Plant Archives Vol. 17 No. 1, 2017 pp. 417-422 *ISSN 0972-5210*

ASSESSMENT OF SELECTED ECO-FRIENDLY PESTICIDES ON *AMRASCA BIGUTTULA BIGUTTULA* OF OKRA CROP IN CENTRAL REGION OF UTTAR PRADESH, INDIA

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Abstract

The results revealed that significantly lower mean jassid population at 14 days after second spraying were 1.10 and 2.00 jassids/5 plant/3 leaves were recorded on the crop treated with imidacloprid 17.8SL with 87.78 and 75.00 per cent reduction over control during 2014 and 2015, respectively. The ranking of insecticides on the basis of per cent reduction over control after second spraying of 14 days for the management of jassid was imidacloprid 17.8SL > spinosad 45SC > fipronil 5 SC > *Azadirachtin* 1000 ppm > *B. thuringiensis* during 2014 and 2015 except Bt. > *Azadirachtin* 1000 ppm in 2015.

Key words : Okra, *Amrasca biguttula biguttula*, eco-friendly insecticides, per cent reduction.

Introduction

Okra [*Abelmoschus esculentus* (L.)] is an important vegetable crop grown in India. It is known by various local names in different parts of world, as Lady's Finger in England, gumboo in United States of America and Bhindi in India. Okra is alone vegetable member of family malvaceae, which is grown on commercial scale in tropical and subtropical area. Its fresh and immature fruits are used for preparation of various delicious dishes. Okra contains carbohydrate, proteins and vitamin 'C' in large quantities (Abeboye and Oputa, 1996).

India is second largest producer of vegetable in the world (Surpassed only by china), contributes about 10 percent of world production.Vegetables are cultivated in an area of 1148.0 mha with a total production of 7896.3 MT (Indian Horticulture, 2011) and average productivity of 19.18 MT/ha worldwide. Okra is cultivated in an area of 1.06 mha with a total production of 7.83 MT and average productivity of 7.4 MT/ha (Anonymous, 2011). In India, vegetables were cultivated in 9355.00 mha with an annual production of 163388.00 MT in 2014 (Anonymous, 2014a) and productivity 17.30 MT/ha in 2013 (Anonymous, 2014b) and the okra is cultivated 524.00 mha with an annual production of 6203.00 MT (Anonymous, 2015b) and productivity 11.90 MT/ha in 2013-14 (Anonymous, 2014c).

Vegetable based industries are emerging as powerful engine for economic growth in rural India. Cereals are India's mainstay and then production is essential for sustaining the livelihood of the rural poor but cereals alone are little hope for raising farmers out of poverty, therefore, new cropping systems are needed to make farmers prosperous. Vegetables are an excellent choice for a cash crop. Vegetable crops can be grown quickly with good yields and fetch higher price at market in comparison to cereals. Like other crops, okra is also attacked by number of insect-pests, mites and nematodes (Chaudhary and Dadheech, 1989). The major pests of lady's finger included: leafhopper (*Amrasca biguttula biguttula* Ishida), shoot and fruit borer (*Earias vittella* Fab. and *E. insulana* Boisdubal.), Fruit borer (*Helicoverpa armigera* Hubner), Cotton aphid (*Aphis gossypii* Glover), white fly (*Bemisia tabaci* Gennadius), red cotton bug (*Dysdercus cingulatus* Fab.), leaf roller (*Sylepta derogata* Fab.), Okra stem fly (*Melanagromyza hibisci* Spencer) and red spider mite (*Tetranychus cinnabarinus* Boisdubal), Root-Knot nematode (*Meloidogyne incognita* Berkely).

