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Evaluation of newer insecticides against leaf hopper on Bt cotton

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ABSTRACT

Evaluation studies were carried out for management of leaf hoppers on Bt cotton during 2012-13 at three different locations. The pooled results revealed that minimum population of leaf hoppers was recorded in the treatment fipronil 5 SC (0.075%) and it was at par with treatment diafenthiuron 50 WP (0.08%) and imidacloprid 30.5 SL (0.005%). Next best treatment was buprofezin 25 SC (0.05%). Significantly highest seed cotton yield of 19.43 q/ha was harvested in application of treatment fipronil 5 SC (0.075%) followed by diafenthiuron 50 WP (0.08%) and imidacloprid 30.5 SL (0.005%) with 18.66 and 18.19 quintal per hectar, respectively. Highest monetary return Rs. 33,409 per ha was also observed in the treatment fipronil 5 SC (0.075%) followed by imidacloprid 30.5 SL (0.005%) (Rs. 30113 per ha) and diafenthiuron 50 WP (0.08%) (Rs. 28340 per ha) whereas in terms of higher incremental cost benefit ratio, imidacloprid 30.5 SL (0.005%) was found superior which recorded 1: 13.3 followed by fipronil 5 SC (0.075%) (1: 8.9).

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INTRODUCTION

Cotton (*Gossypium hirsutum*) is an important crop of India and 60 million people derive their livelihood directly or indirectly from cotton production and its trade. The cotton crop provides fibre, food, feed, fuel, shelter and has a wide variety of medicinal and industrial uses (Siwach and Sangwan, 2012). With nearly 12 million hectares under the cotton crop, India ranks first in the world in respect of area and fourth in total production which has reached the level of 31 million bales (Mayee, 2011). But average productivity in India is quite low (526 kg lint/ha) as compared to worlds average productivity of 785 kg lint/ha (AICCIP, 2009). The major biotic constraint in attainment of desired productivity levels in Bt cotton production is the sucking pests. Among the sucking pests attacking cotton in early stages of crop growth, leafhoppers constitute as one of the important sap feeders. The desaping by the leafhoppers cause specking symptoms, crinkling, distortion of leaves and reddening all along the sides of leaves and such type of symptom is called “Hopper burn” which lead to drying of leaves affecting the growth and reduction in square number and ultimately become one of limiting factor in the productivity of the crop. The losses in yield due to this pest have been reported to be 1.19 q per hectare

(Dhawan *et al.,* 1988). At present, most of the commonly used insecticides are not able to suppress its population below economic threshold. Hence, there is an increased inclination of the farmers for utilization of newer molecules for the management of leafhoppers on Bt cotton.

Recently, neonicotinoids, a group of insecticides of chloronicotinyl class, such as imidacloprid and thiamethoxam have been found very effective for the control of homopteran insects attacking cotton and okra (Kumar and Santharam, 1999 and Mohan and Katiyar, 2000). The use of these insecticides against sucking pests in cotton and okra is expected to increase in the days to come, because these are new and translocate systematically and acropetally with long residual activity (Gul, 1998 and Elbert *et al.*, 1991). For effective management, the search for new molecules interms of bioefficacy trials is a continuous and inevitable process. Thus, the present study was carried out to evaluate newer chemistries in comparision with conventional insecticides and also economics of thses newer insecticides for effective management of leafhoppers on Bt cotton.

MATERIAL AND METHODS

The investigations were conducted at three research stations of Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola *viz.*, Cotton Research Unit, Akola, Regional Research Center, Amravati and Zonal Agriculture Research Station, Yeotmal during *Kharif* 2012-13. Ten treatments were selected for the management of cotton leafhopper, *A. biguttulla biguttulla viz.*, T_1 - Imidacloprid 30.5 SL (0.005%), T_2 - Fipronil 5 SC (0.075%), T_3 - Acetamiprid 20 SP (0.008%), T_4 - Acephate 75 SP (0.15%), T_5 - Diafenthiuron 50 WP (0.08%), T_6 - Buprofezin 25 SC (0.05%), T_7 - Triazophos 40 EC (0.16%), T_8 - Azadirachtin 10000 PPM (1%), T_9 - Dimethoate 30 EC (0.03%) (Std check) and T_{10} – Control. The experiment was laid out in Randomized Block Design with three replications in 5.40 x 6.30 m plot. The first treatment spray for the management of leaf hoppers was given on attaining ETL and repeated at an interval of 10 days.

