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EVALUATION OF BIO-PESTICIDES AGAINST RED COTTON BUG AND FRUIT BORER OF OKRA

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ABSTRACT

Bio-pesticides were evaluated against red cotton bug (*Dysdercus koenigii* F.) and fruit borer (*Helicoverpa armigera* H.) in okra at Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal during pre-kharif season of 2013. The treatments *viz.* annonin 1% EC, karanjin 2% EC, Azadirachtin 1% EC, *Metarrhizium anisopliae,Verticillium lecanii* , *Beauveria bassiana* , *Bacillus thuringiensis var Kurstaki*, spinosad 45% SC and imidacloprid 17.8% SL were applied twice at 15 days interval at initiation of fruiting stage. Results revealed that mean population of red cotton bugs was lowest in imidacloprid treated plots (2.00 red cotton bugs/5 plants and 63.27% reduction) followed by azadirachtin with 2.87 red cotton bugs/5 plants and 47.90% reduction over control.After second spray, lowest mean fruit damage (1.05%) was recorded in spinosad treated plots followed by *B.t.* (7.88%). Highest marketable yield of okra was also recorded in spinosad treated plots (53.67 q/ha) followed by *B.t.* (42.26 q/ha), *B. bassiana* (39.28 q/ha) and azadirachtin (37.92 q/ha), respectively. Whereas, the yield obtained from untreated control plots was only 24.81 q/ha. Results revealed that imidacloprid and spinosad were very effective treatments against red cotton bug and fruit borer, respectively.

INTRODUCTION

Okra, *Abelmoschus esculentus* L. Moench (Malvaceae) is an important vegetablewhich grown throughout the country. It is key vegetable of the tropical countries and also it is most popular in India. In India, it occupied 5.30 lakh hectare and produced 63.5 lakh tonnes with an average productivity of 12.0 MT/ha during 2012-13 (Anonymous, 2013). The crop is attacked by several insect pests since seedling to maturity. Out of 56 insect species attacking the crop, the shoot and fruit borer appeared to be the most serious inflicting 45-57.1% damage to fruits (Srinivasan and Krishnakumar 1983).It is reported that okra is infested severely by many pests during warm and rainy season such as leaf hopper and shoot and fruit borer (Gandhale *et al.*, 1987; Clement and David 1989; Madan *et al.*, 1996). Damage due to fruit borer accounts for nearly 45% loss in Karnataka (Srinivasan and Krishnakumar 1983) and 22.5% in Uttar Pradesh (Verma *et al.*, 1985). Besides fruit borer, okra crop sometimes suffer from heavy attack of red cotton bug during kharif season. Indiscriminate and injudicious uses of conventional insecticides for management of these insect pests have been causing different environmental hazards including resurgence, resistance and residue problem in food stuff. Therefore, the present experiment was conducted to evaluate some bio-pesticides against red cotton bug and fruit borer in okra for their management.

MATERIALS AND METHODS

The field experiment was carried out in the pre-kharif season of 2013 at Bidhan Chandra Krishi Viswavidyalaya, Kalyani, Nadia, West Bengal, India to evaluate the efficacy of different bio-pesticides against red cotton bug and fruit borer in okra. The experiment was laid out in randomized block design with three replications for each treatment. Crop was sown in the plot size of 3m x 4m area with 45 cm x 60 cm spacing. The crop was raised with recommended management practices except plant protection measures. The treatments *viz.* annonin 1% EC (2 ml/l), karanjin 2% EC (2ml/l), Azadirachtin 1% EC (2ml/l), *Metarrhizium anisopliae* - CFU Count 1 X 10 ^ 8 / g (5 g/l),*Verticillium lecanii*- CFU Count 1 X 10 ^ 8 / g (5g/l), *Beauveria bassiana*- CFU Count 1 X 10 ^ 8 / g (5g/l), *Bacillus thuringiensis var* Kurstaki-18,000 IU/mg (2g/l), spinosad 45 % SC (1ml/l) and imidacloprid 17.8% SL (0.3ml/l) were applied twice at 15 days interval starting from initiation of fruiting stage. Spraying were done with pneumatic knapsack sprayer using spray fluid @ 500l/ha. Observations were taken on 1 day before the spray as pre-treatment and successive observations were recorded on 7 and 14 days after each spray. Cotton bugs were counted from randomly selected five tagged plants/ plot whereas fruit borer was recorded by counting total fruits and infested fruits from each replication after each harvesting

