Eco-friendly Agril. J. 9(11): 66-71, 2016 (November)

# EFFECT OF DIFFERENT APPLICATION METHODS OF IMIDACLOPRID ON ABUNDANCE AND MANAGEMENT OF JASSID IN OKRA

MY Zaman, SMM Rahman*, MA Latif and M Ali

**Address**
Department of Entomology, Sher-e-Bangla Agricultural University (SAU), Dhaka-1207

Correspondence*
smmizanur@gmail.com

**Abstract**

A field study was carried out in the farm of Sher-e-Bangla Agricultural University (SAU) during March to June, 2012 to investigate the effect of different application methods of imidacloprid on abundance and management of jassid in okra. The population of jassid in control plot was gradually increased with the age of the crop and the peak population was found on last week of May and it was remained constant after that. The lowest number of jassid (14.66/plant) was found in $T_2$ (seed treatment by Gauchu 70WS + foliar spray with Admire 200SL), which reduced 77.71% population of jassid over control. Plant height, number of fruits/plot and yield per plot were significantly increased under different treatments. The highest plant height (181.80 cm), number of fruits/plot (652) and yield (13.84 t/ha) were observed in $T_2$ treated plot which was found to be the best treatment in this study. The output of all tested parameters in $T_2$, $T_4$ (seed treatment by Gauchu 70WS + band application of Gauchu 70WS) and $T_5$ (pre-plant injection by Gauchu 70WS at a depth of 4cm below the seed line + foliar spray with Admire 200SL) treated plots were statistically dissimilar with each other. Combination of different application methods yielded better result than that of the single method alone. Taking into account the jassid population, plant growth, number of fruits and fruit yield, seed treatment by Gauchu 70WS associated with foliar spray with Admire 200SL ($T_2$) was the most effective application method.

Accepted by 04 November 2016

**Keywords: Imidacloprid, application method, abundance and jassid**

## Introduction

Okra, *Abelmoschus esculentus* L., a common and popular vegetable crop in Kharif season (February-July), is originated from tropical Africa (Purseglove, 1987) and is grown extensively in South-East Asian countries. Production of okra, from seedling to fruiting stage, is severely hampered due to the attack of as many as 45 species of insect pests belonging to different orders (Nayar et al. 1976). Among them the jassid, *Amrasca biguttula biguttula* Ishida is one of the most serious pests and a major limiting factor in okra cultivation and is widespread in tropical and sub-tropical areas of South and South-East Asia (Distant, 1997). Besides okra, it attacks cotton, potato, brinjal and some wild relatives (Atwal and Dhaliwal, 2007). The incidence of this pest is reported to be year-round having peak occurrence from November to February, when temperature and relative humidity is low (Senapati and Khan, 1978).

Both adults and nymphs suck plant sap from the lower surface of leaves affecting the vegetative and reproductive growth stages of plant. It attacks all plant parts but it has special preference to tender leaves. The main symptoms are curling of leaf tips, yellowing, burning and sometimes drying of the affected leaves. In leaf tips and margins necrotic areas are developed. Finally, the affected leaves show hopper burn symptoms.

Considering the seriousness of the pest, farmers use a wide range of chemical insecticides with various spray formulations to control the jassid ravage on okra (Indira Gandhi et al. 2006; Nazrussalam et al. 2008; Singh et al. 2005). Insecticides are highly effective, rapid in curative action and relatively economic. Frequent and enormous use of conventional synthetic pyrethroids, organophosphate insecticides have been used to bring down the jassid population during crop growth period, but none of them have proved effective to reduce the pest population significantly. Moreover, the pest was also found to develop resistance to insecticides (Mandal et al. 2006).

