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Bioefficacy and dissipation of β-cyfluthrin against white fly *Bemisia tabaci* Genn.) in okra (*Abelomoschus esculentus* L.)

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Abstract: A field experiment was conducted to evaluate the efficacy of different insecticides *viz.,* bifenthrin, flubendiamide, fipronil, quinalphos, pronofos and β-cyfluthrin against white fly (*Bemisia tabaci*) of okra (*Abelomoschus esculentus*) by spraying twice. Among the insecticides evaluated, β cyfluthrin at 18.75 g a.iha^{-1} was found to be the effective by registering 57.00 and 54.21 per cent reduction of whitefly (*B. abaci*) during first and second sprays, respectively. Further β-cyfluthrin at 18.75 g a. i ha^{-1} was subjected to dissipation studies by collecting okra (*A. esculentus*) fruit samples at interval of zero, one, three, five, seven, 10 and 15 days after last spray. Results of the dissipation studies showed that the initial deposits of β-cyfluthrin (18.75 g a.iha^{-1}) in okra (*A. esculentus*) fruit sample was registered to be 0.11 mg kg^{-1}and dissipated to below detectable level (BDL) within five days after spray.

Keywords: β-cyfluthrin, Dissipation, Efficacy, Insecticides, Okra

INTRODUCTION

Among the vegetable crop grown in India, okra (*Abelomoschus esculentus*) is an important crop grown throughout the year, which occupies an area of 4.51 lakh ha with an annual production of 47.96 lakh tons and productivity of 10.62 ton ha^{-1} (Anonymous, 2013). The major okra (*A. esculentus*) growing state includes Assam, Uttar Pradesh, Bihar, Orissa, West Bengal, Maharashtra, Andhra Pradesh and Karnataka. Okra (*A. esculentus*) is a major economically important vegetable crop, which alone accounts for 21 per cent of the total exchange earnings from export of vegetables from India. Insect pests and diseases are the major constraints for the production of this important export oriented vegetable crop. The major insect pest includes, leafhopper (*Amrasca biguttula biguttula* Ishida), whitefly (*B. tabaci*), which is a vector of vein clearing disease and shoot and fruit borer (*Earias vittella* Fab.)(Gupta *et al.,* 2009).In order to tackle these insect pests, several insecticides are being used by farmers throughout the crop growth period.

β- cyfluthrin, cyano(4-fluoro-3-phenoxyphenyl) methyl 3-(2,2-dichloroethenyl)-2,2-dimethylcyclo propane carboxylate belongs to pyrethroid group, which acts as a contact and stomach poison. Nowadays, these synthetic pyrethroids are the most popular choice among the farmers for the management of vegetable pests due to their quick knock down effect. Several times farmers are going for repeated application of these pesticides in order to keep their crops to be pest free. In this way a huge quantity of pesticides were accumulated in the plant parts. Similarly, the residues of β-cyfluthrin were reported in previous studies on various vegetable crops *viz.,*eggplant (Sharma *et al.*, 2004), okra (*A. esculentus*) (Sahoo *et al.*, 2012), tomato (Dikshit and Pachauri, 2000) and chickpea (Dikshit and Singh, 2000). Such presence of pesticide residues above the maximum limit in vegetables and other crops is a major concern for human health due to its toxic nature. Hence, the current study was conducted to evaluate the efficacy different insecticides (bifenthrin, flubendiamide, fipronil, quinalphos, pronofos and β-cyfluthrin) against white fly (*Bemisia tabaci*) and to establish the dissipation pattern of the most effective insecticide (β-cyfluthrin) to fit them in the okra (*A. esculentus*) pest management strategy.

MATERIALS AND METHODS

To evaluate the efficacy of different insecticides (Table 1), a field experiment was laid out with three replications having seven treatments. Okra (*A. esculentus*) crop of the variety 'Arka Anamika' was raised with spacing of 45x15cm by following all the agronomic practices as recommended by the university. Insecticidal treatments (Table 1) were sprayed at 50 per cent flowering in okra (*A. esculentus*) plants and second spray was given on 15 days after the first spray.

