Bulletin of Environment, Pharmacology and Life Sciences
Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue [2] 2017: 274-281

Online ISSN 2277-1808
Journal's URL:http://www.bepls.com
CODEN: BEPLAD
Global Impact Factor 0.533
Universal Impact Factor 0.9804
NAAS Rating 4.95

FULL LENGTH ARTICLE **OPEN ACCESS**

Efficacy of Conventional And Newer Insecticides Against *Bt* Cotton Leafhopper, *Amarasca biguttula biguttula* (Ishada) Under High Density Planting System

TUKARAM A. NIKAM[1*], C. B. LATPATE[2], RAMESH K. B.[3], VRUNDA S. THAKARE
[1*] Ph.D. Scholar, [2]Associate Prof., Department of Agricultural Entomology,
Vasantrao Naik Marthwada Agriculture University Parbhani-431 402, Maharashtra, India
[3]Ph.D. Scholar, Department of Agricultural Entomology, IARI, Delhi
*Corresponding Author: Email: tukaramnikam.agri@gmail.com

ABSTRACT
The field experiment were conducted at VNMKV, Parbhani in two successive crop seasons (kharif) during 2015 to 2016 with Balwan (NSC-8899) BG-II (cotton) to study the efficacy of conventional and newer against cotton leafhopper, Amarasca biguttula biguttula (Ishada). Flonicamide 50% WP was found most effective against leafhopper reduction over untreated check, however it was at par with dinotefuran 20 SG, followed by fipronil 5 SC and diafenthiuron 50% WP, however, which was on par with acephate 75% SP and clothianidin 50% WDG, followed by acetamipride 20% SP and imidacloprid 17.8 SL, which were found at par with each other and the treatment imidacloprid 17.8 SL showed least effective results as to untreated check. . Further, these insecticide interventions found to be safe to the natural enemy activity as there was no significant variation among the treatments with respect to the natural enemies population (lady bird beetle, Chrysopa, Spiders and ***syr****phid maggots). Hence, these insecticides can safely be included in IPM of cotton for sucking pests, which are increasing in trend.*
Key word: Efficacy, leafhopper, Bt cotton and high density planting system.

Received 25.07.2017 Revised 13.08.2017 Accepted 26.08.2017

INTRODUCTION

Cotton is a major fiber crop of global significance, cultivated in more than seventy countries in the world. Cotton crop is playing an important role in economic, political and social affairs of the world. Cotton belongs to the family "*Malvaceae*" and genus "*Gossypium*" Cotton crop as commercial commodity, plays an important role in industrial activity of nation, in terms of both employment generation and foreign exchange, Hence it is popularly known as "White Gold" and "Friendly Fiber".

Cotton is being cultivated in 70 countries of the world with a total coverage of 33.14 m ha. China, India, USA and Pakistan are the major cotton producing countries in the world accounting for 70 per cent of the world's cotton area and production. India is the largest cotton growing country in the world with 35.29 per cent of world cotton area followed by China (15.23%). China and India are the major cotton consuming countries in the world (around 55%). USA and India constitute 27 and 19.5 per cent of the worlds cotton exports respectively. China is the major importer in the world with around 28 per cent of the total imports (11.00 million bales of 480 kg). Among the major cotton growing countries, Australia tops the productivity level of 2151 kg lint/ha followed by Turkey (1484 kg lint/ ha) and Brazil (1465 kg lint/ha). In production, India ranks second next to China. In India, cotton is cultivated in an area of 11.70 m ha with a production of 29.00 million bales of seed cotton during 2015-16. Average productivity of cotton in India is 540 kg lint/ha, which is low when compared to world average of 766 kg lint/ha (Anonymous, 2015-16).Gujarat, Maharashtra and Telangana are the major cotton growing states contributing around 70% of the area and 67% of cotton production in India. As per the CAB estimates, the cotton productivity is expected to be around 503 kg lint per hectare during the year 2015-16. The year was not congenial for cotton due to both abiotic and biotic stresses which pulled down the area as well as productivity. In Maharashtra, the present cotton growing situation is showing improvement after release

of *Bt* cotton and is cultivated in an area of 38.27 lakh hectares with total production 71.25 lakh bales with an average productivity of 342 Kg per hectare (Anonymous, 2015-16). The area under transgenic cotton is up to 99%.