Imidacloprid (1-[(6-chloro-3-pyridinyl)-methyl]-N-nitro-2-imidazolidinimine), is a relatively new, systemic chloronicotinyl or neonicotinoid insecticide which is marketed under many names depending on concentration and how it is administered. Trade names include Gaucho, Provado, Admire, Marathon, Merit, Imicide, Confidor, Intercept, Winner, Premier, and Premise. It is registered in approximately 120 countries and is used on over 140 different agricultural crops (Buffin, 2005). Because of its broad insecticidal spectrum, excellent systemic and translaminar properties, high residual activity and low mammalian toxicity, imidacloprid has become a popular insecticide worldwide for use in ornamentals, field crops, and vegetables against sucking and some biting pests such as aphids, leafhoppers, planthoppers, whiteflies, thrips,

scales, leafminers, termites, etc. (Ishaaya and Horowitz, 1998; Matsuda et al. 2001; Nauen and Denholm, 2005). It can be applied for seed dressing, soil-drenching or foliar treatment (Elbert et al. 1998; Takahashi et al. 1992). It is not mutagenic nor carcinogenic (Krieger, 2001). Furthermore, it is not a primary embryonic toxicant or a reproductive toxicant, nor it is teratogenic due to its high insecticidal potency (Lal and Sinha, 2005; Parveen et al. 2007; Solangi and Lohar, 2007).
Keeping in view the economic importance of jassid on okra and ineffectiveness of conventional insecticides to combat this pest, the objective of the current study was to investigate and compare the different application methods of imidacloprid on the incidence of abundance of okra jassid and their efficacy for the management of this pest.

## Materials and Methods

The field experiment was conducted at the experimental farm of Sher-e-Bangla Agricultural University (SAU), Dhaka during March to June, 2012 to assess the various application methods of imidacloprid and/ or their combinations on the pest incidence and management. The experiment was laid out in a randomized complete block design (RCBD) with four replications having six treatments including an untreated check. Each plot measured 3m x 4.2 m with 1 m of inter-plot and inter-block distance. The okra (cv. BARI *Derosh* 1) seeds were sown on 23 March, 2009 keeping a space of 60 cm x 50 cm @ 3 seeds $pit^{-1}$ and 24 pits $plot^{-1}$. All the normal agronomic practices except the insecticide applications were carried out throughout the growing season of the crop in all treatments for maintaining healthy crop growth.

The treatments were: $T_1$ = seed treatment by Gauchu 70WS @ 5.0 g/kg seed; $T_2$ = seed treatment by Gauchu 70WS @ 5.0 g/kg seed + foliar spray with Admire 200SL @ 0.5 ml/L of water; $T_3$ = band application of Gauchu 70WS @ 2.0 g/L of water; $T_4$ = seed treatment by Gauchu 70WS @ 5.0 g/kg seed + band application of Gauchu 70WS @ 2 g/L of water; $T_5$ = pre-plant injection by Gauchu 70WS at a depth of 4.0 cm below the seed line @ 2.0 g/L of water + foliar spray with Admire 200SL @ 0.5 ml/l of water; and $T_6$ = untreated check.

For seed treatment, okra seeds were soaked in Gauchu 70WS mixed-water for 2 hours prior to sowing. In case of band application of Gauchu 70 WS, a circular band was made around each pit. First foliar spray of Admire 200 SL was done on 15 days after germination of seeds and continued throughout the cropping season at 7 days interval. Spraying was done in the afternoon with high volume knapsack sprayer and a through coverage of leaf area, tender shoots and fruits was ensured.

Data were collected on jassid population, plant height, number of fruit, fruit weight and yield of okra. The population of jassid was counted at 7 days interval starting from 14 days after germination when first incidence of jassid was noticed. Jassid nymphs as well as adults population were observed from the top five leaves of the 12 randomly selected tagged plants in each of the replicate. Both jassid nymphs and adults were counted visually on lower surface of the leaves in the early morning (7 to 9 AM), when the jassids were found inactive. Mean population per plant was calculated from these recorded data. The height of selected twelve plants was measured at 15, 30, 45, 60, and 75 days after germination. Fruits were harvested at every alternate date and a total of 20 harvests were done throughout the fruiting period (May-June). The number and weight of fruits per plot were recorded after each harvest. Yield of okra per hectare for each treatment was calculated in tons from cumulative fruit production in a plot.

The data thus recorded on different parameters were subjected to analysis of variance to record the level of significance for variation and the mean values were compared by using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984) through MSTAT-C software.

