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RESEARCH ARTICLE

Efficacy of newer insecticides on sucking pests in Bt cotton under Khandesh region of Maharashtra

■ D.V. SANER[1], G.B. KABRE[1] AND Y.A. SHINDE[2]*

[1]Department of Entomology, College of Agriculture, DHULE (M.S.) INDIA

[2]Department of Entomology, C.P. College of Agriculture, Sardarkrushinagar Dantiwada Agricultural University, SARDARKRUSHINAGAR (GUJARAT) INDIA

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***Corresponding author:**
Email: suthinagri@gmail.com

ABSTRACT

The field studies on efficacy of newer insecticides on sucking pests in Bt cotton under in Khandesh region of Maharashtra, India showed that out of 9 treatments, all were significantly reduced by the test synthetic chemical insecticides in comparision with untreated control. Population of jassid, aphid, thrip was promisingly suppressed by thiamethoxam 25 WG, fipronil 80 WG, followed by fipronil 5 SC, acetamiprid 20 SP, lambdacyhalothrin 5 SC, imidacloprid and triazophos. Population of whiteflies was effectively suppressed by thiamethoxam 25 WG, acetamiprid 20 SP, fipronil 80 WG followed by fipronil 5 SC, imidacloprid 70 WG, imidacloprid 17.80 SL, lambdacyhalothrin 5 SC and triazophos 40 EC. The promising insecticides against mealy bugs were found to be acetamiprid 20 SP, thiamethoxam 25 WG, fipronil 80 WG, lambdacyhalothrin 5 SC, triazophos 40 EC followed by imidacloprid 17.80 SL, fipronil 5 SC and imidacloprid 70 WG.

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INTRODUCTION

Cotton, the word is derived from Arabic word 'Qutun'. Cotton (*Gossypium* spp.) popularly known as 'white gold' is one of the most important commercial crops referred as 'king of fibre', which belongs to family Malvaceae and genus *Gossypium*.

India ranks 1st in area and 2nd in production of cotton. The area covered under cotton crop in India is 101.52 lakh hectares with production of 295.00 lakh bales. Maharashtra is one of the leading cotton states in India having 35.03 lakh hectare area with the production of 67 lakh bales and productivity of 325 kg/ha (Anonymous, 2010).

More than 10 per cent of the world's pesticides and nearly 25 per cent of worlds insecticides are used in cotton farming (Khadi, 2003). Bt cotton is genetically modified cotton plant in which cry1 Ac gene from *Bacillus thuringiensis* (a common soil bacterium) is introduced through genetic engineering. The target insect for cry 1 Ac toxin protein has been the lepidopteran pests like *Helicoverpa* sp. and not the sucking pests, which also cause sustainable damage in cotton and need to be controlled through insecticides. Hence, Bt cotton requires control measure for sucking pests (Khadi, 2003).

The neo-nicotinoid group of insecticides is basically launched for sucking pests as seed dresser and foliar spray (Elbert *et al.*, 1990). Insecticides used are Imidacloprid 17.80 % S.L., Fipronil 5% S.C., Thiamethoxam 25%W.G., Trizophos 40 E.C., Acetamiprid 20% S.P., Fipronil 80 % W.G., Imidacloprid 70% W.G., Lambda cyhalothrin 5% E.C. Application of these nitroguanidine analogue insecticides as foliar spray were tested for their efficacy against sucking pests on Bt cotton hybrid.

MATERIAL AND METHODS

The experiment was carried out at Field of Department of Agricultural Entomology, College of Agriculture, Dhule

under Mahatma Phule Krishi Vidyapeeth, Rahuri during *Kharif* season in 2011-2012.

The material required for conducting field experiment *viz.*, cotton seed (RCH-2 BG-II), fertilizers, insecticides *viz.*, Imidacloprid 17.80 % SL, Fipronil 5 % SL, Thiamethoxam 25 % WG, Imidacloprid 70 % WG, Trizophos 40 EC, Acetamiprid 20 % SP, Fipronil 80 WG, Lamdacyhalothrin 5 % EC, rope, tape, pegs, labels, markers, weighing balance and magnifier were supplied by the Department of Agricultural Entomology which were used for conducting experiment.

