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EFFEECT OF BIOPESTICIDES ON THE POPULATION OF NATURAL ENEMIES IN OKRA, *ABELMOSCHUS ESCULENTUS* L. AT RAIPUR (CHHATTISGARH)

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ABSTRACT

Various species of insect pests and their associated natural enemies observed in okra, *Abelmoschus esculentus* L. crop ecosystem. The treatments used against major insect pests to manage the minimum level of population i.e. neem oil 0.03 w/w @ 20 ml/L of water, *Pongamia* oil (crude) @ 20 ml/ l of water, NSKE 0.15EC @ 50 mL/ l of water, *Bacillus thuringiensis* (Bt) 5%WP @ 2 gm/l of water, *Beauveria bassiana*(Bb) 1.15WP @ 4 gm/l of water, imidachlorprid 17.8SL @ 0.25 ml/l of water and spinosad 45SC @ 0.25 ml/l. The population of natural enemy like coccinellids, rove beetles and spiders was observed to see the effect of bio-pesticides. The results revealed that spinosad was most safe and suited for the management of various insect pests of okra which no detrimental effect to the population of natural enemies. Overall, spinosad treated with 45 SC @ 0.25 ml/l of water were recorded most safe with highest population of 1.03 coccinellid/plant, 0.89 rove beetle/plant and 1.13 spider/plant spiders respectively.

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INTRODUCTION

Okra, *Abelmoschus esculentus* (L.) belongs to family Malvaceae. It is generally known as lady finger and is an important summer vegetable crop used all over the world. The okra crop is infested by a number of insect pests like *Amrasca devastans, Earias vittella, Bemisia tabaci, Helicoverpa armigera, Acrocercopsbi fasciata, Thrips tabaci, Aphis gossypii, Podagrica, Anomis flava, Sylepta derogata, Haritalodes derogata, Dysdercus koengii and Nezara viridula*. But *Amrasca devastans*, *E. vittela, H. armigera and B. tabaci* are the notorious and major insect pests of okra (Dubey *et al.*, 1999; Basu, 1995; Lohar, 2001). India is the second largest vegetable producer in the world contributing 14 per cent of the total world production. In India, the total vegetable production was 13, 37, 37,600 metric tons (mt.) from an area of 79, 84,800 hectare (ha.) with the productivity of 16.7 mt/ha during the year 2009-2010. (Anonymous, 2010). However, one of the major constraints for okra production is heavy infestations caused by several insect pests which not only exert quantitative loss but also qualitative loss to the crop. As many as 72 insect species have been recorded on okra (Srinivasa and Rajendran, 2002). Among the natural enemies, coccinellids and spiders are important predators feeding on various sucking pests. The indiscriminate use of pesticides has resulted in the development of resistance and resurgence in the pest besides environmental and health hazards. High intensity of insecticide sprays causes mortality of beneficial arthropods associated with predation or parasitism (Gogi*et al.*, 2006; Desneux *et al.*, 2007). The reduction of natural enemies caused by the use of nonselective insecticides may invite serious consequences for the pest population dynamics. One of them is the important phenomena of resurgence and eruption of secondary pests (Gallo *et al.*, 2002).Therefore, before incorporating newer insecticides with novel mode of actions in IPM programmes, it is imperative to screen them for their safety to natural enemies. The success of IPM programs depends, in part, on the optimal use of selective insecticides that are less harmful to natural enemies (Tillman and Mulrooney, 2000; Stark *et al.*, 2007), which requires knowledge of their side-effects on the biological and behavioural traits of these organisms (Stark *et al.*, 2007).Keeping in view of above points the present study had been undertaken to overcome the problem at the department of Entomology, college of Agriculture, Raipur.

MATERIALS AND METHODS

Total seven type of insecticides was used to control the insect pests of okra, *A.esculentus* namely neem oil 0.03%, *Pongamia* oil, NSKE 0.15 EC, *Baccillus thuringiensus* 5%WP, *Beauveria bassiana* 1.15 WP, imidachlorprid 17.8 SL and spinosad 45EC. Observations were recorded on natural enemy population at one day before and 1,5,10 and 15 days after spraying on five randomly selected plants in each treatment. The tested insecticides were first diluted to the desired concentration by using distilled water. Each insecticidal concentration was sprayed by knapsack sprayer. Daily Observations from the date of sowing were recorded on insect pests appearance of okra. Observations were recorded in each plot of okra on number of infested shoots and fruits at each picking on randomly selected five plants. Pre-treatment observations were recorded at 24 hours before treatment and post treatment after 1, 3, 5,7,15 days of spray. The population of natural enemies was recorded on five randomly selected plants in each plot before treatment and after 1, 3, 7 and 15 days of spray. Similarly methodology was also used by Zala et al. (2010). The activity of coccinellids and spiders per plant at 5 days interval at 20 days after germination from the randomly selected plants to record the effect of the insecticidal treatments (Anonymous, 2013).