## Results and Discussion

### *Effect of different treatments on the abundance of jassid*

The effect of different application methods of imidacloprid on jassid population in okra was significant at different time interval throughout data recording period (Table 1). At first observation ($3^{rd}$ week after germination), the lowest number of jassid population (33.75) was observed in $T_1$ followed by 39.00 and 40.75 in $T_5$ and $T_2$, respectively having no significant difference among them. The highest number of jassid (68.75/plant) was observed in control plot which was significantly higher than any other treated plot. On the contrary, no significant relation was observed among the population of jassid in other treatments. The almost similar trend of jassid population was noticed during whole study period. It is clearly evident that jassid population in control plot was significantly higher than any other treatment plot during all time intervals of data recording. It is also noted that pest population was decreasing gradually from $1^{st}$ observation to $4^{th}$ observation irrespective of treatment, i.e. jassid incidence was higher in mid-April and declined up to $2^{nd}$ week of May. After that the jassid population was increasing sharply and this steady increase was maintained till June ($10^{th}$ observation) in unchecked control. However, in other treatments a slight increase in jassid population was

observed from mid-May (5th observation) to June (10th observation).

The results of the present study is supported by Mahmood et al. (1988) who reported that the jassid population remained below the economic threshold for about five weeks after germination of the okra crop. The population exceeded the threshold level in June and remained at the same level until late August. Ali and Karim (1991) found the similar trend of jassid population on cotton plants in Kharif season.

Considering the average population of jassid during cropping season, the lowest population was found in $T_2$, which was statistically similar with $T_5$, but different from other treatments. The intermediate level of jassid was found in $T_4$, $T_3$ and $T_1$ having no significant different between $T_3$ and $T_4$; and between $T_1$ and $T_3$. The highest number of jassid (65.78/plant) was found in $T_6$ (untreated control) which was significantly higher than any other treated plots.

In case of percent reduction of jassid population over control, it was also revealed that all application methods significantly reduced the jassid population over control although none of the treatments succeeded to reach the standard level of population reduction (80%). However $T_2$ showed the best performance in reducing the jassid population which reduced 77.71% jassid population over control. $T_5$ also gave the satisfactory results in reduction of jassid population (74.96%). $T_4$ and $T_3$ showed the moderate performance in reduction of jassid population and $T_1$ gave the lowest efficacy regarding this parameter.

In the present study it was found that seed treatments by Gauchu 70WS in combination to foliar spray with Admire 200SL ($T_2$) gave the best result against jassid population. The population of jassid was initially high and gradually decreased to below economic threshold level in the best treated plot and was remained constant up to last harvest. The results also proved that foliar routine spray of imidacloprid gave a considerable synergistic effect by combining with either band application or seed treatment or pre-plant injection than that of single application method alone. Thus, the order of effectiveness of different methods was: $T_2>T_5>T_4>T_3>T_1$.

The result is similar to the findings of Lal and Sinha (2005) who revealed that seeds treated with imidacloprid afforded an effective protection of okra crop against the management of leafhoppers and their populations remained below the economic threshold throughout the experiment. Satpathy et al. (2004) found that foliar application of imidacloprid (200SL) and monocrotophos (36.6EC) protected the crop from the leaf hopper at desired level. The result is also similar to the findings of Rana et al. (2006) who stated that management of sucking pests of okra with the use of insecticides as seed treatment by imidacloprid provided an opportunity to minimize the quantity of the insecticide.

***Effect of different application methods of imidacloprid on plant height***

Significant variation was found in plant height at different ages of plant at different treatments (Table 2). There was a sharp significant difference among all treatments at every stage of plant growth. Seed treatment by Gauchu 70WS in combination with foliar spray with Admire 200 SL ($T_2$) gave the best result irrespective of plant-growth period than all other treatments. On the other hand, plant height was not adequate in untreated plot as found in the treated plots due to the infestation of okra jassid and was significantly lower than that of any other treatment at every data recording period. Considering the 75-day-old plant (last observation), the maximum height of control plot was 69.80 cm while it was 181.80 cm in the $T_2$ treated plot followed by $T_4$ (172.50 cm). Consequently, the plant height was ranked as $T_2>T_4>T_5>T_1>T_3>T_6$.