Among various sucking insect pests of cotton, the leafhopper, *A.biguttula biguttula* is the most important pest and accounts for 35 per cent reduction in the Cambodian cotton (Neelakantan, 1957) and 25.45% reduction in non-hairy varieties (Bhat *et al.,* 1986). Dhawan *et al*. (1988) reported that 11.6% yield loss can be avoided due to leafhopper in *Gossypium hirsutum* and *G. arboreum* genotypes. The nymphs and adults suck sap from the leaves and inject saliva into the tissues which cause 'Toxaemia'. Causes leaf burning, drying and shedding in young plants and arrests the plant growth. Though it is an early phase pest, it occurs all through the season serving as one of the limiting factors in economic productivity of the crop. The large scale adoption of seed treatment against sucking pests and introduction of *Bt* cotton in India has completely changed the pest dynamics and scenario on cotton. Of late, the leafhopper has become a more serious pest during the reproductive phase also (Radhika *et al*., 2006).

MATERIAL AND METHOD

A field experiment was laid out in a randomized block design (RBD) during *kharif* 2015 and 2016 at Department of Agricultural Entomology, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS). The experiment consisted of 9 treatments replicated thrice. A cotton hybrid, Balwan (NSC-8899) *BG-II* was raised in plots with 90 x 30 cm row to row and plant to plant spacing. All agronomic practices were followed as per the recommended packageof practices except plant protection to get good crop. Treatments details Eight Synthetic chemical molecules *viz.,* imidacloprid, acetamaprid, chlothanidin, flonocamide, dinetofuron, diafenthuron, fipronil and acephate were evaluated against four major sucking pests along with untreated control.

Pesticide appliance manual operated knapsack sprayer (Aspee make) with hollow cone nozzle was used for spraying of insecticides on cotton crop. Application of insecticides three foliar sprays of insecticides were given at an interval of 20 days. First spray was given soon after the pest population was cross ETL. Method of recording observations on adult leafhopper was recorded on five randomly selected plants per plot. Number of leafhopper was recorded from three levels of each randomly selected five plants *i.e.* upper, middle and bottom. Observations were recorded just before first spraying and 1, 3, 5, 7, 10 days after spraying (DAS). Statistical analysis the field population data was subjected to statistical analysis by using RBD (Randomized Block Design), procedure given by Panse and Sukhatme (1967). The significance of treatment was assessed at 5 per cent of significance. Impact of insecticide on natural enemies the observations on population of major natural enemies like lady bird beetle, chrysopa, predatory spiders, syrphid maggots *etc*. per plant were recorded on the randomly selected five plants from each quadrant at weekly interval.

RESULTS AND DISCUSSION

During one day prior to first spraying, the data of two consecutive years along with pooled showed non-significant results with no significant difference among the leafhopper population and evaluated treatments.

During first spray pooled *Kharif* 2015-16 and 2016-17

In two successive cropping years, the results (Table 1) during first spray revealed that significant reduction in leafhopper population was noticed at 1st, 3rd 5th, 7th and 10th day after application of pesticides compared to untreated check. It was observed that all the treatments proved their superiority over the untreated control. First spray after pooled mean data showed that all the 9 observations regarding the efficacy of different treatments against leafhopper revealed that, after 1, 5, 7 days after spraying dinotefuran 20% SG (1.42, 1.66 and 1.76 leafhopper/ 3 leaves) and 3, 10, days after spraying flonicamide 50% WP (1.35 and 2.05 leafhopper/ 3 leaves) recorded significantly lowest leafhopper along with highest per cent reduction leafhopper population followed by fipronil 5 SC and diafenthiuron 50% WP, however, which was on par acephate 75% SP and clothianidin 50% WDG, which was on par with acetamipride 20% SP, and imidacloprid 17.8 SL respectively which were found at par with each other and the treatment imidacloprid 17.8 SL showed least effective results as to untreated check.

During second spray pooled *Kharif* 2015-16 and 2016-17

After second spray pooled it was observed that all the treatments proved their superiority over the untreated control. The pooled mean data after second spray (Table 2) showed that all the 9 observations regarding the efficacy of different treatments against leafhopper revealed that, after 1 and 5 days after spraying dinotefuran 20% SG (0.98 and 1.22 leafhopper/ 3 leaves) and 3, 7 and 10, days after spraying flonicamide 50% WP (0.71, 0.98 and 1.26 leafhopper/ 3 leaves) recorded significantly lowest leafhopper population along with highest per cent reduction leafhopper population, which was at par followed by diafenthiuron 50% WP, fipronil 5 SC and clothianidin 50% WDG, however, which was on par with

acephate 75% SP followed by imidacloprid 17.8 SL and acetamipride 20% SP respectively, which were found at par with each other and acetamipride 20% SP showed least effective results to untreated check.