To evaluate the efficacy of newer systemic insecticides on Bt cotton hybrid RCH-2 BG-II was sown on 30/06/2011 immediately after onset of monsoon. Newer systemic insecticides were applied at ETL levels for sucking pests on RCH-2 BG-II Bt cotton hybrid with randomized block design and observations were recorded at 3, 7 and 14 days after each application on five tagged plants from each plot.

The following ETL were considered for need based plant protection for target pests.

Aphids - 10 aphids nymphs/ leaf.

Jassids - 2 jassids nymphs/ leaf

Thrips- 10 thrips/ leaf

Whiteflies – 8 to 10 adult/ leaf or 20 nymphs/ leaf.

The following observations were recorded :

- Population of sucking pests (aphid, jassid, thrips and whiteflies) per plant on 3 leaves (top, middle, bottom).
- Population of mealybugs and natural enemies (ladybird beetle grubs and adults, chrysopa larvae).

RESULTS AND DISCUSSION

Pre-count data on mean sucking pests population under the studies were recorded during 2011 and were observed to be statistically non-significant, indicating the homogenous population in the field. Eight chemical insecticides *viz.*, Imidacloprid 17.80 SL, Fipronil 5 per cent SC, Thiamethoxam 25 per cent WG, Imidacloprid 70 per cent WG, triazophos 40 EC, Acetamiprid 20 per cent SP, Fipronil 80 WG and Lambdacyhalothrin 5 per cent were evaluated against five major sucking pests *viz.*, jassids, aphids, thrips, whiteflies and mealybugs along with untreated control. In respect of all two sprays against all the major sucking pests under studies were computed at an interval of 3, 7 and 14 DAS indicated that all the chemical insecticidal treatments under studies were significantly superior over untreated control by exhibiting better field efficacy. The results from the mean population computed from 3, 7 and 14 DAS from each spray application are presented in Tables 1 to 6 for validation.

Field efficacy observed against jassids during 2011 :

The pre-treatment count of jassid per three leaves was in the range of 4.2 to 5.8.

After first spray **:**

The data on the post treatment mean jassids count per three leaves are presented in Table 1. The result revealed that all the insecticidal treatments were statistically significant over untreated control at 3,7 and 14 DAS. At 3 days after I spray, the insecticidal treatment imidacloprid 70% WG (3.40) was superior but at par with thiamethoxam 25% WG (3.80), acetamiprid 20% SP (3.86), fipronil 80 WG (4.00), imidacloprid 17.80 SL (4.00) fipronil 5% SC (4.07), lambdacyhalothrin 5% SC (4.07) were found statistically significant over untreated control. Almost similar trend was observed at 7 and 14 days after I spray.

Table 1 : Field efficacy of newer insecticides against jassid, *A. bigutulla bigutulla* on Bt cotton hybrid after first and second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of jassid / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	5.6 (2.46)	4.00 (2.12)	3.73 (2.05)	4.47 (2.22)	3.33 (1.95)	3.4 (1.97)	4.27 (2.18)
T_2	Fipronil 5% SC	50 g ai/hac.	5.4 (2.42)	4.07 (2.13)	3.8 (2.07)	4.53 (2.24)	3.07 (1.88)	3.0 (1.87)	3.60 (2.02)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	4.2 (2.16)	3.80 (2.07)	3.67 (2.04)	3.93 (2.10)	2.93 (1.85)	2.8 (1.81)	3.13 (1.90)
T_4	Imidacloprid 70% WG	80 g ai/hac.	5.66(2.48)	3.40 (1.97)	3.33 (1.94)	3.80 (2.07)	3.27 (1.94)	3.06 (1.88)	3.93 (2.10)
T_5	Triazophos 40 EC	400 g ai/hac.	5.3 (2.40)	5.13 (2.37)	5.2 (2.38)	6.33 (2.61)	3.6 (2.02)	3.93 (2.10)	6.60 (2.66)
T_6	Acetamiprid 20% SP	20 g ai/hac.	5.66(2.48)	3.86 (2.08)	3.86 (2.08)	4.87 (2.31)	3.13 (1.90)	3.53 (2.00)	3.80 (2.07)
T_7	Fipronil 80 WG	64 g ai/hac.	5.6 (2.46)	4.00 (2.12)	3.93 (2.10)	4.26 (2.18)	3.26 (1.93)	2.86 (1.83)	3.40 (1.97)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	5.8 (2.50)	4.07 (2.13)	4.00 (2.12)	4.47 (2.22)	3.40 (1.97)	3.47 (1.99)	3.87 (2.09)
T_9	Untreated control		5.2 (2.38)	6.26 (2.6)	6.27 (2.60)	7.73 (2.86)	6.6 (2.66)	6.67 (2.67)	7.4 (2.81)
SE±			0.12	0.10	0.10	0.10	0.09	0.10	0.10
CD @ 5%			N S	0.31	0.30	0.32	0.27	0.31	0.32

