adding with saturated Nacl and Dichloromethane. The extract was cleaned up with florosil column eluting with hexane. The elute evaporated to dryness for Gas Chromatography analysis.

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Estimation

The residues beta-cyfluthrin was estimated using GC-ECD by comparing peak area of the standard with that of peak in the sample under identical conditions.

From the technical grade of beta-cyfluthrin, one ppm standard solution was prepared by diluting with n-hexane and used for carrying out recovery and comparative studies of pesticide residues in the fruit samples collected at different intervals. The recovery study of Beta-cyfluthrin carried out at the levels of 0.01, 0.10 in okra fruit and recovery ranged from 87–88 per cent respectively with standard deviation of 1.10 - 3.28 per cent.

The sample was analyzed on (Shimadzu) GC-2010 equipped with fused silica capillary column Factor Four (30 mt×0.25 mm id) coated with 1 per cent phenyl-methylpolysiloxane (0.25 µm film thickness) using 63Ni electron-capture detector (ECD). General operating conditions were as follows: For Beta-cyfluthrin, Column temperature program: initially 200◦C for 2 min, increase at 3◦C min-1 to 240◦C hold for 10 min, Total programme is 25.33 min; injection volume: 1 µl nitrogen flow rate 0.93 ml min-1 and makeup 25 ml min-1 with split ratio 1:10; using carrier gas (N_2) 99.5 per cent; Injector port temperature 260◦C; detector temperature 300˚C. Retention time of Beta-cyfluthrin is 14.9 min.

Results and discussion

The observations on over all efficacies revealed (Table-1) that all the insecticidal treatments were superior to control.

Table 1. Efficacy of insecticides against white fly, *Bemisia tabaci* after 2 sprays

Treatment	Dosage g a.i/ha	Mean % of reduction over untreated check	
		Over all after I spray	Over all after II spray
T_1 Bifenthrin	80	51.69^{ab} (46.0)	50.69^{a} (45.4)
T_2 Fipronil	500	47.28^{b} (43.4)	46.62^{a} (43.0)
T_3 Flubendiamide	60	46.42^{b} (42.9)	37.35^{b} (37.6)
T_4 Quinalphos	350	54.42^{a} (47.5)	54.21^{a} (47.4)
T_5 Profenofos	400	51.34^{ab} (45.8)	46.14^{a} (42.8)
T_6 Beta-cyfluthrin	18.75	57.00^{a} (49.0)	54.21^{a} (47.4)
T_7 Control	--	0.00 (0.00)	0.00 (0.00)
S.Em±	--	1.14	1.62
C.D at 5%	--	3.63	5.18
C.V.%	--	5.02	7.45

(DAS - Days after spraying

*Figures in the parentheses are arc transformed values)

Beta-cyfluthrin at 18.75 g a.i. ha^{-1} and quinalphos at 350 g a.i. ha^{-1} were most effective and significantly superior to all other treatments recording 57.00 per cent and 54.42 per cent of white fly population reduction, respectively. The other promising treatments were bifenthrin at 80 g a.i. ha^{-1} (51.69 %) and profenofos at 400 g a.i. ha^{-1} (51.34 %) which were superior over other treatments and were on par with beta-cyfluthrin and quinalphos. Fipronil at 500 g a.i. ha^{-1} and flubendiamide at 60 g a.i. ha^{-1} were least effective among all insecticides tested with population reduction of 47.28 and 46.42 per cent respectively (Figure 1).

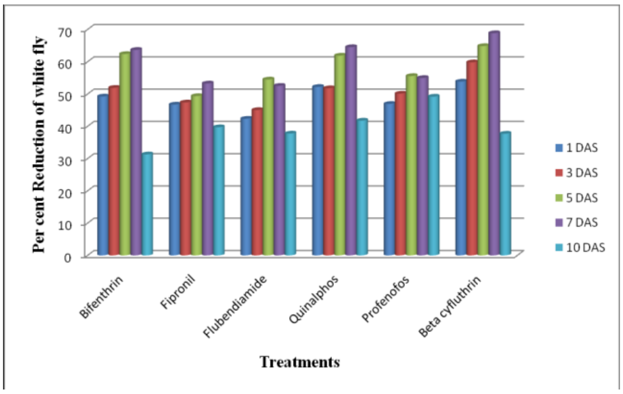

Figure 1. Efficacy of insecticides against whitefly, *Bemisia tabaci* after first spray

The observations recorded after second spray with regard to the reduction of whitefly population indicated that all the treatments were significantly superior to control. The efficacy in descending order was beta-cyfluthrin at 18.75 g a.i. ha^{-1}, quinalphos at 350 g a.i. ha^{-1}, bifenthrin at 80 g a.i. ha^{-1}, fipronil at 500 g a.i. ha^{-1} and profenofos at 400 g a.i ha^{-1} with reduction of 54.21, 54.21, 50.69, 46.62 and 46.14 per cent, respectively. All the insecticides except flubendiamide at 60 g a.i. ha^{-1} were superior over in controlling white fly population. Flubendiamide at 60 g a.i. ha^{-1} exhibited least white fly population reduction of 37.35 per cent (Figure 2). But very efficient in the reduction of lepidopterous insects “[7]”, “[14]”, “[10]” and fruit and shoot borer “[8]”.