During third spray pooled *Kharif* 2015-16 and 2016-17

The third spray after pooled in the current study, it was observed that all the treatments proved their superiority over the untreated control. The pooled mean data after third spray(Table 3) showed that all the 9 observations regarding the efficacy of different treatments against leafhopper revealed that, after 1 and 5 days after spraying dinotefuran 20% SG (0.73 and 0.85 leafhopper/ 3 leaves) and 3, 7 and 10, days after spraying flonicamide 50% WP (0.56, 0.70 and 0.78 leafhopper/ 3 leaves) recorded significantly lowest leafhopper population along with highest per cent reduction leafhopper population which was at par fipronil 5SC, diafenthiuron 50% WP and clothianidin 50% WDG, however, which was on par acephate 75% SP, imidacloprid 17.8 SL and acetamipride 20% SP respectively, which were found at par with each other and the treatment (Acetamipride 20% SP) showed least effective results to untreated check.

The efficacy different insecticides of two years pooled mean data (Table 1, 2 & 3) on leafhopper at 1, 3, 5, 7 and 10 days after 1st, 2nd and 3rd application indicated the superiority of flonicamide 50 % WP in recording lowest leafhopper population. Our results are in agreement with the findings of Ghelani *et al.* (2014), who reported that flonicamid was very effective for the control of sucking insect pests of *Bt* cotton, also similar kind of finding reported by Chandi *et al.* (2016) and Halappa and Patil (2014) who reported based on pooled analysis of two years per cent reduction of in leafhopper population over untreated check was highest (> 70 %) with dinotefuran 20 SG (0.25g/l) which was followed by diafenthiuron 50 WP and fipronil 5 SC and Kumar and Dhawan (2011), who reported that dinotefuran 20 SG and flonicamid 50 WG were effective against cotton leafhopper, Similar observations were also made by Mandal *et al.* (2013) The effectiveness of fipronil 5 SC against leafhoppers has been reported by earlier worker like Rohini *et al.* (2011) and Kalyan *et al.* (2012), hence, confirm the present findings of efficacy of fipronil in this respect.

Effect of different insecticides on the population of natural enemies

The pooled mean count of the field prevailing natural enemies *viz.,* lady bird beetle, *chrysopa,* spider and syrphid maggots per plant computed from three sprays during *Kharif* 2015-16 and *Kharif* 2016-17, which were recorded prior and after the treatments applications along with pooled data are presented in (Table 4). The data on two year pooled revealed that the effect of 1st, 2nd and 3rd spraying and average of three sprays pooled indicated that there were no significant differences among the treatments in respect to population of natural enemies.

Above explained results are in conformity Gaurkhede *et al.* (2015) was reported the cumulative effect of spraying indicated that there were no significant differences among the treatments in respect to population of natural enemies (*i.e.* ladybird beetle, *Chrysopa* larvae and spider). However, numerically more number of natural enemies was observed in untreated control plot. Halappa *et al.*(2014), Nemade (2015). At present study, none of the insecticides used in present investigation fell under the category of harmful. Thus, all the insecticides tested were found to be safe to natural enemies (Table 4).