The observations on the population of leaf hoppers were recorded 3 and 7 days after each treatment spray on randomly selected five plants from each net plot on 3 leaves (top, middle and bottom) per plant. The observations on predators *i.e.* chrysopa larvae, lady bird beetles, syrphid larvae and spiders were also recorded at 3 and 7 days after each treatment spray on randomly selected 5 plants from each net plot on whole plant. The picking wise yield of seed cotton was recorded. The data recorded on population of sucking pests at 3 and 7 days after each treatment spray was averaged. Stastitical analysis was done and treatment wise net returns and incremental cost benefit ratio was calculated.

RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented in Table 1, 2 and 3.

Effect of insecticidal treatments on leafhopper population on Bt cotton at Akola location:

3 days after treatment:

The data recorded at Akola location depicted in Table 1 revealed that all the treatments were found significantly superior over control. Minimum population of leaf hoppers (0.31 hoppers/leaves) was observed in treatment fipronil 5 SC (0.075%) and it was at par with treatment diafenthiuron 50 WP (0.08%). Next effective treatment was acephate 75 SP (0.15%) recording 0.58 leaf hoppers per leaves followed by acetamiprid 20 SP (0.008%) and imidacloprid 30.5 SL (0.005%). Among the tested insecticides dimethoate 30 EC (0.03%) was least effective treatment whereas, maximum leaf hopper population (4.58/leaves) was recorded in untreated control.

7 days after treatment :

The data noted in Table 1, revealed that all the treatments were showed significant differences over control. Minimum population of leaf hoppers *i.e.* 0.35 leaf hoppers/leaves was observed in the treatment diafenthiuron 50 WP (0.08%) and it was at par with treatment fipronil 5 SC (0.075%) and acephate 75SP (0.15%). Next effective treatment was acetamiprid 20 SP (0.008%) which recorded 0.74 leaf hoppers per leaves followed by imidacloprid 30.5 SL (0.005%) and buprofezin 25 SC (0.05%). Highest leaf hopper population (4.38 leaf hoppers /leaves) was recorded in untreated control whereas, dimethoate 30 EC (0.03%) was noted maximum leaf hopper population among the insecticidal treatments.

Effect of insecticidal treatments on leafhopper population on Bt cotton at Amravati location:

3 days after treatment:

According to data recorded at Amravati location depicted in Table 1, all the treatments showed significant differences over control. Minimum leaf hoppers population *i.e.* 0.29 hoppers /leaves was recorded in the treatment fipronil 5 SC (0.075%) and it was at par with the treatment diafenthiuron 50 WP (0.08%), imidacloprid 30.5 SL (0.005%) and acephate 75SP (0.15%). These treatments are followed by acetamiprid 20 SP (0.008%) and buprofezin 25 SC (0.05%). Untreated control recorded maximum leaf hopper population of 4.37 leaf hoppers/leaves.

7 days after treatment:

The data noted at 7 days after treatment application revealed statistically significant differences among the treatments. Minimum leaf hoppers population (0.20 leaf hoppers /leaves) was observed in the treatment fipronil 5 SC (0.075%) and it was at par with the treatment diafenthiuron 50 WP (0.08%), imidacloprid 30.5 SL (0.005%). Acephate 75SP (0.15%) was the next effective treatment followed by buprofezin 25 SC (0.05%) and acetamiprid 20 SP (0.008%). Maximum leaf hopper population of 4.10 leaf hoppers /leaves was recorded in untreated control.