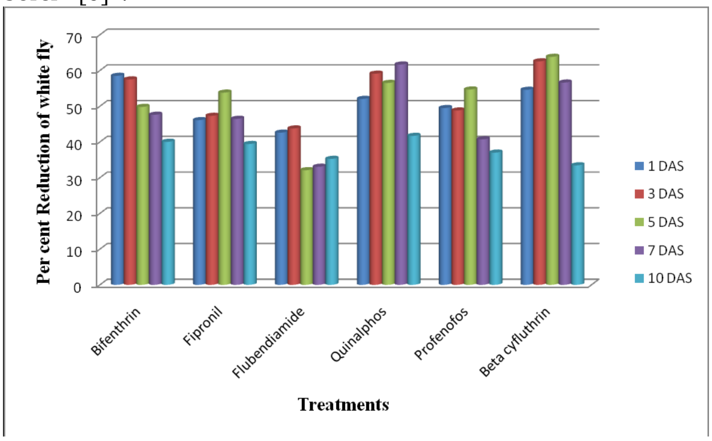

Figure 2. Efficacy of insecticides against whitefly, *Bemisia tabaci* after second spray

The overall mean efficacy showed that among all the treatments, beta-cyfluthrin at 18.75 g a.i. ha^{-1} is the most effective in controlling white fly population. It is also found that quinalphos at 350 g a.i. ha^{-1} was promising against white fly population followed by bifenthrin at 80 g a.i. ha^{-1}. The findings of the present study also proved that profenofos at 400 g a.i. ha^{-1} is an effective insecticide in controlling the whitefly.

Dissipation

The initial deposit and subsequent residues of beta-cyfluthrin (18.75 g a.i. ha^{-1}) in okra fruits collected at intervals of 0, 1, 3, 5, 7, 10, 15 days after last spraying (Table-2) have shown the initial deposit as 0.11 mg kg^{-1} and by one day after treatment dissipated by 45.04 per cent. Further very rapid dissipation was evident by third day dissipated to below tolerance limit of 0.02 mg kg^{-1} in 2.62 days. (Figure-3). Residues reached non-detectable level by 10 and 15 days after spray of beta-cyfluthrin at 18.75 and 37.50 g a.i ha^{-1} in tomato“[2]”. Beta-cyfluthrin 25 SC persisted up to 15 days in brinjal fruits and reduced to safe waiting period in 6-10 days at dosages of 12.5, 18.75 and 25 g a.i ha^{-1}“[13]”.

Table-2. Dissipation of beta-cyfluthrin (18.75 g a.i. ha^{-1}) in okra

Days	R1	R2	R3	Average	Dissipation %
0	0.124	0.12	0.1	0.11	0
1	0.06	0.06	0.05	0.06	45.40
3	0.02	0.02	0.01	0.02	80.95
5	BDL	BDL	BDL	BDL	100
7	BDL	BDL	BDL	BDL	100
10	BDL	BDL	BDL	BDL	100
15	BDL	BDL	BDL	BDL	100

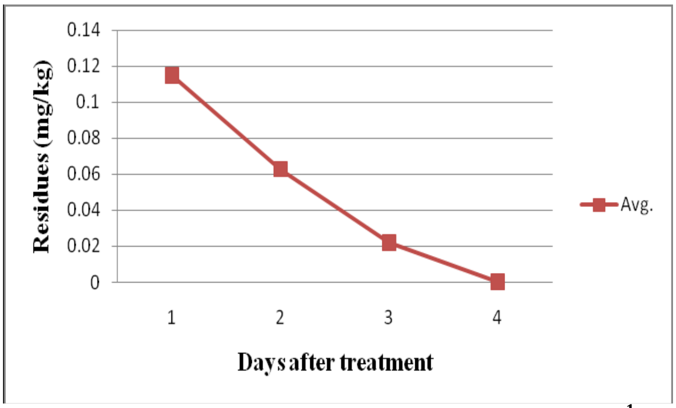

Figure 3. Dissipation of beta-cyfluthrin (18.75 g a.i. ha^{-1}) in okra

The dissipation of pesticide residues in/on crops depends on climatic conditions, type of application, plant species, dosages, interval between application and time of harvest "[9]".

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