Figures in parentheses are square root of (X + 0.50) transformed values, NS = Non-significant

After second spray :

The data on the post treatment mean jassids count per three leaves are presented in Table 1. The result indicated that all the insecticidal treatments were statistically significant over untreated control. At 3 days after II spray the insecticidal treatments thiamethoxam 25% WG (2.93) found statistically significant over untreated control and also on par with fipronil 5% SC (3.07), acetamiprid 20% SP (3.13), fipronil 80 WG (3.26), imidacloprid 70% WG (3.27), imidacloprid 17.80 SL (3.33), lambdacyhalothrin 5% SC (3.40) and triazophos 40 EC(3.60). Almost similar trend was observed at 7 days after II spray. At 14 days after II spray the treatment thiamethoxam 25% WG (3.13) was found superior and at par with fipronil 80 WG (3.40), fipronil 5% SC (3.60), acetamiprid 20% SP (3.80), lambdacyhalothrin 5% SC (3.87) and imidacloprid 70% WG (3.92) which were statistically significant over untreated control. The next best treatment was triazophos 40 EC(6.60) which was at par with untreated control.

The general trend of the field efficacy of the treatments under studied against the jassids at 14 days after II spray indicated as thiamethoxam 25% WG > fipronil 80 WG > fipronil 5% SC > acetamiprid 20% SP > lambdacyhalothrin 5% SC > imidacloprid 70% WG > imidacloprid 17.80 SL > triazophos 40 EC.

Field efficacy observed against aphids during 2011 :

The pre-treatment population count of aphid on three leaves was in the range of 5.06 to 5.46 and difference among various treatments were statistically non significant.

After first spray :

The data on the post treatment mean aphids count per three leaves are presented in Table 2. The results indicated that all insecticidal treatments were statistically significant over untreated control. At 3 days after I spray the results indicated that thiamethoxam 25% WG (1.40), imidacloprid 70% WG (1.67), acetamiprid 20% SP (1.67), imidacloprid 17.8%SL, triazophos 40 EC (1.93), fipronil 80 WG (2.00),lambda cyhalothrin %% EC (2.00) and fipronil 5% SC (2.07) were found to be most effective treatments and were at par with each other. At 7 DAS almost similar trend was observed. At 14 DAS the insecticidal treatments fipronil 80 WG (4.13), thiamethoxam 25% WG (4.26), imidacloprid 17.80 SL (4.26) and all the insecticidal treatments were at par with each other and significantly superior over untreated control.

After second spray :

The data on post treatment mean aphid count per three leaves are presented in Table 2. The results indicated that all the insecticidal treatments were statistically significant over untreated control at 3, 7 and 14 DAS. The results revealed that at 3 DAS the insecticidal treatments thiamethoxam 25% WG (1.67), fipronil 80 WG (1.73), imidacloprid 70% WG (1.87), imidacloprid 17.80% SL, acetamiprid 20% SP (2.0), fipronil 5% EC(2.20), lambdacyhalothrin 5% SC (2.27), were found to be most effective treatments and were at par with each other. At 7 DAS in the insecticidal treatments almost similar trend was observed. At 14 days after II spraying, the treatments thiamethoxam 25% WG (2.13), imidacloprid 70% WG (2.27), fipronil 80 WG (2.33), acetamiprid 20% SP (2.53), imidacloprid 17.80 SL (2.53), fipronil 5% SC (2.60) and lambdacyhalothrin 5% SC (2.73) were at par with each other and statistically significant over triazophos 40 EC (5.73) and untreated control (7.26).