(Jat and Ameta, 2013). The critical difference (CD) at 5% level of significance was worked out (Fisher and Yates (1963) from the data of mean population of red cotton bug and fruit borer of different observations after necessary transformation.

RESULTS AND DISCUSSION

Efficacy of insecticides against red cotton bug

Efficacies of insecticides against red cotton bug are presented in Table 1. Pre-treatment observation showed that there were no significant differences among the population.During first spray,lowest population of red cotton bugs were recorded in imidacloprid treated plots (1.83 red cotton bugs/ 5plants and 56.00% reduction) followed by azadirachtin, karanjin, annonin and *B. bassiana* with 2.49, 2.83, 3.16 and 3.16 red cotton bugs/5 plants and 40.14, 31.97, 24.03, 24.03% reduction over control, respectively. After second spray, imidacloprid recorded lowest population with 2.16 red cotton bug/5 plants followed by azadirachtin (3.25 red cotton bug/5 plants) and karanjin (3.91 red cotton bug/5 plants). Highest percentage reduction (70.53%) of red cotton bug population was observed in imidacloprid treated plots followed by azadirachtin (55.66%). Bio-pesticides *viz. M. anisopliae*, *V. lecanii*, *B. bassiana* and *B.t.* were not effective as other treatments in reducing population of red cotton bugs but were found to be superior over untreated control plots.It was observed that after two spray mean population of red cotton bugs was also lowest in imidacloprid treated plots(2.00 red cotton bugs/5 plants and 63.27% reduction) followed by azadirachtin, karanjin and spinosad with 2.87, 3.37 and 3.83 red cotton bugs/5 plants and 47.90, 39.31 and 30.44% reduction over untreated control, respectively.

During the present investigation, imidacloprid provided best control with lowest mean population of red cotton bug followed by azadirachtin. Literature regarding the efficacy of these insecticides on red cotton bug is very scanty. Though, many authors reported that neem based formulations are highly effective against both nymphs and adults of red cotton bug (Pandey and Tiwari, 2011; Fakhri and Murad, 2002; Chakraborti and Chatterjee, 1999; Gupta *et al.*, 1997; Singh *et al.*, 1997 and Gujar and Mehrotra, 1993). Present results of imdacloprid are in disagreement with the observation of Kodandaram *et al.* (2008) who reported that econeem (a neem-based product, 1%) proved least toxic to the nymphs of red cotton bug. Annonin showed moderate efficacy against red cotton bug in the present experiment which may be corroborated with results of Kodandaram *et al.* (2008) who reported that annonin (1%) was found to be the most toxic against red cotton bug. Efficacy of *M. anisopliae* against red cotton bug are in contradictory with the findings of Bahayaraj and Borgio (2008) who reported that two isolates of *M. anisopliae* (CPRC 16 and CPRC 18) were effective against the red cotton bug on the cotton saplings.

Efficacy of insecticides against *H. armigera* (Hub.)

The data pertaining the efficacy of biological origin insecticides against *H. armigera* is presented in Table 2. There was no significant variation among treatments in mean percent fruit infestation after 14 days of first spray.However, at 7 and 14 days of second spray all the insecticides showed significant reduction of borer infestation and showed superior performance over control.Among the insecticides, spinosad exhibited lowest mean fruit infestation (1.05%) at 7 and 14 days after second spraying followed by *B.t.* (7.88%). Azadirachtin and imidacloprid provided moderate control with mean fruit infestation of 8.74% and 8.96%, respectively. Percent reduction of fruit infestation over control was also highest in spinosad treated plots (93.39%) followed by *B.t.* (50.17%). Next best treatments were azadirachtin (44.71%) and imidacloprid (43.34%) in reducing fruit infestation over control. Biopesticides *viz.V. lecanii*, Karanjin and *M. anisopliae* were less effective in reducing fruit damage with minimum percent reduction of 12.12, 18.96 and 21.44%, respectively but all were superior over untreated control plots.