REFERENCES

1. Anonymous (2004) studies on population dynamics of key pests of cotton. Ann. Prog. Report of Cotton Research, 2003-04, MAU, Parbhani, *ENT*: 78-80.
2. Anonymous (2015– 16) ICAR - All India Coordinated Research Project on Cotton – Annual Report**,** E-1 to E-179.
3. Bhat, M. G., Joshi, A. B and Munshi, S. 1986. Relative loss of seed cotton yield by leafhopper and bollworms in some cotton genotypes. *Indian Journal of Entomology*. 74(9):4152.
4. Chandi R. S., V Kumar, H. S. Bhullar and A. K. Dhawan (2016). Field efficacy of flonicamid 50 WG against sucking insect pests and predatory complex on Bt cotton. *Ind. J. of Pl.Prot.* **44**(1):1-8.
5. Dhawan, A.K., Sidhu, A.S and Simwat, G.S. 1988. Assessment of avoidable lossin cotton (*G. hirustum* and *G. arboretum*) due to sucking pests and bollworms. *Indian Journal of Agricultural Sciences.* 58(4):290-292.
6. Dipak, M., Bhomika, P. and chaterjee, M.P. 2013. Effect of newer insecticides against white fly, *Bemisia tabaci* (Gennadius) and jassid, *Amrasca biguttula biguttula* (Ishida) on cotton. *Pesticide res. J. vol.* ***25*** (2): 117-122.
7. Gaurkhede A.S., S. K. Bhalkare*, A. K. Sadawarte **And** D. B. Undirwade (2015). Bioefficacy of new chemistry molecules against sucking pestsof Bt transgenic cotton. *Inter. J. Pl. Protec.* 8(1): 7-12.
8. Ghelani, M.K., Kabaria, B.B and Chhodavadia, S.K. (2014). Field efficacy of various insecticides against major sucking pests of *Bt* cotton. *JBiopest.*, **7**: 27-32.
9. Halappa B. and Patil R. K. (2014). Bioefficacy of different insecticides against cotton leafhopper, *Amarasca biguttula biguttula* (Ishada) under field condition. *Trends in Biosciences* **7**(10): 908-914.
10. Kalyan, R.K., Saini, D.P., Jambhulkar, P.P. and Pareek, A. (2012). Comparative bioefficacy of some new molecules against jassids and whiteflies in cotton. *Bioscan.*, **7**(4) : 641-643.
11. Kumar V. and Dhawan A. K. (2011). New chemistry molecules for the management of cotton jassid in transgenic cotton. New Horizons in Insect Science. ICIS 2013, International Conference on Insect Science. Banglore, India. :19.

12. Nemade P.W., S.B. Deshmukh and Jayashri D. Ughade (2015). Evaluation of newer insecticides against leaf hopper on Bt cotton. *Internat. J. Pl. Protec.*, **8** (2) : 313-318.
13. Neelakantan, L. 1957. Problems of immediate concern for Cambodia and Karungani cotton in Madras state. VIII Conf Gr Probl India December. S.8, Paper 2.
14. Panse, V. G. and Sukhatme, P. V. (1967). Statistical Methods for Agricultural Workers, ICAR Publication, New Delhi: 359.
15. Radhika, P., Sudhakar, K., Sahadeva Reddy, B and Basha, M. S. 2006. Field evaluation of cotton genotypes against *Amrasca biguttula biguttula* (Ishida). *Journal of Cotton Research and Development.* 20 (1): 134-134.
16. Rohini, A., Prasad, N. D. and Chalam, M. V. (2011). Management of major sucking pests in cotton by insecticides. *Ann. Pl. Protect. Sci.,* **20**(1): 102-106.

Table 1. Efficacy of newer and conventional insecticides against leafhopper of *Bt* cotton in HDPS after first spraying during *kharif* 2015-16 and 2016-17.

