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Bio-efficacy of neonicotinoids against *Aphis gossypii* Glover of okra

A. GHOSAL, M. L. CHATTERJEE AND [1]A. BHATTACHARYYA

Department of Agricultural Entomology, [1]Department of Agricultural Chemicals
Bidhan Chandra Krishi Viswavidyalaya
Mohanpur-741252, Nadia, West Bengal

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ABSTRACT

An experiment was conducted to observe the efficacy of some neonicotinoids against aphid of okra during pre- kharif season of 2010 and 2011 at Instructional Farm, Bidhan Chandra Krishi Viswavidyalaya. Imidacloprid 17.8 SL @ 50 g a.i. ha^{-1} was found as a most effective neonicotinoid insecticide against aphid. It recorded least aphid infestation and 84.54 % reduction of population over control. To control aphid population of okra the other two neonicotinoids viz., thiamethoxam 25WG @ 50 g a.i. ha^{-1} and acetamiprid 20SP @ 40 g a.i. ha^{-1} were also found at par with imidacloprid and showed better result than acephate 75WP and dimethoate 30EC. Considering incremental cost benefit ratio acetamiprid 20SP @ 40g a.i. ha^{-1} was found most economic over other neonicotinoids. None of the neonicotinoids have adverse effect on natural enemies of aphid in okra ecosystem.

***Keywords**: Acetamiprid, aphid, imidacloprid, okra and thiamethoxam*

Okra [*Abelmoschus esenlentus* (L.) Moench] is an important vegetable crop valued for its immature, tender and green fruits in India. Efforts are being made to increase the yield of okra crop by adopting improved agricultural practices, such as use of high yielding varieties, balanced fertilizer, supplement irrigation etc. However these composite efforts are nullified if the crop is not protected from the ravages of insect pests. One of the major bottlenecks in successful production of okra is the damage caused by early season sucking pests and fruit borers. Many of the pests occurring on cotton are found to ravage okra crop. As high as 72 species of insects have been recorded on okra (Rao and Rajendran, 2003), among the sucking pests, okra jassids (*Amrasca biguttula biguttula* Ishida), white fly (*Bemisia tabaci* Guenn.) and aphids (*Aphis gossypii* Glover) are of major sucking pests cause significant damage to the crop. Aphids and leaf hoppers are important pests in the early stage of the crop which desap the plants, make them weak and reduce the yield to the tune of 54.04 per cent (Chaudhary and Dadeech, 1989).To tackle this menacing sucking pests a number of insecticidal sprays are given, which led to several problems like toxic residues, elimination of natural enemies, environmental disharmony and development of resistance. To overcome those problems, identification of new molecules with selective insecticidal properties, low toxicity to non target, well suited in the IPM practices, is a need of the hour. With a view to develop effective chemical management strategy against sucking pests on okra, imidacloprid and acetamiprid belonging to the chloronicotinyl or thiamethoxam belonging to the thionicotinyl group active ingredient with low use rate and novel mode of action attracted the attention. Its broad-spectrum activity against sucking pests and systemic property appear to be useful for pest management of okra. The present investigation was undertaken to evaluate the efficiency of three insecticides against aphid of okra and their natural enemies.

MATERIALS AND METHODS

The field study was conducted to determine the efficacy of three neonicotinoid insecticides namely acetamiprid 20SP, thiamethoxam 25WG and imidacloprid 17.8SL in suppressing the aphid population in okra during the pre-*kharif* season of 2010 and 2011 at university instructional farm of Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The experimental site was geographically located at 22.93^{0}N latitude, 88.53^{0}E longitude and 9.75m above MSL. Healthy seeds of okra cv. OH 152 (Syngenta) were treated with fungicide and sown during second week of March in rows at 50×30 cm spacing. The experiment was laid out in a randomized block design (RBD) with 6 insecticidal treatments namely, T_1= acetamiprid 20SP (Pride), T_2= spinosad 45SC (Spintor), T_3= thiamethoxam 25WG (Actara), T_4= acephate 75SP (Asataf), T_5= imidacloprid 17.8SL (Confidor), T_6= dimethoate 30EC (Rogor) and T_7= control. Total seven treatments including an untreated control were replicated thrice. The crop was raised adopting standard agronomic practices. After built up of uniform aphid population in the field, two sprays were given with a pneumatic knack sac sprayer with a spray fluid volume of 500 litres ha^{-1}. The pre-

Email: abhijishu@gmail.com

treatment count and post treatment observations on aphid population at l, 7 and 14 days after spraying were recorded from three leaves per plant, one each from top, middle and bottom. Five plants per plot ($8m^2$ each) were selected at random leaving border rows during pre-treatment observation and subsequent data were recorded from those selected plant. Per cent protection over control was calculated in respect of overall mean aphid infestation in insecticidal treatment from that of control. To determine the effect of insecticides on natural enemies each selected plants were examined after 3 days of each spraying and there by count the number of predators namely coccinelid beetles, *Chrysopela carnea* and spider.