The productivity of okra is low due to many factors and one of the most important constraints in production is the attack of insect pests. Aphid (*A. gossypii*), shoot

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and fruit borer, *Earias insulana* (Boisduval) and *E. vittella* and Jassid, *A. biguttula biguttula* are most serious pests of okra and cause 45.00-57.10% damage to fruits (Shrinivasan and Krishna Kumar, 1983 and Nderitu *et al*., 2008). The sucking pest complex of okra consisting of aphids, leaf hoppers, whiteflies, thrips and mites causes 17.46% yield loss and failure to control them in initial stages was reported to cause 54.04% yield loss (Chaudhary & Daderch, 1989 and Anitha & Nandihalli, 2008). Among these pests the jassids isan important insect pest, therefore, present investigation is carried out okra jassid.

Among two most common insect pests, spotted boll worm (*Earias vittella* Fab.) and spiny boll worm (*Earias insulana* Boisduval), which are the most common and abundant in India and nearby countries. Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. The manipulation of planting time helps to minimize pest damage by producing synchrony between host plant and the pest. Due to staggered sowing, pests are able to complete 1-2 additional generations in the season. In order to avoid these generation, sowing dates of the crop can be adjusted. The distinct differences in the pest fauna on the okra crop sown on different dates in the main season was observed in different agro-ecological conditions with early sown crop favouring the population build-up of leafhoppers, while the late sown crops suffered more damage by *Earias* spp. (Rai and Satpathy, 1998; Satpathy and Rai, 1999; Singh and Brar, 1994). The information regarding insect pest appearance, infestation and its severity of damage in relation to sowing time on the okra seed crop need to be established for the agro-climatic conditions of the Uttar pradesh, India.

In order to prevent the crop losses due to attack of spotted boll worms, various conventional insecticides have been recommended, which are hazardous and harmful to human being due to their presence in fruit as residue. However, some entomologists have found that the use of novel insecticides, bio-insecticides and Neem based insecticides is advantageous in several ways over synthetic insecticides and safer to mammals, natural enemies and beneficial insects.

Materials and Methods

To evaluate the effect of selected eco-friendly insecticides on okra jassid in central region of UP, the experiments was conducted in two consecutive years *i.e.* Zaid season of 2014 and 2015 at Vegetable Research Farm, CSAUAT Kalyanpur, Kanpur. Geographically, Kanpur is situated in the sub tropical alluvial tract of central plains of Ganga-Yamuna at $26^0$26' north and 80^0-24' east longitude at the elevation of 125.9 above sea level. The mean annual rain fall is about 800 mm in this area. The experimental plot was ploughed with a soil turning plough followed by two harrowing to make the soil well pulverized and free from weeds.Before sowing, FYM was applied in the field and mixed properly in the soil. The required dosage of fertilizers *i.e.* NPK were applied at the rate of 120, 60 and 60 kg, respectively. The whole amount of phosphorus (By DAP), potassium (By MOP) and half dose of nitrogen (By DAP + Urea was incorporated in the soil while, remaining half dose of nitrogen (by urea) was applied as top dressing after one month.

The experiment is laid out in RBD with six treatment in four replication with a plot size 3 × 2.25 including control and Field border, Block border cum Irrigation Channel, Sub irrigation channel and Plot border are 1.00 metre, 1.5 metre, 1 metre and 0.5 metre, respectively. All the treatments were allotted randomly in each replication .Normal agronomic practices were adopted to keep the field free from weeds to increase soil aeration and to conserve the moisture. The registered formulations and insecticides used, in this study are given in table 1.

The insecticidal spray solutions were prepared by the following formula :

$$\text{Amount of insecticidal formulation} = \frac{\text{Concentration required (\%)} \times \text{Volume required (litre)}}{\text{Concentration of toxicant in insecticidal formulation}}$$

First spraying was applied after one month of sowing followed by 15 days interval of second spraying. The effect of insecticides was studied against insect pest (*Amarasca biguttula biguttula*) and their effect on plants was also recorded.