Sr. no	Treat-ments	Dose g or ml/l	First spraying (*Kharif* 2015) Av. no. of leafhopper population/3 leaves						First spraying (*Kharif* 2016) Av. no. of leafhopper population/3 leaves						First spraying pooled (*Kharif* 2015 and 2016) Av. no. of leafhopper population/3 leaves						
			DBS	1DAS	3DAS	5DAS	7DAS	10DAS	DBS	1DAS	3DAS	5DAS	7DAS	10DAS	DBS	1DAS	3DAS	5DAS	7DAS	10DAS	Mean
T_1	Imida-cloprid 17.8 SL	0.4	6.50 (2.64)	5.13 (2.37)	4.93 (2.32)	5.67 (2.47)	5.97 (2.53)	6.60 (2.66)	6.88 (2.70)	4.57 (2.25)	4.18 (2.16)	4.61 (2.26)	5.05 (2.35)	5.55 (2.45)	6.69 (2.68)	4.85 (2.31)	4.56 (2.25)	5.14 (2.37)	5.51 (2.45)	6.08 (2.56)	5.32 (2.39)
T_2	Acetami prid 20% SP	0.2	7.57 (2.84)	4.47 (2.22)	5.27 (2.40)	6.10 (2.56)	6.07 (2.55)	6.80 (2.70)	8.32 (2.96)	4.70 (2.28)	4.53 (2.24)	4.96 (2.33)	5.34 (2.41)	5.87 (2.52)	7.94 (2.90)	4.59 (2.25)	4.90 (2.32)	5.53 (2.45)	5.71 (2.49)	6.33 (2.61)	5.41 (2.42)
T_3	Clothian idin 50% WDG	0.2	6.57 (2.65)	3.13 (1.90)	3.75 (2.06)	4.80 (2.30)	5.08 (2.36)	4.98 (2.34)	6.58 (2.66)	2.37 (1.69)	2.30 (1.67)	2.73 (1.79)	3.12 (1.90)	3.65 (2.03)	6.58 (2.66)	2.75 (1.80)	3.03 (1.87)	3.77 (2.05)	4.10 (2.13)	4.32 (2.19)	3.59 (2.01)
T_4	Floni-camide 50% WG	0.2	5.43 (2.43)	1.85 (1.53)	1.80 (1.51)	1.98 (1.57)	2.13 (1.62)	2.17 (1.63)	7.38 (2.80)	1.04 (1.24)	0.87 (1.16)	1.30 (1.33)	1.35 (1.36)	1.88 (1.54)	6.41 (2.62)	1.47 (1.40)	1.35 (1.35)	1.66 (1.46)	1.77 (1.50)	2.05 (1.60)	1.66 (1.46)
T_5	Dinote-furan 20% SG	0.3	6.60 (2.64)	1.80 (1.51)	1.85 (1.53)	2.27 (1.66)	2.17 (1.63)	2.23 (1.65)	8.10 (2.93)	1.09 (1.26)	0.90 (1.18)	1.33 (1.35)	1.40 (1.37)	1.93 (1.55)	7.35 (2.80)	1.42 (1.38)	1.36 (1.35)	1.78 (1.50)	1.76 (1.50)	2.06 (1.60)	1.68 (1.47)
T_6	Diafen-thiuron 50% WP	1.2	5.80 (2.51)	2.98 (1.86)	2.05 (1.60)	2.12 (1.62)	2.22 (1.65)	3.03 (1.88)	6.72 (2.68)	2.22 (1.64)	1.31 (1.34)	1.74 (1.50)	2.13 (1.62)	2.66 (1.78)	6.26 (2.60)	2.60 (1.76)	1.68 (1.47)	1.93 (1.56)	2.17 (1.63)	2.85 (1.83)	2.25 (1.65)
T_7	Fipronil 5% SC	3.0	6.57 (2.65)	2.23 (1.65)	1.95 (1.56)	1.93 (1.56)	1.85 (1.53)	2.65 (1.77)	7.57 (2.83)	1.27 (1.33)	1.24 (1.31)	1.67 (1.46)	2.06 (1.59)	2.59 (1.75)	7.07 (2.75)	1.75 (1.49)	1.59 (1.44)	1.80 (1.52)	1.95 (1.57)	2.62 (1.77)	1.94 (1.56)
T_8	Acephat e 75% SP	2.0	5.43 (2.43)	3.15 (1.91)	3.08 (1.89)	3.17 (1.91)	3.12 (1.90)	3.27 (1.94)	7.38 (2.80)	2.39 (1.70)	2.33 (1.68)	2.76 (1.81)	3.15 (1.91)	3.68 (2.04)	6.41 (2.62)	2.77 (1.81)	2.71 (1.79)	2.97 (1.86)	3.14 (1.91)	3.48 (1.99)	3.01 (1.87)
T_9	Control	-	7.50 (2.83)	7.90 (2.89)	7.70 (2.86)	7.05 (2.73)	6.85 (2.69)	6.97 (2.71)	8.22 (2.95)	8.15 (2.94)	8.22 (2.95)	8.59 (3.01)	8.72 (3.03)	9.12 (3.09)	7.86 (2.89)	8.03 (2.92)	7.96 (2.91)	7.82 (2.88)	7.78 (2.87)	8.04 (2.92)	7.93 (2.90)
SE ±			0.11	0.10	0.08	0.12	0.13	0.11	0.13	0.08	0.08	0.07	0.07	0.09	0.12	0.09	0.08	0.10	0.11	0.10	0.10
CD at 5%			NS	0.30	0.24	0.36	0.39	0.33	NS	0.24	0.23	0.20	0.21	0.28	NS	0.26	0.22	0.28	0.30	0.30	027