**Table 1. Average population of jassid per plant during the cropping period under different treatments**

| Treatments | Average number of jassid plant$^{-1}$ | | | | | | | | Grand Mean | Percent of jassid reduction over control |
|---|---|---|---|---|---|---|---|---|---|---|
| | *1st | *2nd | *3rd | *4th | *5th | *6th | *7th | *8th | | |
| | 17 April | 24 April | 1 May | 8 May | 15 May | 22 May | 29 May | 5 June | | |
| $T_1$ | 33.75 c | 23.75 b | 15.25 b | 14.00 b | 13.25 c | 20.75 b | 30.75b | 29.25b | 22.60 b | 65.64 |
| $T_2$ | 40.75bc | 28.5 b | 13.5 bc | 8.50 c | 6.00 b | 7.00 d | 7.50 d | 8.00 d | 14.66 e | 77.71 |
| $T_3$ | 47.75 b | 23.25 b | 13.25bc | 7.25cd | 15.75bd | 16.25bc | 19.00c | 22.5bc | 20.60 bc | 68.68 |
| $T_4$ | 44.00 b | 21.00 b | 9.50 c | 4.75 d | 7.75 cd | 14.75bc | 20.25c | 15.00c | 18.72 cd | 71.55 |
| $T_5$ | 39.00bc | 18.50 b | 11.50 b | 9.50bc | 11.00bc | 10.25cd | 16.25c | 15.75c | 16.47 de | 74.96 |
| $T_6$ | 68.75 a | 45.75 a | 30.00 a | 33.75a | 58.50 a | 99.00 a | 91.75a | 98.75a | 65.78 a | - |
| LSD $_{0.05}$ | 0.167 | 0.1507 | 0.1718 | 0.1965 | 0.2077 | 0.2131 | 0.1581 | 0.2383 | 3.552 | |
| CV (%) | 4.66 | 7.22 | 9.79 | 12.98 | 12.27 | 11.36 | 11.36 | 11.91 | 8.90 | |

Note: In column, values followed by same letter(s) are statistically identical by DMRT at 5% level of significance and *indicate time of observation of jassid population.

This result indicates that application of imidacloprid decreased the population of jassid and caused normal growth of the okra crop. Treatment $T_2$ exerted the maximum growth of the crop. This result supports the findings of Bhargava and Ashok (2001), who stated that plant growth characters, *viz.*, plant height, greenness of leaves, leaf area, number of fruits per plant, and yield was superior in plots treated with both formulations of imidacloprid compared with untreated control.

***Efficacy of different application methods of imidacloprid on mean number of fruit and fruit-yield of okra.***

Okra production was significantly affected by the infestation of jassid. The data (Table 3) revealed that the highest number of fruits per plot (652.0) was obtained in $T_2$ which was significantly higher than all other treatments. On the other hand, the lowest number of fruits (502.0) was found in control which was significantly lower than all other treatments. Consequently, $T_2$ resulted 29.88% increase of fruit number over control. The second highest number of fruits (641.3) was harvested from $T_4$ followed by 623.8 in $T_5$ having significant difference between the two treatments. Therefore, $T_2$ performed the best regarding the number of fruit against jassid attack.

This result supports the findings of Kaur (2002) who observed that seed dressing by imidacloprid along with foliar spray of same insecticide resulted lowest population of jassid and highest number of boll in cotton. Application of imidacloprid increased fruit yield of okra. The yield data of okra (Table 3) revealed that the highest yield was obtained from $T_2$ (seed treatment by Gauchu 70WS + foliar spray with Admire 200SL) treated plot (13.84 t/ha) followed by $T_4$ (13.56 t/ha) and $T_5$ (13.09 t/ha), and each value was significantly different from each other. The intermediate yield was obtained from the $T_3$ (15.45 t/ha) and $T_1$ (12.30 t/ha) having no significant difference between them. The lowest yield was obtained from the control plot (11.21 t/ha), which was significantly lower than all other treated plots. From this study it was evident that all treated plots had significantly higher yield than that of control plot. However, seed treatment by Gauchu 70WS associated with foliar spray of Admire 200SL ($T_2$) gave the highest yield over control plot.