The general trend of field efficacy of the treatments under studied against aphid indicated as thiamethoxam 25% WG > imidacloprid 70% WG > fipronil 80 WG > acetamiprid 20% SP > imidacloprid 17.80 SL > fipronil 5% SC > lambdacyhalothrin 5% SC > triazophos 40 EC.

Table 2 : Field efficacy of newer insecticides against aphid, *A. gossypii* on Bt cotton hybrid after first and second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of aphid / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	2.33 (1.68)	1.80 (1.51)	2.00 (1.58)	4.2 (2.16)	1.93 (1.55)	2.27 (1.66)	2.53 (1.74)
T_2	Fipronil 5% SC	50 g ai/hac.	2.13 (1.62)	2.07 (1.60)	2.33 (1.68)	5.53 (2.45)	2.20 (1.64)	2.33 (1.68)	2.60 (1.76)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	2.2 (1.64)	1.40 (1.37)	1.93 (1.55)	4.26 (2.18)	1.67 (1.47)	1.86 (1.53)	2.13 (1.62)
T_4	Imidacloprid 70% WG	80 g ai/hac.	2.46 (1.72)	1.67 (1.47)	1.93 (1.55)	4.7 (2.28)	1.87 (1.53)	1.73 (1.78)	2.27 (1.66)
T_5	Triazophos 40 EC	400 g ai/hac.	2.26 (1.66)	1.93 (1.55)	2.40 (1.70)	4.53 (2.24)	2.40 (1.70)	2.67 (1.78)	5.73 (2.49)
T_6	Acetamiprid 20% SP	20 g ai/hac.	2.13 (1.62)	1.67 (1.47)	2.00 (1.58)	5.17 (2.38)	2.00 (1.58)	2.00 (1.58)	2.53 (1.74)
T_7	Fipronil 80 WG	64 g ai/hac.	2.26 (1.66)	2.00 (1.58)	2.07 (1.60)	4.13 (2.15)	1.73 (1.49)	1.93 (1.55)	2.33 (1.68)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	2.4 (1.70)	2.00 (1.58)	2.1 (1.61)	4.53 (2.24)	2.27 (1.66)	1.93 (1.55)	2.73 (1.79)
T_9	Untreated control		2.06 (1.66)	5.13 (2.37)	5.53 (2.45)	6.66 (2.67)	6.60 (2.66)	7.00 (2.73)	7.26 (2.78)
SE ±			0.08	0.13	0.10	0.10	0.07	0.11	0.09
CD @ 5%			N S	0.40	0.30	0.31	0.20	0.34	0.29

Figures in parentheses are square root of (X + 0.50) transformed values, NS = Non-significant

Field efficacy observed against thrips during 2011 :

The pre treatments thrips count per three leaves was recorded in range of 5.73 to 6.33 which were statistically non-significant.

After first spray :

The data on post treatment mean thrip count per three leaves are presented in Table 3. The results indicated that all insecticidal treatments were statistically significant over untreated control at 3, 7 and 14 DAS. The results revealed that at 3 DAS the insecticidal treatments thiamethoxam 25% WG (2.6), fipronil 80 WG (2.73), acetamiprid 20% SP(2.80), imidacloprid 70% WG(2.80), fipronil 5% SC(2.87), lambdacyhalothrin 5% SC (2.93), imidacloprid 17.80 SL (2.93) and triazophos 40 EC(3.46) were found to be the most effective treatments and were at par with each other. At 7 DAS, almost similar trend was recorded. At 14 DAS, the most promising insecticides were thiamethoxam 25% WG (3.93), imidacloprid 70% WG (4.0), acetamiprid 20% SP (4.07), lambdacyhalothrin 5% SC (4.07), fipronil 80 WG (4.27), fipronil 5% SC (4.27), imidacloprid 17.80 SL (4.33) and triazophos 40 EC (5.26) and were at par with each other.