The concentration of B.*t*., neem product (Azadirachtin), Spinosad, Imidacloprid and Fipronil were sprayed on the basis of active ingredient. Desired amount of insecticides was measured by micro pipette and solution were prepared in plastic containers in required water just at the spraying in the field with the help of Knapsack sprayer. The data pertaining to efficacy of different insecticides against *Amarasca biguttula biguttula* during zaid 2014 and 2015 after first spray has been given in table 2. The efficacy data was recorded by counting the jassid /three leaves 1 day before spray and 3, 7 and 14 days after of spraying. The efficacy was also assessed on the basis of jassid population and per cent reduction over control.

Results and Discussion

To control the jassid (*Amarsca bigutulla bigutulla*) on okra variety Arka anamika efficiently, two spray of selected eco-friendly insecticides such as Imidacloprid, Spinosad, Fipronil, and one microbial insecticide such as *Bacillus thuriengiensis* and one neem product such as *Azadirachtin* were made and jassid population were recorded one day before and after 3, 7 and 14 days of spraying (in each spray) to judge their efficacy.

During 2014

First spraying

The jassid population in each treatment before one day spraying was varied from 4.0 to 9.00 jassids /5 plants (3 leaves) (table 2). The population reduction of jassid reveals that all treatments were significantly superior to control at all intervals of the observation. When the insecticides were compared amongst themselves three days after spraying, imidacloprid 17.8 SL was significant to with less number of jassid population 2.09 jassids/5 plants and more per cent of reduction over control 76.77% compared with all treatment followed by Spinosad and Fipronil were 2.30 and 2.57 jassids/5 plants with 71.25 and 63.28 Percent reduction overl control respectively. *Azadirachtin* and *Bacillus thuriengiensis* were at par with each other having 48.83 and 53.71 Percent reduction over control. Imidacloprid 17.8 SL found effective to control jassid population.

The application of imidacloprid, spinosad, and fipronil were superior after seven days spraying provided decreased 2.00, 2.10 and 2.47 jassids/5plants, with 77.78, 73.75, and 64.71% per cent reduction over control, respectively.

After fourteen days when jassid reduction was recorded, Fipronil, Spinosad, and imidacloprid were effective against jassid with population 2.36, 2.00 and 2.10 jassids/5 plants with 66.28, 75.00 and 87.78% per cent reduction over control. Here, population were decreases as compare to seven days after spraying and it was significantly superior over control. Both botanical and microbial insecticides results 2.15 and 2.77 jassid/5 plants with 64.16 and 60.43 percent reduction of jassid population were recorded by *Azadirachtin* and *B. thuriengiensis*, respectively.

Second spraying

It is seen from the data that the population of jassid homogenously distributed in the field (experimental plots) before second spraying. It is evident from the table on reduction of jassid that all insecticidal treatments found significantly superior to control at all the interval of observation. At three day after spraying imidacloprid, and Spinosad gave excellent control of jassid with minimum population 2.07 and 2.31 jassids/5plants. imidacloprid was superior among all treatment with 77 percent reducing pest population. Botanical, *Azadirachtin* results 49.67 percent reduction pest population while Microbial insecticide, *B. thuriengiensis* found slightly effective to control jassid population with 54 per cent compare to other chemical insecticides.

After seven days of spraying imidacloprid, spinosad, Fipronil were observed effective against pest recorded to reduce jassid population 1.88, 2.19 and 2.32 jassids/5 plants with 79.11, 72.62 and 66.86 percent reduction of pest population. Efficacies of other treatments were also significantly superior over control recorded 2.72, and 3.03 jassids/5plants. *Azadirachtin* and *B. thuriengiensis* found most effective for reducing pest population up to 54.67 and 56.71 per cent.

After fourteen days of spraying imidacloprid and Spinosad were found most effective against pest. These both insecticides were significantly superior to all treatment and grouped in excellent category and recorded 1.10 and 2.03 jassids/5 plants reducing maximum per cent pest population among treatment with 87.78 and 74.63 Percent reduction over control followed by Fipronil was reducing population 2.21 jassids/5plants spinosad and fipronil at par with each other *Azadirachtin* and *B. thuriengiensis* reduced the jassid population up to 65.33 and 61.28 per cent, respectively. Among all chemicals, effect of spinosad recorded less pest population with 87.78 percent maximum reduction over control.