**Table 2. Efficacy of different application methods of imidacloprid on the plant height of okra due to jassid infestation**

| Treatments | Plant height (cm) at different ages (days) | | | | |
|---|---|---|---|---|---|
| | 15 | 30 | 45 | 60 | 75 |
| $T_1$ | 17.02 c | 28.64 e | 54.08 d | 101.20 d | 155.00 d |
| $T_2$ | 20.35 a | 39.00 a | 72.18 a | 128.30 a | 181.80 a |
| $T_3$ | 16.51 d | 34.05 d | 50.75 e | 97.04 e | 152.00 e |
| $T_4$ | 17.70 b | 36.53 b | 65.60 b | 119.00 b | 172.50 b |
| $T_5$ | 16.54 d | 35.07 c | 61.05 c | 110.60 c | 160.50 c |
| $T_6$ | 13.49 e | 16.15 f | 25.69 f | 32.05 f | 69.80 f |
| $LSD_{0.05}$ | 0.1846 | 0.9532 | 0.1581 | 0.2335 | 0.2860 |
| CV (%) | 0.73 | 0.19 | 0.19 | 0.16 | 0.13 |

Note: In column, values followed by same letter(s) are statistically identical by DMRT at 5% level of significance.

**Table 3. Efficacy of different application methods of imidacloprid on total number of fruits and fruit-yield of okra**

| Treatments | No. of fruit plot$^{-1}$ | Percent increase over control | Weight of fruit plot$^{-1}$ (kg) | Yield (t ha$^{-1}$) | Percent increase over control |
|---|---|---|---|---|---|
| $T_1$ | 519.0e | 3.39 | 8.863d | 12.30d | 9.76 |
| $T_2$ | 652.0a | 29.88 | 9.988a | 13.84a | 23.69 |
| $T_3$ | 537.3d | 7.03 | 8.962d | 12.45d | 10.98 |
| $T_4$ | 641.3b | 27.75 | 9.762b | 13.56b | 20.89 |
| $T_5$ | 623.8c | 24.26 | 9.425c | 13.09c | 14.45 |
| $T_6$ | 502.0f | - | 8.075e | 11.21e | - |
| $LSD_{0.05}$ | 8.835 | - | 0.2184 | 0.1312 | - |
| CV (%) | 1.01 | - | 1.58 | 1.50 | - |

Note: In a column, values with different letter(s) are significantly different at 5% level by DMRT.

These results were in conformity with those reported by Praveen et al. (2007) who reported that seed treatment with imidacloprid gave the highest okra-seed yield of 642 kg/ha against jassid attack. Indira Gandhi et al. (2006) showed that the systemic chemical insecticide imidacloprid performed better producing 11.280 and 11.580 t/ha of marketable fruit yield of okra. Singh et al. (2005) also found that imidacloprid formulation, Confidor 350SC was the most effective treatment in reducing the jassid incidence and produced the maximum fruit yield of 8.74 t/ha. Misra and Senapati (2003) also reported that imidacloprid gave significant control of the jassid (83.30-100.00%) during both the test seasons and increased the marketable fruit yield (32.40-35.44%) of okra compared to untreated control.

## Conclusion

It can be concluded from the present research findings that jassid infestation varied with ages of okra plant and hampered the growth severely at initial stage of plant. It should be advised to dress seed of okra by Gauchu 70WS in combination with foliar spray of Admire 200SL at weekly interval for controlling jassid when the population is very high. Treatment $T_5$ and $T_4$ can be used as second line of defense to combat this pest. However, treatment $T_3$ and $T_1$ was also effective to some extent against jassid over control. This investigation may potentially contribute towards devising an IPM strategy for jassid on okra.

## References


Ali M I and Karim M A. 1991. Plant-age-specific seasonal abundance of cotton jassid on cotton plants. Bangladesh J. Agril. Res. 16(1): 11-16

Atwal A S and Dhaliwal G S. 2005. Agricultural pests of south Asia and their management. 4th edition. Kalyani Publishers, India. pp. 236-238.

Bhargava, K K and Ashok B. 2001. Bioefficacy of imidacloprid as a seed dresser against sucking pests of okra. Pest Manag. Eco. Zool. 9(1): 31-34

Buffin D. 2005. Pesticide Action Network UK (PAN international), imidacloprid http://www.pan-uk.org/pestnews/Archives/imidaclo. htm

Distant W L. 1977. Fauna of British India. Rhynchota, Vol. IV. Homoptera and Appendix (Pt.). Today and Tomorrow Printers and Publishers, New Delhi. p.401.

Elbert A, Nauen R and Leicht W. 1998. Imidacloprid, a novel chloronicotinyl insecticide: biological activity and agricultural importance. In Ishaaya I and Degheele D. Insecticides with novel modes of action: mechanism and application. Springer Verlag, Berlin Heidelberg, Germany. pp. 50-74

Gomez K A and Gomez A A. 1984. Statistical procedures for agricultural research. 2nd edition. John Wiley & Sons, New York. 490 pp.