DAS- Days after spray DBS- Days before spray

* Figures in parentheses denote $\sqrt{x+0.5}$ transformed values. NS-Non significant

Table 2. Efficacy of conventional and newer insecticides against leafhopper of *Bt* cotton in HDPS after second spraying during *kharif* 2015-16 and 2016-17

Sr. no	Treatments	Dose g or ml/l	Second spraying (*Kharif* 2015-16) Av. no. of leafhopper population/3 leaves					Second spraying (*Kharif* 2016-17) Av. no. of leafhopper population/3 eaves					Second spraying pooled (*Kharif* 2015-16 and 2016-17) Av. no. of leafhopper population/3 leaves					
			1DAS	3DAS	5DAS	7DAS	10DAS	1DAS	3DAS	5DAS	7DAS	10DAS	1DAS	3DAS	5DAS	7DAS	10DAS	Mean
T_1	Imidacloprid 17.8 SL	0.4	3.77 (2.04)	3.72 (2.05)	4.23 (2.16)	5.03 (2.33)	5.70 (2.49)	2.10 (1.61)	1.81 (1.52)	2.26 (1.66)	2.43 (1.71)	2.83 (1.82)	2.93 (1.84)	2.76 (1.79)	3.25 (1.92)	3.73 (2.03)	4.27 (2.16)	3.50 (1.95)
T_2	Acetamiprid 20% SP	0.2	4.32 (2.18)	4.22 (2.17)	4.08 (2.14)	4.80 (2.29)	5.52 (2.43)	2.24 (1.65)	1.95 (1.55)	2.40 (1.69)	2.57 (1.74)	3.19 (1.92)	3.28 (1.92)	3.08 (1.87)	3.24 (1.92)	3.68 (2.03)	4.35 (2.19)	3.53 (1.99)
T_3	Clothianidin 50% WDG	0.2	2.77 (1.79)	2.12 (1.62)	2.73 (1.80)	2.17 (1.63)	2.12 (1.62)	1.12 (1.27)	0.84 (1.15)	1.29 (1.34)	1.46 (1.40)	1.63 (1.46)	1.94 (1.54)	1.48 (1.39)	2.01 (1.57)	1.81 (1.52)	1.88 (1.54)	1.82 (1.51)
T_4	Flonicamide 50% WG	0.2	1.35 (1.36)	0.87 (1.17)	1.35 (1.36)	1.25 (1.32)	1.25 (1.32)	0.93 (1.20)	0.48 (0.99)	0.93 (1.19)	0.88 (1.17)	1.10 (1.26)	1.14 (1.28)	0.71 (1.09)	1.24 (1.31)	0.98 (1.21)	1.26 (1.33)	1.07 (1.24)
T_5	Dinotefuran 20% SG	0.3	1.20 (1.30)	0.93 (1.19)	1.55 (1.43)	1.07 (1.25)	1.42 (1.38)	0.77 (1.12)	0.64 (1.07)	1.09 (1.26)	1.05 (1.24)	1.28 (1.33)	0.98 (1.21)	0.75 (1.12)	1.22 (1.31)	1.15 (1.28)	1.27 (1.33)	1.11 (1.26)
T_6	Diafenthiuron 50% WP	1.2	1.95 (1.56)	1.20 (1.30)	1.35 (1.36)	1.45 (1.40)	2.17 (1.63)	1.18 (1.29)	0.90 (1.18)	1.35 (1.36)	1.52 (1.42)	2.03 (1.59)	1.57 (1.43)	1.05 (1.24)	1.35 (1.36)	1.49 (1.41)	2.10 (1.61)	1.51 (1.41)
T_7	Fipronil 5 % SC	3.0	2.22 (1.64)	1.35 (1.36)	1.60 (1.45)	1.65 (1.46)	2.32 (1.67)	1.25 (1.32)	0.97 (1.21)	1.42 (1.39)	1.60 (1.44)	2.30 (1.67)	1.73 (1.49)	1.16 (1.29)	1.51 (1.42)	1.63 (1.46)	2.31 (1.68)	1.67 (1.47)
T_8	Acephate 75% SP	2.0	5.30 (2.41)	2.68 (1.78)	2.12 (1.60)	2.45 (1.72)	2.55 (1.74)	2.50 (1.73)	2.20 (1.64)	2.65 (1.77)	2.84 (1.83)	3.16 (1.91)	3.90 (2.07)	2.44 (1.71)	2.39 (1.70)	2.65 (1.77)	2.86 (1.83)	2.85 (1.82)
T_9	Control		16.28 (4.09)	16.43 (4.09)	21.07 (4.63)	21.40 (4.68)	21.27 (4.66)	20.20 (4.55)	20.47 (4.58)	20.83 (4.62)	21.03 (4.64)	14.27 (3.84)	18.24 (4.32)	18.45 (4.35)	20.95 (4.63)	21.22 (4.66)	17.77 (4.25)	19.33 (4.44)
SE ±			0.14	0.12	0.10	0.11	0.10	0.08	0.06	0.07	0.08	0.08	0.11	0.10	0.09	0.09	0.09	0.10
CD at 5%			0.41	0.36	0.31	0.32	0.30	0.25	0.19	0.22	0.24	0.25	0.33	0.28	0.26	0.27	0.27	0.28