After second spray:

The data on post treatment mean thrips count per three leaves are presented in Table 3 which revealed that all insecticidal treatments were statistically significant over untreated control at 3, 7 and 14 DAS. The results indicated that at 3 DAS insecticidal treatments acetamiprid 20% SP (2.26), thiamethoxam 25% WG (2.33), imidacloprid 17.80 SL (2.40), fipronil 5% SC (2.46), fipronil 80 WG (2.46), imidacloprid 70% WG (2.60), triazophos 40 EC (2.6), lambdacyhalothrin 5% SC (2.73) were found to be the most effective treatments and were at par with each other. At 7 DAS all the insecticidal treatments were promising and statistically significant over untreated control. At 14 days after II spraying, the results indicated that the insecticidal treatments, thiamethoxam 25% WG (2.67), fipronil 80 WG (2.93), acetamiprid 20% SP (3.13), fipronil 5% SC (3.13), imidacloprid 17.80 SL (3.13), imidacloprid 70% WG (3.20), lambdacyhalothrin 5% SC (3.53) were on par with each other and statistically significant over rest of the treatments.

The general trend of field bio-efficacy of the treatments under the studies against the thrips indicated as the best insecticides in descending order as thiamethoxam 25% WG > fipronil 80 WG > acetamiprid 20% SP > fipronil 5% SC > imidacloprid 17.80 SL > imidacloprid 70% WG > lambdacyhalothrin 5% SC > triazophos 40 EC.

Field efficacy observed against whiteflies during 2011 :

The pretreatment whiteflies count per three leaves was recorded in the range of 3.53 to 4.13 and was statistically non-significant.

After first spray :

The data on the post treatment mean whiteflies count per three leaves are presented in Table 4. The results revealed that at 3, 7 and 14 DAS after I spraying the differences among various treatments were found to be statistically non-significant.

After second spray :

The data on post treatment mean whiteflies counts per three leaves are presented in Table 4. The results revealed that all insecticidal treatments were statistically significant over untreated control at 3, 7 and 14 days after II spraying. The results indicated that 3 DAS the insecticidal treatments acetamiprid 20% SP (3.0), thiamethoxam 25% WG (3.20), fipronil

Table 3 : Field efficacy of newer insecticides against thrip, *T. tabaci* on Bt cotton hybrid after first and second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of thrips / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	5.73 (2.49)	2.93 (1.85)	3.06 (1.88)	4.33 (2.19)	2.40 (1.70)	2.40 (1.70)	3.13 (1.90)
T_2	Fipronil 5% SC	50 g ai/hac.	5.86 (2.52)	2.87 (1.83)	3.13 (1.90)	4.27 (2.18)	2.46 (1.72)	2.06 (1.6)	3.13 (1.90)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	5.8 (2.50)	2.6 (1.76)	2.80 (1.81)	3.93 (2.10)	2.33 (1.68)	1.8 (1.51)	2.67 (1.78)
T_4	Imidacloprid 70% WG	80 g ai/hac.	5.8 (2.50)	2.80 (1.81)	3.00 (1.87)	4.00 (2.12)	2.60 (1.76)	2.33 (1.68)	3.20 (1.92)
T_5	Triazophos 40 EC	400 g ai/hac.	6.13 (2.57)	3.46 (1.98)	3.46 (1.98)	5.26 (2.4)	2.6 (1.76)	2.73 (1.79)	5.47 (2.44)
T_6	Acetamiprid 20% SP	20 g ai/hac.	5.8 (2.50)	2.80 (1.81)	2.73 (1.79)	4.07 (2.13)	2.26 (1.66)	1.93 (1.55)	3.13 (1.90)
T_7	Fipronil 80 WG	64 g ai/hac.	5.93 (2.53)	2.73 (1.79)	3.00 (1.87)	4.27 (2.18)	2.46 (1.72)	2.26 (1.66)	2.93 (1.85)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	6.33 (2.61)	2.93 (1.85)	3.27 (1.94)	4.07 (2.13)	2.73 (1.79)	2.87 (1.83)	3.53 (2.00)
T_9	Untreated control		5.86 (2.52)	4.93 (2.33)	5.53 (2.45)	6.73 (2.68)	6.80 (2.70)	6.13 (2.57)	6.26 (2.6)
SE ±			0.03	0.10	0.12	0.12	0.11	0.11	0.14
CD @ 5%			N S	0.30	0.35	0.35	0.34	0.33	0.44