Statistical analysis of data

The data obtained were analyzed statistically using appropriate transformation wherever necessary .The data on population of jassids, aphids and whitefly and fruit borer were analyzed with a randomized block design (RBD) directly wherein SE (m) and C.D. were calculated for interpretation. Observation on okra fruit and shoot borer infestation were transformed to Arc-sine transformation before statistical analysis.

RESULTS AND DISCUSSION

Natural enemies, parasitoids and predators are the main sources of reduction in the populations of noxious insect pests (Pfadt, 1980). So that the main purpose of the present investigation was to evaluate the new and safer molecules for management of insect pests of okra, *A. esculentus*. It revealed thatspinosad was observed most suitable insecticide for reduce the population of insect pests of okra along with most safer to above mentioned natural enemies associated with insect pests.The efficacy of eco-friendly bio-pesticides on natural enemies were studied during Rabi-Summer 2014 on okra. The treatments against major pests of okra were neem oil 0.03 w/w @ 20 ml/L of water, *Pongamia* oil (crude) @ 20 ml/L of water, NSKE 0.15EC @ 50 ml/ l of water, *Bacillus thuringiensis* (Bt) 5%WP @ 2 gm/L of water, *Beauveria bassiana* (Bb) 1.15WP @ 4 gm/L of water, imidachlorprid 17.8SL @ 0.25 ml/L of water, spinosad 45SC @ 0.25 ml/L of water and the population of natural enemies viz., coccinellids, rove beetles and spiderswere observed given the following to effect of bio-pesticides.

Table 1: List of tested insecticides and their doses against insect pests of okra

SN	Name of Insecticides	Doses (mL or gm/ lit. water)
1	Neem oil 0.03%	20 mL
2	*Pongamia* oil	20 mL
3	NSKE 0.15 EC	50 mL
4	*Baccillusthuringiensus*5%WP	2 gm
5	*Beauveriabassiana*1.15WP	4 gm
6	Imidachlorprid 17.8 SL	0.25 mL
7	Spinosad 45EC	0.25 mL
8	Untreated (Control)	

Coccinellids

About 90 per centof approximately 4,200 coccinellid species are considered asbeneficial because of their predatory activity, mainly against homopterous insects and mites (Swaminathan *et al.,* 2010). Two species of coccinellids *Menochilussex maculata* and *Coccinellaseptum punctata* were recorded as major bio-agents. They made their first appearance on the crop in the second week of February (7thSMW) with 0.78 grub and adult/ plant. In present study, both species of coccinellid were preyed upon aphid and jassid and played an important role to suppress the population of the pests. Sardana (2006) reported that significantly higher population of coccinellids and predatory spiders were observed.In pre-treatment observation, the coccinellids population ranged between 1.28 and 1.58, there was non-significant differences among different plots. After first spray, among treated plots spinosad 45SC @ 0.25 ml/L of water showed highest (1.03/plant) coccinellids population followed by NSKE 0.15 EC @ 50 ml/L of water (0.95/plant). Lowest population was recorded in imidachlorprid 17.8 SL @ 0.25 ml/L of water (0.57/plant) followed by Bb 1.15 WP @ 4 gm/L of water (0.66/plant). After second spray, spinosad 45 SC @ 0.25 ml/L of water recorded highest (1.24/ plant) coccinellid population among treated plots. It was at par with Bt 5% WP @ 2 gm/L of water with the population of 1.23 coccinellid/ plant. Lowest coccinellid population in was imidachlorprid 17.8 SL @ 0.25 ml/l of water (0.65/plant) followed by Bb 1.15 WP @ 4 gm/L of water (0.67/plant) (Table 2). Overall, spinosad 45 SC @ 0.25 ml/L of water (1.13/plant) recorded most safe to coccinellid with highest population followed by Bt 5% WP @ 2 gm/L of water with the population of 1.03 coccinellid/ plant among treated plots whereas, imidachlorprid 17.8 SL @ 0.25 ml/L of water was most toxic which recorded lowest (0.61/plant) coccinellid population. Mittal and Ujagir (2005) reported that the toxicity of spinosad 45 SC (Tracer) and commercial insecticides on natural enemies associated insect pests of pigeonpea. Treatments of insecticides *viz.*, spinosad @ 45 g a.i./ha, spinosad @ 75 g a.i./ha, spinosad @ 90 g a.i./ha were not affected the natural enemies population

Table 2: Relative efficacy of different ecofriendly bio-pesticides on coccinellids.