Yield

It was cleared that highest marketable fruit yield of okra (53.67 q/ha) was recorded in spinosad treated plots followed by *B.t.* (42.26 q/ha), *B. bassiana* (39.28 q/ha) and azadirachtin (37.92 q/ha), respectively (Table 2). Whereas, the yield obtained from untreated control plots was only 24.81 q/ha.

Table 1: Effect of insecticides against red cotton bug on okra

Treatment	Dose (ml or gm/L)	Pre-treatments count of red cotton bugs /5 plants	Mean number of red cotton bugs/5 plants after each spray			% reduction over control		
			First	Second	Mean	First	Second	Mean
Karanjin 2%EC	2ml/L	3.18(1.92)	2.83(1.81)	3.91(2.09)	3.37(1.93)	31.97	46.65	39.31
Annonin 1%EC	2ml/L	3.20(1.92)	3.16(1.90)	4.91(2.33)	4.04(2.12)	24.03	33.01	28.52
Azadirachtin 1%EC	2ml/L	2.83(1.82)	2.49(1.73)	3.25(1.94)	2.87(1.83)	40.14	55.66	47.90
Metarhizium anisopliae	5gm/L	2.45(1.71)	4.00(2.11)	5.66(2.47)	4.83(2.31)	3.84	22.78	13.31
Verticillium lecanii	5gm/L	3.15(1.91)	4.00(2.11)	5.33(2.41)	4.67(2.27)	3.84	27.28	15.56
Beauveria bassiana	5gm/L	2.18(1.64)	3.16(1.91)	5.58(2.46)	4.37(2.16)	24.03	23.87	23.95
Bacillus (B.t.)	2gm/L	3.00(1.87)	3.49(2.00)	5.41(2.43)	4.45(2.22)	16.10	26.19	21.15
Spinosad 45% SC	1ml/L	3.15(1.91)	3.33(1.96)	4.33(2.20)	3.83(2.08)	19.95	40.92	30.44
Imidacloprid 17.8% SL	0.3ml/L	2.17(1.63)	1.83(1.52)	2.16(1.62)	2.00(1.58)	56.00	70.53	63.27
Untreated	-	2.25(1.66)	4.16(2.16)	7.33(2.79)	5.75(2.48)	-	-	-
SE.m ±	-	-	0.07	0.10	0.13	-	-	-
CD at 5%	-	NS	0.21	0.28	0.38	-	-	-