DAS- Days after spray DBS- Days before spray

* Figures in parentheses denote $\sqrt{x+0.5}$ transformed values.

Table 3. Efficacy of conventional and newer insecticides against leafhopper of Bt cotton in HDPS after third spraying during kharif 2015-16 and 2016-17

Sr. no	Treatments	Dose g or ml/l	Third spraying (Kharif 2015-16) Av. no. of leafhopper population/3 leaves					Third spraying (Kharif 2016-17) Av. no. of leafhopper population/3 leaves					Third spraying pooled (*Kharif* 2015-16 and 2016-17) Av. no. of leafhopper population/ 3 leaves					
			1DAS	3DAS	5DAS	7DAS	10DAS	1DAS	3DAS	5DAS	7DAS	10DAS	1DAS	3DAS	5DAS	7DAS	10DAS	Mean
T_1	Imidacloprid 17.8 SL	0.4	4.65 (2.27)	3.37 (1.96)	4.23 (2.15)	4.65 (2.25)	5.33 (2.40)	0.97 (1.21)	0.58 (1.04)	0.90 (1.18)	0.93 (1.20)	0.10 (0.78)	2.81 (1.74)	1.98 (1.50)	2.57 (1.68)	2.79 (1.73)	2.72 (1.60)	2.57 (1.65)
T_2	Acetamiprid 20% SP	0.2	5.17 (2.36)	4.55 (2.24)	4.08 (2.14)	4.50 (2.22)	5.38 (2.42)	1.02 (1.23)	0.65 (1.07)	0.85 (1.16)	0.97 (1.21)	0.12 (0.79)	3.09 (1.81)	2.60 (1.66)	2.47 (1.65)	2.73 (1.72)	2.75 (1.61)	2.73 (1.69)
T_3	Clothianidin 50% WDG	0.2	2.73 (1.80)	2.28 (1.66)	2.73 (1.80)	2.93 (1.85)	2.47 (1.72)	0.50 (1.00)	0.13 (0.79)	0.22 (0.85)	0.33 (0.91)	0.06 (0.75)	1.62 (1.40)	1.21 (1.23)	1.48 (1.32)	1.63 (1.38)	1.26 (1.23)	1.44 (1.31)
T_4	Flonicamide 50% WG	0.2	1.08 (1.26)	1.03 (1.24)	1.35 (1.36)	1.17 (1.29)	1.55 (1.43)	0.35 (0.92)	0.05 (0.74)	0.14 (0.80)	0.18 (0.83)	0.00 (0.71)	0.76 (1.11)	0.56 (1.00)	0.76 (1.09)	0.70 (1.07)	0.78 (1.07)	0.71 (1.07)
T_5	Dinotefuran 20% SG	0.3	1.12 (1.27)	1.15 (1.27)	1.55 (1.43)	1.22 (1.31)	1.68 (1.47)	0.43 (0.97)	0.09 (0.77)	0.17 (0.82)	0.23 (0.86)	0.00 (0.71)	0.73 (1.10)	0.58 (1.01)	0.85 (1.12)	0.70 (1.07)	0.84 (1.09)	0.74 (1.08)
T_6	Diafenthiuron 50% WP	1.2	1.40 (1.38)	1.18 (1.29)	1.40 (1.38)	1.60 (1.45)	1.97 (1.56)	0.53 (1.02)	0.20 (0.84)	0.43 (0.97)	0.52 (1.01)	0.08 (0.76)	0.97 (1.20)	0.69 (1.07)	0.92 (1.17)	1.06 (1.23)	1.03 (1.17)	0.93 (1.17)
T_7	Fipronil 5% SC	3.0	1.50 (1.41)	1.27 (1.32)	1.60 (1.45)	1.42 (1.38)	1.75 (1.50)	0.57 (1.03)	0.18 (0.83)	0.35 (0.92)	0.45 (0.97)	0.07 (0.76)	1.03 (1.22)	0.73 (1.08)	0.98 (1.19)	0.93 (1.18)	0.91 (1.13)	0.92 (1.16)
T_8	Acephate 75% SP	2.0	4.90 (2.31)	2.50 (1.73)	1.53 (1.42)	2.60 (1.76)	2.45 (1.72)	1.12 (1.27)	0.77 (1.12)	0.72 (1.10)	0.85 (1.16)	0.14 (0.79)	3.01 (1.80)	1.63 (1.43)	1.13 (1.26)	1.73 (1.46)	1.29 (1.26)	1.76 (1.44)
T_9	Control	-	8.13 2.91	8.27 2.95	9.53 (3.14	9.43 (3.13	9.63 (3.16)	3.13 (1.90)	1.07 (1.24)	1.03 (1.23)	0.98 (1.22)	0.18 (0.82)	5.63 (2.42)	4.67 (2.11)	5.28 (2.20)	5.21 (2.18)	4.91 (2.00)	5.14 (2.12)
SE ±			0.14	0.11	0.13	0.14	0.14	0.05	0.05	0.06	0.04	0.02	0.11	0.08	0.10	0.11	0.10	0.10
CD at 5%			0.42	0.32	0.38	0.43	0.42	0.15	0.15	0.17	0.12	0.07	0.30	0.24	0.28	0.31	0.29	0.28