Indira Gandhi P, Gunasekaran K and Sa T. 2006. Neem oil as a potential seed dresser for managing Homopterous sucking pests of okra (*Abelmoschus esculentus* (L.) Moench. J. Pest Sci. 79(2): 103-111

Ishaaya I and Horowitz A R. (Eds.). 1998. Insecticides with novel modes of action: mechanisms and applications. Springer-Verlag Press, Berlin.

Kaur S. 2002. Management of cotton jassid, *Amrasca biguttula biguttula* and spotted bollworm, *Earias* spp. in okra. Veg. Sci. 29(2): 172-175

Krieger R I. 2001. Handbook of pesticide toxicology. Vol. 2. 2nd edition. Academic Press, San Diego, California. pp. 345-406

Lal O P and Sinha S R. 2005. Impact of imidacloprid seed treatment along with some insecticidal sprayings against insect pests of okra. Indian J. Entomol. 67(4): 328-333

Mahmood T, Mahmood K and Niazi Z M. 1988. Density variation of leafhopper on okra at Islamabad. Pakistan J. Agril. Res. 9(2): 195-197

Mandal S K, Sah S B and Gupta S C. 2006. Efficacy and economics of biopesticide and insecticide combinations against okra pests. Internat. J. Agric. Sci. 2(2): 377-380

Matsuda K, Buckingham S D and Kleier D. 2001. Neonicotinoids: insecticides acting on insect nicotinic acetylcholine receptors. Trends Pharm. Sci. 22: 573-579

Misra H P and Senapati B. 2003. Evaluation of new insecticides against okra jassid. Indian J. Agril. Sci. 73(10): 576-578

Nauen R and Denholm I. 2005. Resistance of insect pests to neonicotinoid insecticides: current status and future prospects. Arch. Insect Biochem. Phys. 58: 200-215

Nayar K K, Anatnthakrishnan T N and David B V. 1976. General and applied entomology. Tata McGraw Hill Publishing Co. Ltd., New Delhi, India. 589p.

Nazrussalam, Shafiq A M, Haidar A and Tufail A. 2008. Efficacy of multineem and NSKE with insecticides for management of *Amrasca biguttula biguttula* and *Earias vittella* on okra. Annals Plant Protec. Sci. 16(1): 17-20

Praveen K S, Sajjan A S, Patil R K, Dharmatti P R and Kurdikeri M B. 2007. Influence of seed treatment and foliar spray with insecticides and neem products on growth and seed yield in okra (*Abelomoschus esculentus* [L] Moench). Karnataka J. Agril. Sci. 20(2): 388-390

Purseglove J W. 1987. Tropical crops: dicotyledons. Longman Singapore Publishers (Pvt.) Ltd. p.367

Rana S C, Singh P B, Pandita V K and Sinha S N. 2006. Evaluation of insecticides as seed treatment for control of early sucking pests in seed crop of okra. Annals Plant Prot. Sci. 14(2): 364-367

Satpathy S, Rai S, De N and Singh A P. 2004. Effect of insecticides on leaf net carbon assimilation rate and pest incidence in okra. Indian J. Plant Prot. 32(2): 22-25

Senapati B and Khan S R. 1978. A note on population fluctuation of *Amrasca biguttlula biguttula* (Ishida) at Bhubaneswar. Indian J. Agril. Res. 12 (2): 97-98

Singh S, Choudhary D P, Mathur Y S and Sharma H C. 2005. Efficacy of selected insecticides against jassid (*Amrasca biguttula bigutulla* Ishida) in okra (*Abelmoschus esculentus* Linn.) Pest. Manag. Eco. Zool 13(1): 135-139

Solangi B K and Lohar M K. 2007. Effect of some insecticides on the population of insect pests and predators on okra. Asian J. Plant Sci. 6(6): 920-926

Takahashi H, Mitsui J, Takakusa N, Matsuda M, Yoneda H, Suzuki J, Ishimitsu K and Kishimoto T. 1992 NI-25, a new type of systemic and broad spectrum insecticide. Brighton Crop Protection Conference—Pests and Diseases, pp. 89–96