S.N.	Name of insecticide	Dosegm or mL/litre of water	Pre-treatment population/plant	Post treatment population/plant	
				I spray	II spray
1.	Neem oil	20 mL	1.58(1.44)	0.72e(1.31)	0.72e(1.30)
2.	*Pongamia* oil	20 mL	1.40(1.38)	0.58g(1.25)	0.71ef(1.31)
3.	NSKE	50 mL	1.50(1.41)	0.95c(1.39)	1.04d(1.42)
4.	*Baccillusthuriegiensis*	2 gm	1.40(1.38)	0.84d(1.35)	1.23bc(1.49)
5.	*Beauveriabassiana*	4 gm	1.28(1.33)	0.66f(1.29)	0.67g(1.29)
6.	Imidaclorprid	20 mL	1.30(1.34)	0.57h(1.25)	0.65h(1.28)
7.	Spinosad	20 mL	1.35(1.36)	1.03b(1.42)	1.24b(1.49)
8.	Untreated control		1.55(1.43)	1.57a(1.60)	1.37a(1.53)
	SEm ±CD at 5%		0.051NS	0.0100.029	0.0060.010

Table 3: Relative efficacy of different ecofriendly bio-pesticides on rove beetle.

S.N.	Name of insecticide	Dosegm or mL /L of water	Pretreatment population/plant	Post treatment population / plant	
				I spray	II spray
1.	Neem oil	20 mL	1.09 (1.44)	0.71e (1.10)	0.79e (1.34)
2.	*Pongamia* oil	20 mL	1.14 (1.46)	0.58g (1.03)	0.78efg (1.33)
3.	NSKE	50 mL	1.17 (1.47)	0.96c (1.20)	0.82bc (1.34)
4.	*Baccillusthuriegiensis*	2 gm	1.09 (1.44)	0.85d (1.16)	0.81bcd (1.34)
5.	*Beauveriabassiana*	4 gm	1.17 (1.47)	0.63f (1.06)	0.79ef (1.33)
6.	Imidaclorprid	20 mL	1.17 (1.47)	0.57gh (1.03)	0.68h (1.29)
7.	Spinosad	20 mL	1.12 (1.45)	1.04b (1.24)	0.82b (1.35)
8.	Untreated control		1.22 (1.49)	1.57a (1.43)	0.92a(1.38)
	SEm ±CD at 5%		0.017NS	0.0500.170	0.0110.033

Table4: Relative efficacy of different ecofriendly bio-pesticides on spider

S.N.	Name of insecticide	Dosegm or mL /L of water	Pre-treatment population/plant	Post treatment population / plant	
				I spray	II spray
1.	Neem oil	20 mL	1.32 (1.35)	1.01e (1.42)	0.92de (1.38)
2.	*Pongamia* oil	20 mL	0.99 (1.22)	0.82f (1.34)	0.43g (1.19)
3.	NSKE	50 mL	1.33 (1.35)	1.15c (1.46)	1.11c (1.45)
4.	*Baccillusthuriegiensis*	2 gm	1.21 (1.31)	1.14d (1.46)	0.93d (1.39)
5.	*Beauveriabassiana*	4 gm	1.10 (1.26)	0.76g (1.32)	0.52f (1.23)
6.	Imidaclorprid	20 mL	1.44 (1.39)	0.68h (1.29)	0.41h (1.19)
7.	Spinosad	20 mL	1.21 (1.31)	1.20b (1.48)	1.17b (1.47)
8.	Untreated control		1.44 (1.39)	1.96a (1.72)	2.14a (1.77)
	SEm ±CD at 5%		0.07NS	0.0080.025	0.0100.030

during the crop growth.Xu JianJun *et al.* (2005) conducted field and laboratory experiments to evaluate the safety of Tracer (spinosad 48 SC) no major predatory natural enemies of cotton insect pests. The densities of predatory natural enemies in treated and untreated plots did not vary significantly.Shinde*et al.* (2007) reported that spinosad 45 SC @ 75 g a.i./ha was most safer insecticide to the predators on okra. The maximum population of ladybird beetle (1.78), *chrysopa* (0.55) and spiders (1.36) per plant, respectively were recorded in the treatment of spinosad 45 SC @ 75 g a.i. /ha over different treatments. Sharma and Kaushik (2010) evaluated spinosad 45 SC along with six chemical insecticides. Spinosad 45 SC (162.5 mL/ha) was safe to natural enemies whereas the chemical insecticides proved toxic to them.