Effect of insecticidal treatments on leafhopper population on Bt cotton at Yeotmal location:

3 days after treatment:

The data noted at Yeotmal location depicted in Table 1 revealed that all the treatments were found significantly superior over untreated control. Minimum population of leaf hoppers (0.29/leaves) was observed in treatment fipronil 5 SC (0.075%) and it was at par with treatment diafenthiuron 50 WP (0.08%) and imidacloprid 30.5 SL (0.005%) whereas, maximum leaf hopper population (4.58 leaf hoppers /leaves) was recorded in untreated control. Acephate 75SP (0.15%) was next effective treatment followed by buprofezin 25 SC (0.05%) and acetamiprid 20 SP (0.008%).

Table 1: Average population of leaf hoppers after treatment application

Tr. No.	Treatments	Leaf hoppers population at 3 DAT				Leaf hoppers population at 7 DAT			
		AKL	AMT	YTM	Pooled	AKL	AMT	YTM	Pooled
T_1	Imidacloprid 30.5 SL (0.005%)	0.79 (0.89)	0.39 (0.61)	0.50 (0.71)	0.56 (0.74)	0.81 (0.89)	0.33 (0.57)	0.46 (0.67)	0.53 (0.71)
T_2	Fipronil 5 SC (0.075%)	0.31 (0.55)	0.24 (0.49)	0.31 (0.55)	0.29 (0.53)	0.44 (0.65)	0.20 (0.45)	0.25 (0.49)	0.30 (0.53)
T_3	Acetamiprid 20SP (0.008%)	0.69 (0.83)	0.82 (0.90)	0.96 (0.98)	0.82 (0.90)	0.74 (0.85)	0.73 (0.85)	0.83 (0.90)	0.76 (0.87)
T_4	Acephate 75SP (0.15%)	0.58 (0.76)	0.45 (0.66)	0.69 (0.82)	0.57 (0.75)	0.56 (0.74)	0.50 (0.70)	0.56 (0.75)	0.54 (0.72)
T_5	Diafenthiuron 50WP (0.08%)	0.35 (0.59)	0.33 (0.57)	0.35 (0.58)	0.34 (0.58)	0.35 (0.59)	0.22 (0.47)	0.29 (0.52)	0.29 (0.53)
T_6	Buprofezin 25SC (0.05%)	0.96 (0.98)	0.85 (0.92)	0.79 (0.89)	0.87 (0.94)	0.96 (0.98)	0.52 (0.72)	0.61 (0.77)	0.70 (0.81)
T_7	Triazophos 40 EC (0.16%)	1.26 (1.12)	1.83 (1.35)	1.33 (1.15)	1.47 (1.21)	1.29 (1.14)	1.61 (1.27)	1.26 (1.12)	1.39 (1.18)
T_8	Azadirachtin 10000 PPM (1%)	1.48 (1.21)	2.24 (1.49)	1.56 (1.25)	1.76 (1.32)	1.55 (1.24)	1.81 (1.34)	1.52 (1.23)	1.63 (1.27)
T_9	Dimethoate 30 EC (0.03%)	1.65 (1.28)	2.43 (1.55)	1.67 (1.29)	1.92 (1.38)	1.64 (1.28)	1.94 (1.39)	1.63 (1.27)	1.73 (1.31)
T_{10}	Control	4.58 (2.14)	4.37 (2.09)	4.58 (2.13)	4.51 (2.12)	4.38 (2.09)	4.10 (1.99)	4.11 (2.02)	4.20 (2.04)
	F test	Sig	Sig	Sig	Sig	Sig	Sig	Sig	Sig
	S.E. (m)±	0.05	0.07	0.07	0.03	0.05	0.08	0.07	0.02
	C.D. (P=0.05)	0.15	0.21	0.21	0.10	0.15	0.23	0.22	0.07
	CV	8.33	11.26	11.14	8.72	9.40	13.71	12.86	10.72

AKL :Cotton Research Unit, Dr. PDKV, Akola, AMT: Regional Research Center, Amravati,
YTM: Zonal Agriculture Research Station, Yeotmal Figures in parenthsis are square root transformed values.