Therefore, imidacloprid, Spinosad, fipronil and *Azadirachtin* were included in the most effective group of insecticides against okra jassid. At all the testing intervals *i.e.* three, seven and fourteen days, whereas imidacloprid and spinosad were remained effective up to fourteen days after second spraying.

During 2015

First spraying

Initial counts of the jassid population present on okra plant before treatment reveal that the population of jassid was present uniformly throughout the experimental plots. Data reveals from the observation that all the insecticides proved better against jassids than control at all the interval of observation. The jassid populations on various treatments at pre treatment count varied from 5.00 to 8.00 jassids/5 plants significantly differ among themselves (table 3).

Maximum reduction of jassid population was noticed

Table 1 :

S. no.	Common Name	Trade name	Formulations	Dose (a.i./ha)	Source of Availability
1.	*Azadirachtin*	Azacel	1000 (ppm)	1500 ml	Biotech, International Ltd.,New Delhi
2.	*Bacillus thuringiensis*	Biolep	500 IU per mg	500gm	Biotech, International Ltd.,New Delhi
3.	Spinosad	Tracer	45SC	75gm	Dow Agro Science India Pvt. Ltd. Mumbai
4.	Imidacloprid	Ultimo	17.8 SL	22.25gm	Sudarsan Chemicals Industries Ltd.,Pune (M.S.) India
5.	Fipronil	Regent	5 SC	75gm	Bayer Crop Science Pvt Ltd. Mumbai, India)
6.	Control (water spray)	-	-	-	

three days after spraying in the imidacloprid treated plots, followed by spinosad, and fipronil. All the chemicals were also proved quite toxic to jassid at three days after treatment. It is evident from the observations that reduction of jassid population in all insecticidal treatments proved significantly superior to control at all the interval of observation. The significant efficacy all insecticide was increased after three days of application over control except *B. thuriengiensis* and *Azadirachtin.*

The reduction of jassid population was 2.26, 2.50, 2.80, 3.34 and 3.53 jassids/5plants against treated insecticides imidacloprid, spinosad, fipronil, *Azadirachtin* and *B. thuriengiensis* respectively. Maximum percent of pest reduction was recorded by imidacloprid followed by spinosad, fipronil, *Azadirachtin* and *B. thuriengiensis* with 71.75, 64.30, 60.00, 33.20 and 41.17 per cent. While in seven days of insecticide spraying imidacloprid and spinosad were found most effective to minimize the jassid population up to 2.04 and 2.12 jassids/5 plants with reducing 74.50 and 69.71 per cent pest population respectively. In other hand, *B. thuriengiensis* and Fipronil found very effective for reducing the pest population up to 44.30 and 61.57 percent. *Azadirachtin* found least effective for reducing with pest population 37.80 per cent.

After 14 days of spraying imidacloprid and spinosad were at par and fipronil grouped in excellent category of the insecticides having population 2.00, 2.00 and 2.56 / 5plants. Hence decrease jassid population after seven days spraying. All insecticides show minimum controlling pest population up to fourteen days of spraying that why second spraying was necessary for controlling jassid population. *Azadirachtin* and *B. thuriengiensis* show the effective control of jassid population up to 40 and 46 per cent.

Second spraying

The perusal of table 3 indicates that all treatments were again proved significantly effective to reduce the jassid population after first and second spraying. After three days of spraying the efficacy of all insecticides were significantly increased over control, imidacloprid and spinosad were found most effective to reduce jassid population and most significant all treated insecticides. The minimum number of jassid found in, imidacloprid, spinosad and fipronil 2.24, 2.51, and 2.61 jassids/ 5 plants, respectively. The maximum percent of reduction found 72.00, 64.14 and 62.71 of imidacloprid, spinosad, fipronil was found, respectively. *Azadirachtin* and *B. thuriengiensis* found less effective for reducing pest population up to 34.20 and 41.50 per cent.