DAS- Days after spray DBS- Days before spray

* Figures in parentheses denote $\sqrt{x+0.5}$ transformed values.

Table 4. Impact of conventional and newer insecticides on natural enemies population of *Bt* cotton under HDPS during *kharif* 2015 and 2016 (Three spray pooled)

Sr. no	Treatments	Dose (ml or g/l)	Average of three spray pooled *kharif* 2015-16 and 2016-17			
			Average no. natural enemies population/plant			
			LBB	*Chrysopay*	Spiders	syrphid maggots
T_1	Imidacloprid 17.8 SL	0.4 ml	1.15 (1.26)	0.70 (1.08)	1.09 (1.26)	0.82 (1.13)
T_2	Acetamiprid 20% SP	0.02 g	1.31 (1.32)	0.61 (1.04)	0.98 (1.21)	0.73 (1.09)
T_3	Clothianidin 50% WDG	0.02 g	1.19 (1.28)	0.60 (1.03)	0.96 (1.20)	0.73 (1.09)
T_4	Flonicamide 50% WG	0.2 g	1.46 (1.37)	0.75 (1.10)	1.23 (1.31)	0.90 (1.16)
T_5	Dinotefuran 20% SG	0.3 g	1.29 (1.32)	0.63 (1.04)	0.99 (1.21)	0.72 (1.09)
T_6	Diafenthiuron 50% WP	1.2 g	1.25 (1.30)	0.49 (0.98)	0.92 (1.19)	0.68 (1.07)
T_7	Fipronil 5% SC	3.0 ml	1.35 (1.33)	0.56 (1.02)	0.86 (1.15)	0.69 (1.07)
T_8	Acephate 75% SP	2.0 g	1.00 (1.20)	0.61 (1.04)	0.92 (1.19)	0.67 (1.07)
T_9	Control	-	1.95 (1.53)	0.95 (1.18)	1.49 (1.40)	1.09 (1.24)
SE ±			0.06	0.06	0.05	0.03
CD at 5%			NS	NS	NS	NS

DAS- Days after spray DBS- Days before spray

* Figures in parentheses denote $\sqrt{x + 0.5}$ transformed values.

NS-Non significant

CITATION OF THIS ARTICLE

Tukaram A. Nikam, C. B. Latpate, Ramesh K. B., Vrunda S. Thakare. Efficacy of Conventional And Newer Insecticides Against *Bt* Cotton Leafhopper, *Amarasca biguttula biguttula* (Ishada) Under High Density Planting System. Bull. Env. Pharmacol. Life Sci., Vol 6 Special issue 2, 2017: 274-280