For the efficacy studies, the population of whitefly (*B. tabaci*) was recorded on five randomly selected okra (*A. esculentus*) plants per plot leaving the border rows. The population counts were taken from top, middle and bottom leaves in each of the five selected plants in

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every plot and mean number of whitefly (*B. tabaci*) per five plants were calculated. The percentage reduction of whitefly (*B. tabaci*) in all treatments over the control was calculated using modified Abbot's formula (Fleming and Ratnakaran, 1985).

$$\text{Population reduction (\%)} = \left\{ 1 - \left(\frac{\text{Post treatment population in treatment}}{\text{Pretreatment population in treatment}} \times \frac{\text{Pre treatment population in check}}{\text{Post treatment population in check}} \right) \right\} \text{x100}$$

Where,

Pretreatment population is whitefly count taken one day before spray

Post treatment population is whitefly count taken at one, three, five, seven and ten days after the spray

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 treatment was obtained by combining these five days observations and that data was analysed by ANOVA (Gomez and Gomez, 1984).

Dissipation: The insecticidal treatment, which found most effective (β-cyfluthrin @ 18.75 g a.i ha^{-1}) in reducing the whitefly (*B. tabaci*) in the previous experiment, was subjected to dissipation studies at the laboratory of AINP on pesticide residues, Hyderabad. The okra (*A. esculentus*) fruit samples of 250 g were collected randomly from β-cyfluthrin treated plots three replications at zero, one, three, five, seven, 10 and 15th day after last spray in polythene bags and brought to the laboratory immediately for processing. Further, the procedures of extraction, clean up and analysis of fruit sample was followed according to Dikshit and Pachauri (2000) with slight modification.

Extraction and clean-up: 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. Elute was evaporated to dryness for Gas Chromatography analysis.

Estimation: The residue of β- cyfluthrin was estimated using GC-ECD by comparing the peak area of standard with that of the peak area in the sample under identical conditions.

From the technical grade of β- cyfluthrin, one ppm standard solution was prepared by diluting with n-hexane and used for carrying out the recovery and comparative studies of pesticide residues in the fruit samples collected at different intervals. The recovery study of β- cyfluthrinwas carried out at the level of 0.01 and 0.10 ppm, which recorded the recovery of 87 and 88 per cent, respectively.

The sample was analyzed on (Shimadzu) GC-2010 equipped with fused silica capillary column factor four (30 mt x 0.25 mm id) coated with one per cent phenyl-methylpolysiloxane (0.25 µm film thickness) using 63Ni electron-capture detector (ECD). General operating conditions were as follows: For β- cyfluthrin, the column temperature program was initially 200^{0}C for 2 min, increased 3^{0}C min^{-1} to 240^{0}C hold for 10 min, Total programme was 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^{0}C, detector temperature 300^{0}C. Retention time of β- cyfluthrin was 14.9 min.

RESULTS AND DISCUSSION

The observations on over all efficacies of all the insecticides (table 2) evaluated against whitefly (*B. tabaci*) on okra (*A. esculentus*) revealed that all the insecticidal treatments were significantly superior over control during first and second spray, respectively.

At first spray, β- cyfluthrin at 18.75 g a.i. ha^{-1} and quinalphos at 350 g a.i. ha^{-1} were most effective with a population reduction of 57.00 and 54.42 per cent, 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 on par with β-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 the insecticides tested with whitefly (*B. tabaci*) population reduction of 47.28 and 46.42 per cent, respectively.

At second spray, the efficacy in descending order was β- 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}, which recorded the population reduction of 54.21, 54.21, 50.69, 46.62 and 46.14 per cent, respectively and all the insecticidal treatments were significantly superior over flubendiamide. Furthermore, the least whitefly (*B. tabaci*) population reduction of 37.35 per cent was observed in flubendiamide at 60 g a.i. ha^{-1}.

Overall scenario of the current investigation revealed that, all the insecticidal treatments were significantly superior over untreated control against whitefly (*B. tabaci*) on okra (*A. esculentus*). However, β-cyfluthrin at 18.75 g a.i. ha^{-1} was found to be the most effective among the all insecticides tested. These findings are in conformity with Sharma and Lal (2002) who asserted that, β-cyfluthrin at 18.75 g a.i. ha^{-1} was effective in reducing the whitefly (*B. tabaci)* population (93.74%) on brinjal. Medeiros *et al.*, (2001) confirmed that a combination of mineral oil and β- cyfluthrin was effective for the management of whitefly nymph (*B. tabaci* of Race - B) on melon plants. The results of current investigation are also supported by Lin *et al.* (2009), who observed that β- cyfluthrin applied in combination with imidacloprid (0.5 %) reduced 92.70 per cent of silver whitefly population on tomato in green house condition. Similarly, efficacyof β-cyfluthrin on leaf-hopper was also reported by Kumari *et al.* (2005),

Table 1. Details of treatments for field application.