Figures in parentheses are square root of (X + 0.50) transformed values, NS = Non-significant

80 WG (3.20), imidacloprid 70% WG (3.27), fipronil 5% SC (3.33) , imidacloprid 17.80 SL (3.33), lambda cyhalothrin 5% SC ((3.60) and triazophos 40 EC(3.86) were found most promising treatments and were at par with each other. At 7 DAS almost similar trend of result was recorded. The results at 14 days after II spraying indicated, that the insecticidal treatments thiamethoxam 25% WG (4.47), fipronil 80 WG (4.60) acetamiprid 20% SP (4.60), fipronil 5% SC (4.87), imidacloprid 70% WG (5.13) were most promising and significantly superior to rest of the treatments. The next best treatments were imidacloprid 17.80% SL (5.4) and lambda cyhalothrin 5% SC(6.0) followed by triazophos 40 EC (6.60) being significantly superior over untreated control.

The general trend of the field efficacy of the treatments under the studies against whiteflies at 14 days after second spray indicated as thiamethoxam 25% WG > acetamiprid 20% SP > fipronil 80 WG > fipronil 5% SC > imidacloprid 70% WG > imidacloprid 17.80 SL > lambdacyhalothrin 5% SC > triazophos 40 EC.

Field efficacy observed against mealybug during 2011 :

The pre-treatment mealybug count per plant was recorded in the range 1.26 to 2.13 and was statistically non-significant.

After first spray :

The data on post treatment mealy bug count per plant are presented in Table 5. The results revealed that at 3, 7 and 14 days after I spraying, the differences among various treatments were found to be statistically non-significant.

Table 4 : Field efficacy of newer insecticides against whitefly, *B.tabaci* on Bt cotton hybrid after first second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of whitefly / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	3.73 (2.05)	3.73 (2.05)	3.47 (1.99)	5.53 (2.45)	3.33 (1.95)	3.07 (1.88)	5.4 (2.42)
T_2	Fipronil 5% SC	50 g ai/hac.	3.53 (2.00)	3.67 (2.04)	3.27 (1.94)	5.33 (2.41)	3.33 (1.95)	3.20 (1.92)	4.87 (2.31)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	3.73 (2.05)	3.27 (1.94)	3.2 (1.92)	4.60 (2.25)	3.20 (1.92)	3.20 (1.92)	4.47 (2.22)
T_4	Imidacloprid 70% WG	80 g ai/hac.	3.66 (2.03)	3.6 (2.02)	3.27 (1.94)	5.00 (2.34)	3.27 (1.94)	2.93 (1.85)	5.13 (2.37)
T_5	Triazophos 40 EC	400 g ai/hac.	3.93 (2.10)	4.4 (2.21)	4.40 (2.21)	6.6 (2.66)	3.86 (2.08)	4.73 (2.28)	6.60 (2.66)
T_6	Acetamiprid 20% SP	20 g ai/hac.	3.93 (2.10)	3.30 (1.94)	3.60 (2.02)	5.53 (2.45)	3.0 (1.87)	2.6 (1.76)	4.60 (2.25)
T_7	Fipronil 80 WG	64 g ai/hac.	4.13 (2.15)	3.6 (2.02)	3.20 (1.92)	5.13 (2.37)	3.20 (1.92)	3.00 (1.87)	4.60 (2.25)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	4.13 (2.15)	4.20 (2.16)	3.86 (2.08)	5.93 (2.53)	3.60 (2.02)	3.47 (1.99)	6.0 (2.54)
T_9	Untreated control		3.8 (2.07)	4.87 2.31)	5.60 (2.36)	6.93 (2.72)	6.93 (2.72)	7.87 (2.19)	9.67 (3.18)
SE±			0.05	0.15	0.13	0.09	0.11	0.10	0.06
CD @ 5%			N S	N S	N S	N S	0.33	0.31	0.19

Figures in parentheses are square root of (X + 0.50) transformed values, NS=Non-significant