RESULTS AND DISCUSSION

The effects of insecticidal treatments were presented in Table-1. Precount aphid pupulation did not vary significantly among the treatments. All the three neonicotinoids were significantly superior over the control in respect of reducing aphid population count at 1 day after first spray. Acetamiprid @ 40g *a.i.* ha^{-1} recorded lowest aphid count significant reduction of aphid at 1, 7 and 14 days after first spray (1.03, 0.95 and 1.00 aphid per leaf respectively with 83.19%, 84.50% and 83.68% reduction of aphid population over pre-treatment count). The other two neonicotinoid also provided similar result and *at par* with acetamiprid. The data of mean reduction of aphid population at 1 day after second spray showed the similar result like first spray; imidacloprid and acetamiprid recorded zero aphid count per leaves closely followed by thiamethoxam (0.20), acephate (1.32), dimethoate (2.01), and spinosad (4.01). Similar result was noticed in overall mean aphid count where imidacloprid recorded lowest aphid population (1.78) followed by thiamethoxam (1.80) and acetamiprid (1.82), but a steady increase of population was noticed in untreated plot (11.53). Imidacloprid was considered as the best effective insecticidal treatment with 84.54% protection over control followed by thiamethoxam (84.36%), and acetamiprid (84.25%). The present investigation on neonicotinoid molecules against okra aphid is in line with the finding of Misra, 2002; Kumar *et al*., 1999; Sreelatha and Divakar, 1997.

Observations regarding impact of neonicotinoids on population of natural enemies were furnished in the Table - 2. Two rounds of spray of neonicotinoids on okra had no significant impact on the *Coccinellid*s (grubs and adults), *Chrysoperla* and spider population when compared with untreated control plot. However, acephate and dimethoate recorded relatively lowest population of these three natural predator population compared to untreated control. The result showed that acephate was toxic to these natural enemies, while dimethoate showed toxicity towards them. Spinosad was considered as less toxic compound against them which is *at par* with the findings of Thompson and Hutchins (1999). Sun *et al.* (1996) reported that imidacloprid was safe for spider communities.

Maximum marketable fruit yield of 71.35q ha^{-1} was recorded in acetamiprid, which was on par with imidacloprid (69.24q ha^{-1}), and thiamethoxam (65.42q ha^{-1}) (Table 1). The increased yields over control were found to be 38.5q ha^{-1}, 36.39q ha^{-1} and 32.57q ha^{-1} in acetamiprid, imidacloprid and thiamethoxam treatments, respectively. The maximum incremental cost benefit ratio of 1: 13.12 was achieved in acetamiprid treatment. This was followed by imidacloprid (1:10.37) and thiamethoxam (1:9.02) (Table 1). Raghuraman and Gupta (2006) reported that neonicotinoids were cost effective to control the sucking pests' population of cotton efficiently along with simultaneous increase in yield. Saha *et al.*, (2011); Kencharaddi and Balikai (2012) also reported neonicotinoids as better option for managing various sucking pests with higher C: B ratio. Here, acetamiprid 20SP @ 40g *a.i.* ha^{-1}, imidacloprid 17.8SL @ 50g *a.i.* ha^{-1} and thiamethoxam 25WG @ 50g *a.i.* ha^{-1} were effective in controlling aphid and registered higher yields with best cost: benefit ratio.

From the above experiment it can be concluded that the neonicotinoid insecticides were quite effective against aphid population and they were relatively less toxic to the natural enemies found in the natural ecosystem. During our course of study spinosad was considered as safest insecticide against the natural predator population of aphid but its efficacy against aphid was not admirable therefore it can not be considered as an insecticidal treatment against aphid. The other two conventional insecticides acephate and dimethoate were toxic against the natural enemies; therefore use of them should be restricted when there was very less number of natural enemies present in a field.