The application of imidacloprid was again proved most effective with less number of jassid population 2.07 jassids/ 5 plants after seven days spraying followed by spinosad and fipronil were at par with each other having population 2.21 and 2.52 jassids/ 5plants. *Azadirachtin* and *B. thuriengiensis* were found effective to control pest population up to 40.80 and 45.00 per cent, respectively.

Imidacloprid was most effective treatment after 14 days of application, which reduced jassid population up to 2.00 jassids/5 plants but at par with spinosad having with population 2.06 jassids/5plants followed by fipronil. The chemical insecticides imidacloprid and spinosad were found effective up to fourteen days after spraying continuous reduce jassid population. *B. thuriengiensis* effective to reduce jassid population up to fourteen days after spraying, *Azadirachtin* effective to control jassid population up seven day after that it was slightly decrease population up to fourteen days. *Azadirachtin* found most less effective to reducing pest population up to 44 per cent which is less than *B. Thuriengiensis* 47.17 per cent. Maximum per cent reduction was found in imidacloprid, spinosad and fipronil with 75.00, 70.57, and 64.30 per cent, respectively.

The efficacy of all the tested insecticides *viz.* systemic, contact and microbial exhibited similar result during two consecutive 2014 and 2015 years and were significantly superior over control. The best effective

Table 2 : Effect of different insecticides against jassid on okra crop 2014.

S. no.	Treatments	Dosa/ha	1st Application (Mean population/3 leaves)							IInd Application (Mean population/3 leaves)					
			1DBS	3DAS	PROC.	7DAS	PROC.	14 DAS	PROC.	3DAS	PROC.	7DAS	PROC.	14 DAS	PROC.
T_1	Azadirachtin	500ml/ha	6.00(2.54)	3.07(1.88)	48.83	2.85(1.83)	52.50	2.15(1.62)	64.16	3.02(1.87)	49.67	2.72(1.79)	54.67	2.08(1.60)	65.33
T_2	Bt.(biolep)	500gm	7.00(2.73)	3.24(1.93)	53.71	3.07(1.88)	56.14	2.77(1.80)	60.43	3.22(1.93)	54.00	3.03(1.87)	56.71	2.71(1.79)	61.28
T_3	Spinosad	75gm	8.00(2.91)	2.30(1.67)	71.25	2.10(1.61)	73.75	2.00(1.58)	75.00	2.31(1.67)	71.12	2.19(1.64)	72.62	2.03(1.59)	74.63
T_4	Imidacloprid	40gm	9.00(3.08)	2.09(1.60)	76.77	2.00(1.58)	77.78	2.10(1.61)	87.78	2.07(1.60)	77.00	1.88(1.83)	79.11	1.10(1.26)	87.78
T_5	Fipronil	75gm	7.00(2.73)	2.57(1.75)	63.28	2.47(1.72)	64.71	2.36(1.69)	66.28	2.40(1.70)	65.71	2.32(1.67)	66.86	2.21(1.65)	68.43
T_0	Control	-	4.00(2.12)	3.98(2.12)	-	4.09(2.14)	-	4.15(2.15)	-	4.00(2.12)	-	4.09(2.14)	-	4.19(2.16)	4.09
	SEm±	-	0.11	0.125	-	0.094	-	0.090	-	0.101	-	0.084	-	0.102	-
	C.D.	-	0.33	0.38	-	0.28	-	0.27	0.31	0.30	-	0.25	-	0.30	0.28

Note: Figures in bracket parenthesis are under root x+0.5 Transformed value, DAS- Day After Spraying, PROC-Percent Reduction Over Control.

Table 3 : Effect of different insecticides against jassid on okra crop 2005.