Rove beetle

The rove beetle, *Atheta coriaria* Kraatz (Coleoptera: Staphylinidae) is a natural enemy for control of certain insect pests on okra.This population on okra crop appeared during second week of February (7[th]SMW) with (0.64 grubs and adult/ plant). In pre-treatment observation, the rove beetle population ranged between 1.09 to 1.22 per plant and non significant differences among different plots. After first spray, among treated plots spinosad 45 SC @ 0.25 ml/L of water recorded highest (1.04/plant) rove beetle population followed by NSKE 0.15 EC @ 50 ml/L of water (0.96/plant). Lowest population (0.60) was recorded in imidachlorprid 17.8 SL @ 0.25 ml/L of water (0.57/plant) followed by *Pongamia* oil (crude) @ 20 ml/ L of water (0.58/plant).After second spray, spinosad 45 SC @ 0.25 ml/L of water recorded highest (0.82/plant) coccinellid population among treated plots. It was at par with NSKE 0.15 EC @ 50 mL/ l of water (0.82/plant) and Bt 5%WP @ 2 gm/l of water with the population of 0.81 rove beetle/ plant. Lowest rove beetle population in was imidachlorprid 17.8 SL @ 0.25 ml/L of water (0.68/plant) followed by *Pongamia* oil (crude) @ 20 ml/ L of water (0.78/plant) (Table3). Overall, spinosad 45 SC @ 0.25 ml/L of water (0.93/plant) recorded most safe to rove beetle with highest population followed by NSKE 0.15 EC @ 50 ml/L of water with the population of 0.89 rove beetle/ plant among treated plots whereas, imidachlorprid 17.8 SL @ 0.25 ml/L of water was most toxic which recorded lowest (0.62/plant) rove beetle population.Similarly Shinde *et al.* (2007) reported that spinosad 45 SC @ 75 g a.i./ha was most safer insecticide to the predators on okra. The maximum population of coccinellid (1.78), *chrysopa* (0.55) and spiders (1.36) per plant, respectively were recorded in the treatment of spinosad 45 SC @ 75 g a.i. /ha over different treatments. Similar results were obtained by Udikeri *et al.* (2004) who reported the activity of predators (*Chrysoperla* and Coccinellids) in emamectin benzoate and spinosad treated with was as good as untreated control indicating the safety of these molecules to predominant natural enemies in cotton ecosystem.

Spiders

Many studies have demonstrated that spiders can significantly reduce prey densities. The importance of spiders as a major factor in regulating pest and they have been considered as important predators of insect pests and serve as a buffer to limits the initial exponential growth of prey population (Chatterjee *et al.*, 2009; Jayakumar and Sankari, 2010). Besides the coccinellids and rove beetles, a predatory spider was found preying upon aphid and jassid. The spider made its first appearance on the crop in the second week of February (7[th] SMW) with (0.63 spider/plant). Hegde *et al.* (2004) reported that coccinellids and spiders were found throughout the year with a low population level.In pre-treatment observation, the spider population ranged between 0.99 to 1.44 / plant and non significant differences among different plots.After first spray, among treated plots spinosad 45 SC @ 0.25 ml/L of water recorded highest (1.20/plant) spider population followed by NSKE 0.15 EC @ 50 ml/L of water (1.15/plant). Lowest population (0.68/plant) was recorded in imidachlorprid 17.8 SL @ 0.25 ml/l of water followed by Bb 1.15 WP @ 4 gm/L of water (0.76/plant). After second spray, spinosad 45 SC @ 0.25 ml/l of water recorded highest (1.17/plant) spider population among treated plots. The second best treatment was NSKE 0.15 EC @ 50 ml/L of water (1.11/plant). Lowest spider population was imidachlorprid 17.8 SL @ 0.25 ml/l of water (0.41/plant) followed by *Pongamia* oil (crude) @ 20 ml/ l of water (0.43/plant) (Table4). Overall, it is clear that spinosad 45 SC @ 0.25 ml/L of water (1.18/plant) recorded most safe to spider with highest population followed by NSKE 0.15 EC @ 50 ml/L of water with the population of 1.13 spider/ plant among treated plots whereas, imidachlorprid 17.8 SL @ 0.25 ml/L of water was most toxic which recorded lowest (0.54/ plant) spider population.

In the present investigation, the data is clearly shown that the spinosad 45 SC can be used to manage the insect pests of okra without any adverse effect on natural enemies. This is most safer molecules than used to other. Similarly Shinde*et al.* (2007) reported that spinosad 45 SC @ 75 g a.i./ha was most safer insecticide to the predators on okra. The maximum population of coccinellid (1.78), *chrysopa* (0.55) and spiders (1.36) per plant, respectively were recorded in the treatment of spinosad 45 SC @ 75 g a.i. /ha over different treatments. Similar results were obtained by Udikeri*et al.* (2004) who reported the activity of predators (*Chrysoperla* and Coccinellids) in treated with spinosad was as good as untreated control indicating the safety of these molecules to predominant natural enemies in cotton ecosystem. Ghosh *et al.* (2010) found that Spinosad at 73 to 84 g a.i./ ha were very safe to three important predators recorded in tomato field that is, *Menochilus sexmaculaus., Syrphus corollae* and *Chrysoperla carnea*. It is safe to nymphs and adults of the natural enemies.

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