Table 5 : Field efficacy of newer insecticides against mealy bug, *P.solenopsis* on Bt cotton hybrid after first and second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of mealybug / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	2.13 (1.62)	1.46(1.37)	1.53 (1.42)	4.53 (2.24)	2.40 (1.70)	1.73 (1.49)	4.26 (2.18)
T_2	Fipronil 5% SC	50 g ai/hac.	1.93 (1.55)	1.73(1.49)	1.6 (1.44)	3.73 (2.05)	2.47 (1.72)	1.73 (1.49)	4.33 (2.19)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	1.53 (1.42)	1.46(1.37)	1.66 (1.46)	3.86 (2.08)	2.13 (1.61)	1.73 (1.49)	4.53 (2.24)
T_4	Imidacloprid 70% WG	80 g ai/hac.	1.26 (1.32)	1.53(1.42)	1.46 (1.4)	3.73 (2.05)	2.2 (1.64)	1.93 (1.55)	4.93 (2.33)
T_5	Triazophos 40 EC	400 g ai/hac.	1.73 (1.49)	1.6(1.44)	1.26 (1.30)	4.4 (2.21)	2.53 (1.74)	1.93 (1.55)	3.73 (2.05)
T_6	Acetamiprid 20% SP	20 g ai/hac.	1.6 (1.44)	1.53(1.42)	1.33 (1.35)	3.06 (1.88)	2.2 (1.64)	1.53 (1.42)	3.93 (2.10)
T_7	Fipronil 80 WG	64 g ai/hac.	1.53 (1.42)	1.66(1.44)	1.46 (1.4)	3.53 (2.00)	2.27 (1.66)	1.6 (1.45)	4.00 (2.12)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	2.13 (1.62)	1.8 (1.34)	1.67 (1.47)	3.87 (2.07)	2.33 (1.67)	1.87 (1.53)	4.06 (2.13)
T_9	Untreated control		1.8 (1.51)	2.00(1.58)	2.33 (1.64)	5.87 (2.52)	5.53 (2.45)	5.93 (2.53)	8.53 (3.00)
SE±			0.10	0.08	0.09	0.19	0.11	0.09	0.10
CD @ 5%			N S	N S	N S	N S	0.37	0.28	0.31

Figures in parentheses are square root of (X + 0.50) transformed values, NS=Non-significant

After second spray **:**

The data on post treatment mealy bug count per plant are presented in Table 5. The results revealed that all the insecticidal treatments were statistically significant over untreated control at 3, 7 and 14 days after II Spraying. The results indicated that at 3 DAS, the insecticidal treatments thiamethoxam 25% WG (2.13), imidacloprid 70% WG (2.2), acetamiprid 20% SP (2.2), fipronil 80 WG (2.27), lambdacyhalothrin 5% SC (2.33), imidacloprid 17.80 SL (2.40), fipronil 5% SC (2.47) and triazophos 40 EC (3.73) were found most promising treatments and were at par with each other. Almost similar trend was observed at 7 DAS. The results at 14 days after II spraying indicated that the insecticidal treatments acetamiprid 20% SP (3.93), thiamethoxam 25% WG (4.00), fipronil 80 WG (4.00), lambdacyhalothrin 5% SC (4.06), triazophos 40 EC (4.06) imidacloprid 17.80 SL (4.26), fipronil 5% SC (4.33) and imidacloprid 70% WG (4.93) were most promising and at par with each other.

The general trend of the field efficacy of the treatments under the studies against mealybug at 14 days after second spray indicated as acetamiprid 20% SP > thiamethoxam 25% WG > fipronil 80 WG > lambdacyhalothrin 5% SC (4.06)> triazophos 40 EC > imidacloprid 17.80 SL > fipronil 5% SC > and imidacloprid 70% WG.

Field efficacy observed against lady bird beetle :

The pre-treatment lady bird beetle per plant was recorded in range of 1.20 to 1.66 and was statistically non-significant.

After first spray **:**

The data on post treatment lady bird beetle count per plant are presented in Table 6. The results revealed that at 3, 7 and14 days after I spray the mean population of lady bird beetle was more in untreated control but statistically non-significant results were recorded among various treatments.

After second spray **:**

The results presented in Table 6 indicated that although the mean population of ladybird beetle per plant was more in untreated control and statistically non-significant results were observed among various treatments.