Data parentheses are square root transformed values, NS = Non-significant

Table 2: Efficacy of insecticides against *Helicoverpa armigera* (Hub.) on okra

Treatment	Dose (ml/L or gm./L)	Pre-treatment damage (%)	Fruit infestation (%) duringfirst spray			% reduction over control	Pre-treatment damage (%)	Fruit infestation (%) duringsecond spray			% reduction over control	Marketable yield(q/ha)
			7 DAS	14 DAS	Mean			7 DAS	14 DAS	Mean		
Karanjin 2%EC	2ml/L	*	*	3.18(14.13)	1.59	56.39	1.45(7.63)	12.85(21.32)	12.78(21.29)	12.81	18.96	32.19
Annonin 1%EC	2ml/L	*	*	4.77(11.36)	2.39	34.66	5.67(13.74)	8.71(17.62)	10.20(19.08)	9.46	40.19	33.41
Azadirachtin 1%EC	2ml/L	*	*	5.80(12.58)	2.90	20.59	6.40(14.51)	9.80(18.66)	7.68(16.61)	8.74	44.71	37.92
Metarhizium anisopliae	5gm/L	*	*	3.42(13.59)	1.71	53.20	3.42(11.31)	12.36(21.01)	12.48(21.08)	12.42	21.44	30.62
Verticillium lecanii	5gm/L	*	*	3.90(11.12)	1.95	46.58	2.57(9.33)	13.70(22.12)	14.09(22.45)	13.89	12.12	29.38
Beauveria bassiana	5gm/L	*	*	5.80(12.58)	2.90	20.59	2.54(9.27)	8.09(16.98)	12.69(21.26)	10.39	34.28	39.28
Bacillus (B.t.)	2gm/L	*	*	3.08(12.23)	1.54	57.81	3.08(9.60)	7.83(16.73)	7.93(16.81)	7.88	50.17	42.26
Spinosad 45% SC	1ml/L	*	*	2.21(9.33)	1.10	69.77	1.54(7.72)	0.65(5.71)	1.44(7.97)	1.05	93.39	53.67
Imidacloprid 17.8% SL	0.3ml/L	*	*	4.34(12.02)	2.17	40.55	2.96(9.71)	7.67(16.59)	10.24(19.10)	8.96	43.34	37.74
Untreated	-	*	*	7.30(16.05)	3.65	-	6.95(14.02)	15.18(23.23)	16.44(24.28)	15.81	-	24.81
SE.m ±	-	-	-	-	-	-	5.99	1.24	0.92	-	-	3.27
CD at 5%	-	-	-	NS	-	-	NS	3.68	2.73	-	-	9.72

Data parentheses are angular transformed values, NS = Non-significant, *Pest was not infested

Experimental results showed that spinosad recorded lowest mean fruit infestation as well as highest fruit yield. Findings are in conformity with results of Ghosh *et al.* (2011),Meena and Raju (2014) and Gadhiya *et al.* (2014) whore ported that spinosad was more effective against *H. Armigera*. Sridevi *et al.* (2004) reported that individual treatments of spinosad 45 SC (0.0018 or 0.003%) and its combinations (0.006 or 0.0013%) with *Btk* (0.02 to 0.08%) resulted in significantly higher larval mortalities of 100% and 64.8-110.0%, respectively against the third instar larvae of *H. armigera*. Efficacy of *Bt* may be comparable with the findings of Nandanwar *et al.* (2004) who reported that *Bacillus thuringiensis* at 2x10^8 spores ml^{-1} was found the most effective, bringing about 62.10% larval mortality of *H. armigera* while Dhingra (2012) concluded that glycerol based formulation of *Bt* showed minimum decline in cell number and could be used to control *H. armigera* larvae for two months. Azadirachtin and imidacloprid were quite effective in reducing percent fruit infestation. These findings are similar with the results of Packiam *et al.* (2012) who reported that Ponneem exhibited significant oviposition deterrent activity whereas Meena and Raju (2014) showed less effectiveness of NSKE against *H. armigera* in tomato under field condition. Katole *et al.* (2002) reported that seed treatment with imidacloprid 70 WS was equally effective as the spray formulations of the same insecticides in reducing the green fruiting body damage of cotton caused by American bollworm, *H. armigera* under field conditions. Efficacy of *B. bassiana* is analogous with the findings of Sun *et al.* (2001) who reported that the larvae treated with three different concentrations of *B. bassiana*, the larvae died most quickly and the mortalities were the highest. Karthikeyan and Selvanarayanan (2011) reported that 0.25 per cent concentration of *B. Bassiana* recorded the highest mortality of *H. armigera* (86.67 %). *M. anisopliae* was comparatively less effective against the pest which is supported by the results of Nahar *et al.* (2004).Phukon *et al.* (2014) reported that the entomopathogenic fungi-*Beauveria bassiana* and *Metarhizium anisopliae* could be effectively used as pest management option against *H. armigera* in production of organic tomato to reduce the pest population below economic threshold level and increased yield.

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