Table 1: Effect of neonicotinoids on *A. gossypii* of okra (Pooled of two years)

Treatments	Mean population of aphid leaves^{-1} (1st spray)				Mean population of aphid leaves^{-1} (2nd spray)				Overall mean population	Reduction of population over control (%)	Marketable fruit yield (q ha^{-1})	Increased yield over control (q ha^{-1})	Cost: benefit ratio
	Before spray	1 days	7 days	14 days	Before spray	1 days	7 days	14 days					
T_1	6.13 (2.57)	1.03 (1.24)	0.95 (1.20)	1.00 (1.22)	5.12 (2.37)	0 (0.71)	0 (0.71)	0.29 (0.89)	1.82	84.25	71.35	38.5	1: 13.12
T_2	6.03 (2.56)	4.06 (2.14)	4.10 (2.14)	4.25 (2.18)	6.35 (2.62)	4.01 (2.12)	4.05 (2.13)	4.04 (2.13)	4.61	59.98	42.26	9.41	1: 0.37
T_3	5.82 (2.51)	1.27 (1.33)	1.00 (1.22)	1.03 (1.24)	5.10 (2.37)	0.20 (0.84)	0 (0.71)	0 (0.71)	1.80	84.36	65.42	32.57	1: 9.02
T_4	5.83 (2.52)	2.12 (1.62)	2.01 (1.58)	2.46 (1.72)	6.01 (2.55)	1.32 (1.35)	1.02 (1.23)	1.00 (1.22)	2.72	76.38	55.19	22.34	1: 6.65
T_5	5.90 (2.53)	1.17 (1.29)	1.06 (1.25)	1.03 (1.24)	5.09 (2.36)	0 (0.71)	0 (0.71)	0 (0.71)	1.78	84.54	69.24	36.39	1: 10.37
T_6	6.13 (2.57)	2.35 (1.69)	2.26 (1.66)	2.75 (1.80)	6.06 (2.56)	2.01 (1.58)	1.25 (1.32)	1.59 (1.45)	3.05	73.53	56.75	23.9	1: 8.31
T_7	6.12 (2.57)	6.25 (2.60)	7.56 (2.84)	8.09 (2.93)	15.16 (3.96)	15.68 (4.02)	16.29 (4.10)	17.05 (4.19)	11.53	-	32.85	-	-
SEm (±)	**0.02**	**0.11**	**0.09**	**0.10**	**0.03**	**0.08**	**0.06**	**0.12**	**-**	**3.32**	**4.27**	**-**	**-**
LSD (0.05)	**NS**	**0.32**	**0.25**	**0.41**	**NS**	**0.27**	**0.25**	**0.46**	**-**	**10.28**	**13.36**	**-**	**-**

Note: Figures in the parenthesis are $\sqrt{(x+0.5)}$ transformed values, NS- Non significant

T_1= acetamiprid 20SP (Pride), T_2= spinosad 45SC (Spintor), T_3= thiamethoxam 25WG (Actara), T_4= acephate 75SP (Asataf), T_5= imidacloprid 17.8SL (Confidor), T_6= dimethoate 30EC (Rogor) and T_7= control.

Table 2: Effect of neonicotinoids on natural enemies in okra ecosystem (Mean of 2 sprays)

Treatments	Mean of two sprays		
	Coccinella	*Chrysoperla*	Spider
T_1	1.99 (1.41)	0.37 (0.60)	2.31 (1.52)
T_2	2.04 (1.42)	0.46 (0.67)	3.07 (1.75)
T_3	1.98 (1.40)	0.39 (0.62)	2.22 (1.49)
T_4	1.17 (1.08)	0.18 (0.42)	1.50 (1.22)
T_5	2.05 (1.43)	0.38 (0.61)	2.25 (1.50)
T_6	1.58 (1.25)	0.31 (0.55)	1.92 (1.38)
T_7	2.26 (1.50)	0.47 (0.68)	3.16 (1.77)
SEm (±)	**0.05**	**0.01**	**0.09**
LSD (0.05)	**0.17**	**0.05**	**0.29**

Note: Figures in the parenthesis are square root transformed values

T_1= acetamiprid 20SP (Pride), T_2= spinosad 45SC (Spintor), T_3= thiamethoxam 25WG (Actara), T_4= acephate 75SP (Asataf), T_5= imidacloprid 17.8SL (Confidor), T_6= dimethoate 30EC (Rogor) and T_7= control.

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