Sl. No	Common Name	Dosage (g a. i ha^{-1})	Trade Name and Formulation
1.	Bifenithrin	80.00	Player 10% EC
2	Fipronil	500.00	Regent 5% SC
3.	Flubendamide	60.00	Fame 48% SC
4.	Quinalphos	350.00	Milux 25% EC
5.	Profenofos	400.00	Profex 50% EC
6.	β- cyfluthrin	18.75	Bulldock 25% SC

Table 2. Efficacy of insecticides against whitefly (*B. tabaci*)after two sprays.

Treatment	Dosage (g a.iha^{-1})	Mean per cent of reduction over untreated check	
		Over all after first spray	Over all after second spray
T_1 Bifenthrin	80	51.69 (46.00)^{ab}	50.69 (45.40)^{a}
T_2 Fipronil	500	47.28 (43.40)^{b}	46.62 (43.00)^{a}
T_3 Flubendiamide	60	46.42 (42.90)^{b}	37.35 (37.60)^{b}
T_4 Quinalphos	350	54.42 (47.50)^{a}	54.21 (47.40)^{a}
T_5 Profenofos	400	51.34 (45.80)^{ab}	46.14 (42.80)^{a}
T_6 β- cyfluthrin	18.75	57.00 (49.00)^{a}	54.21 (47.40)^{a}
T_7 Control	-	0.00 (0.00)	0.00 (0.00)
S.Em±	-	1.14	1.62
C.D ($p<0.05$)	-	3.63	5.18
C.V (%)	-	5.02	7.45

*Figures in the parentheses are arc transformed values.

Table 3. Dissipation of β-cyfluthrin (18.75 g a.i. ha^{-1}) in okra (*A. esculentus*) fruits.

Days	R_1	R_2	R_3	Average	Dissipation (%)
0	0.12	0.12	0.10	0.11	0.00
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

***** R_1, R_2 and R_3 are the field replications, from where okra fruits with β-cyfluthrin residue were collected at the above mentioned interval of time

Sinha and Sharma (2007) and Satpath and Akhilesh (2010) on okra (*A. esculentus*) crop.

Dissipation: The initial deposit and subsequent residues of β-cyfluthrin (18.75 g a. i. ha^{-1}) in okra fruits at an interval of zero, one, three, five, seven, 10 and 15 days, after the last spray were presented in the table- 3. An average initial deposit of 0.11 mg kg^{-1}on the day of spray gradually dissipated to 0.06 and 0.02 mg kg^{-1}on one and three days after spray, respectively. The per cent dissipation was recorded to be 0.00, 45.40 and 80.95, respectively.

In the current investigation, β-cyfluthrin residues in the okra fruits were reduced below detectable limit within three days after spray, which was in line with findings of Dikshit and Pachauri (2000), who reported that β-cyfluthrin residues were reached to non detectable level by seven and ten days, when sprayed at 18.75 and 37.50 g a. i. ha^{-1} on tomato. Similarly, Sharma *et al.* (2008) asserted that residues of β-cyfluthrin 25 SC sprayed at 12.5, 18.75 and 25 g a. i ha^{-1} on brinjal fruits reduced to safe waiting period within 6-10 days after spray. Furthermore, Koushik *et al.* (2010) also declared that when β-cyfluthrin was sprayed with imidacloprid, the residuesof β-cyfluthrin were dissipated to below detectable limit on five and seven days after spray, respectively on brinjal fruits at the doses of 60 and 120 g a. i. ha^{-1}. Priyadarshini*et al.*, (2014) also clarified that β- cyfluthrin residues were dissipated below detectable limit within three days after spray in green pigeon pods, when sprayed at 18.75 g a. i ha^{-1}. The variation in the dissipation time for the pesticide residue residues in/on crops might depend on climatic conditions, type of application, plant species, dosages, interval between application and time of harvest.

Conclusion

The present studies suggest that β-cyfluthrin at 18.75 g a. i. ha^{-1} was found to be the most the effective insecticidal treatment for the management of whitefly (*B. tabaci*) on okra (*A. esculentus*), meanwhile at the same dose, β-cyfluthrin does not pose any hazards to the consumers, if the waiting period of three days is observed before consumption of okra fruits.

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