S. no.	Treatments	Dosa/ha	1st Application (Mean population/3 leaves)							IInd Application (Mean population/3 leaves)					
			1DBS	3DAS	PROC.	7DAS	PROC.	14 DAS	PROC.	3DAS	PROC.	7DAS	PROC.	14 DAS	PROC.
T_1	Azadirachtin	500ml/ha	5.00(2.34)	3.34(1.96)	33.20	3.11(1.87)	37.80	3.00(1.87)	40.00	3.29(1.94)	34.20	2.96(1.86)	40.80	2.25(1.66)	44.00
T_2	Bt.(biolep)	500gm	6.00(2.54)	3.53(2.00)	41.17	3.34(1.95)	44.30	3.24(1.93)	46.00	3.51(2.00)	41.50	3.30(1.95)	45.00	3.17(1.91)	47.17
T_3	Spinosad	75gm	7.00(2.73)	2.50(1.73)	64.30	2.12(1.61)	69.71	2.00(1.58)	71.43	2.51(1.73)	64.14	2.21(1.64)	68.43	2.06(1.60)	70.57
T_4	Imidacloprid	40gm	8.00(2.91)	2.26(1.66)	71.75	2.04(1.59)	74.50	2.00(1.58)	75.00	2.24(1.65)	72.00	2.07(1.60)	74.12	2.00(1.58)	75.00
T_5	Fipronil	75gm	7.00(2.73)	2.80(1.82)	60.00	2.69(1.81)	61.57	2.56(1.74)	63.43	2.61(1.76)	62.71	2.52(1.73)	64.00	2.50(1.73)	64.30
T_0	Control	-	4.09(2.14)	4.35(2.20)	-	4.47(2.22)	-	4.54(2.24)	-	4.38(2.20)	-	4.46(2.22)	-	4.58(2.25)	-
	SEm±	-	0.07	0.138	-	0.103	-	0.09	-	0.11	-	0.09	-	0.11	-
	C.D.	-	0.23	0.41	-	0.31	-	0.29	-	0.33	-	0.27	-	0.34	-

Note: Figures in bracket parenthesis are under root x+0.5 Transformed value, DAS- Day After Spraying, PROC-Percent Reduction Over Control.

insecticides were imidacloprid followed by spinosad to reduce jassid population. Spraying with fipronil provide moderate control of jassid population but significantly better than microbial product. *B. thuriengiensis* found most effective compare with neem product *Azadirachtin*.

The present findings are in accordance to work done by Babu and Santharam (2002) studied bio efficacy of imidacloprid against leaf hopper (*Empoasca kerr*) on groundnut in comparison with recommended insecticides, dimethoate and methyl-o-demeton during *Kharif* and *Rabi* 1998. Imidacloprid was applied as foliar application at 100, 150, 200 and 250 ml/ha. Observations recorded at 3, 7, 14 and 21 days after first and second treatments showed that imidacloprid treatments were significantly superior to, the standard chemicals III reducing the leaf hopper population as compared to untreated check.

The findings of Sharma *et al*. (2007) evaluate the effectiveness of seven treatment schedules against insect pests of okra. Treatments involving neo-nicotinoids *viz*., as seed treatment with thiamethoxam (3 to 5 g a.i./kg seed) or as a foliar spray of imidacloprid @ 20 g a.i./ha or acetamprid 20 g a.i./ha at 30 days of sowing were found effective in managing leafhopper population. The treatment schedule having a spray of imidacloprid at 30 days of sowing followed by two foliar sprays at fortnightly interval of spinosad @ 150 g a.i./ha resulted in the minimum damage (12.57%) against borer and increase (70.43%) in yield over control, got the similar result that Singh *et al.* (2008) studied effect of insecticidal molecules against Jassid and shoot and fruit borer in okra and concluded that one spray of endosulfan 1250 ml/ha and two sprays of imidacloprid 100 ml/ha gave maximum protection against Jassid (83.05%), but failed to provide protection against fruit borer and gave significantly lower fruit yields and economic returns as compared to mixture of imidacloprid, acephate and indoxacarb.

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