Incidence of major sucking pests was significantly reduced by test insecticides in comparision with untreated control. The population of jassids, aphids, thrips and whiteflies was promisingly suppressed by thiamethoxam, acetamiprid, fipronil, Imidacloprid followed by lambda cyhalothrin and triazophos.

Perusal of literature revealed that thiamethoxam has been advocated by Vadodaria *et al.* (2001) against aphids, jassids and thrips; Pun *et al.* (2005) and Muhamad *et al.* (2005) against jassids and whiteflies; Gautum (2007) against mealy bugs and Dhawan *et al.* (2008) against jassid.

Acetamiprid has been recommended by Acharya *et al.* (2002) against jassids; Muhamad *et al.* (2004) against jassids, whiteflies and thrips; Ulganathan and Gupta (2004) against aphids, jassids, whiteflies and thrips Raguraman *et al.* (2008) against thrips and Dhawan *et al.* (2008) against jassid.

Imidacloprid has been advocated by Rathod *et al.* (2002) against aphids, jassids and thrips; Ulganathan and Gupta (2004) against aphids, jassids, whiteflies and thrips; Gautum (2007) against mealy bugs and Dhawan *et al.* (2008) against jassid.

Triazophos has been recommended by Butler *et al.* (1992) against jassids, whiteflies, aphids and thrips; Raguraman *et al.* (2008) against whitefly and Sharma *et al.* (1999) against major sucking pests.

Table 6 : Field efficacy of newer insecticides against lady bird beetle on Bt cotton hybrid after first second spraying during *Kharif* 2011

T. No.	Treatments	Conc.	Mean no. of ladybird beetle / 3 leaves (Top, middle and bottom)						
			I Spray				II Spray		
			Pre count	3 DAS	7 DAS	14 DAS	3 DAS	7 DAS	14 DAS
T_1	Imidacloprid 17.80% SL	20 g ai/hac.	1.33 (1.35)	0.66 (1.07)	0.73 (1.10)	0.86 (1.16)	0.86 (1.16)	0.66 (1.07)	1.8 (1.51)
T_2	Fipronil 5% SC	50 g ai/hac.	1.26 (1.32)	0.8 (1.14)	0.66 (1.07)	0.46 (0.97)	0.4 (0.94)	0.73 (1.10)	1.6 (1.44)
T_3	Thiamethoxam 25% WG	50 g ai/hac.	1.2 (1.30)	0.8 (1.14)	0.86 (1.16)	0.4 (0.94)	0.53 (1.01)	0.73 (1.10)	1.26 (1.32)
T_4	Imidacloprid 70% WG	80 g ai/hac.	1.13 (1.27)	0.53 (1.01)	0.8 (1.14)	0.46 (0.97)	0.6 (1.04)	0.66 (1.07)	0.86 (1.16)
T_5	Triazophos 40 EC	400 g ai/hac.	1.46 (1.4)	0.53 (1.01)	0.73 (1.10)	0.53 (1.01)	0.6 (1.04)	1.0 (1.22)	0.86 (1.16)
T_6	Acetamiprid 20% SP	20 g ai/hac.	1.46 (1.4)	0.8 (1.14)	1.0 (1.22)	0.53 (1.01)	0.66 (1.07)	0.93 (1.19)	1.2 (1.30)
T_7	Fipronil 80 WG	64 g ai/hac.	1.46 (1.4)	0.93 (1.19)	0.86 (1.16)	0.66 (1.07)	0.8 (1.14)	0.6 (1.04)	1.53 (1.42)
T_8	Lambda cyhalothrin 5% SC	12.5 g ai/hac.	1.66 (1.46)	1.06 (1.24)	0.8 (1.14)	0.80 (1.14)	0.86 (1.16)	1.06 (1.24)	1.2 (1.30)
T_9	Untreated control		1.33 (1.35)	0.93 (1.19)	1.0 (1.22)	0.86 (1.16)	0.93 (1.19)	0.93 (1.19)	1.46 (1.4)
SE±			0.05	0.16	0.05	0.12	0.10	0.08	0.08
CD @ 5%			N S	N S	N S	N S	N S	N S	N S

Figures in parentheses are square root of (X + 0.50) transformed values, NS=Non-significant

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