7 days after treatment :

As per the data depicted in Table 1, it was observed that all the treatments were showed significant differences. Minimum population of leaf hoppers *i.e.* 0.20 leaf hoppers /leaves were recorded in treatment fipronil 5 SC (0.075%) followed by diafenthiuron 50 WP (0.08%) and imidacloprid 30.5 SL (0.005%) which were on par with each other. Next effective treatment was acephate 75SP (0.15%) which followed by buprofezin 25 SC (0.05%) and acetamiprid 20 SP (0.008%). Untreated control recorded maximum leaf hopper population of 4.11 leaf hoppers /leaves.

Pooled of three locations:

As per the pooled data of three research stations, minimum population of leaf hoppers (0.29leaf hoppers / leaves) was observed in treatment fipronil 5 SC (0.075%) and it was at par with treatment diafenthiuron 50 WP (0.08%) after 3 days of insecticidal spray. Next effective treatment was imidacloprid 30.5 SL (0.005%) followed by Acephate 75SP (0.15%). Among the insecticidal treatments maximum leaf hopper population of 1.92 leaf hoppers /leaves was observed in dimethoate 30 EC (0.03%) treatment whereas overall untreated control recorded the highest leaf hopper population (4.51 leaf hoppers /leaves).

However, at 7 days after treatment, similar trend was observed where fipronil 5 SC (0.075%) recorded the minimum population of leaf hoppers (0.30 leaf hoppers /leaves) and it was at par with treatment diafenthiuron 50 WP (0.08%). Next effective treatment was imidacloprid 30.5 SL (0.005%) followed by acephate 75SP (0.15%). Among the insecticidal treatments dimethoate 30 EC (0.03%), azadirachtin 1000 PPM (1%) and triazophos 40 EC (0.16%) were the least effective treatments recording 1.73, 1.63 and 1.39 leaf hoppers / leaves, respectively. Untreated control recorded the highest leaf hopper population of 4.20 leaf hoppers / leaves.

Predators:

Data regarding predator's population showed non

Table 2: Average population of predators after treatment application

Tr. No.	Treatments	Predators population at 3 DAT				Predators population at 7 DAT			
		AKL	AMT	YTM	Pooled	AKL	AMT	YTM	Pooled
T_1	Imidacloprid 30.5 SL (0.005%)	0.16 (0.39)	0.13 (0.36)	0.18 (0.42)	0.16 (0.39)	0.21 (0.46)	0.27 (0.51)	0.28 (0.52)	0.25 (0.50)
T_2	Fipronil 5 SC (0.075%)	0.17 (0.41)	0.12 (0.34)	0.16 (0.39)	0.15 (0.38)	0.28 (0.52)	0.20 (0.44)	0.25 (0.50)	0.24 (0.48)
T_3	Acetamiprid 20SP (0.008%)	0.19 (0.43)	0.08 (0.29)	0.18 (0.42)	0.15 (0.38)	0.28 (0.53)	0.17 (0.40)	0.21 (0.46)	0.22 (0.47)
T_4	Acephate 75SP (0.15%)	0.19 (0.44)	0.20 (0.44)	0.21 (0.45)	0.20 (0.44)	0.26 (0.51)	0.10 (0.32)	0.25 (0.50)	0.20 (0.44)
T_5	Diafenthiuron 50WP (0.08%)	0.21 (0.45)	0.18 (0.42)	0.27 (0.52)	0.22 (0.46)	0.34 (0.59)	0.23 (0.47)	0.31 (0.55)	0.29 (0.53)
T_6	Buprofezin 25SC (0.05%)	0.16 (0.39)	0.12 (0.34)	0.18 (0.42)	0.15 (0.38)	0.46 (0.67)	0.33 (0.58)	0.48 (0.69)	0.42 (0.64)
T_7	Triazophos 40 EC (0.16%)	0.16 (0.39)	0.22 (0.46)	0.17 (0.41)	0.18 (0.43)	0.38 (0.62)	0.17 (0.40)	0.34 (0.58)	0.30 (0.55)
T_8	Azadirachtin 10000 PPM (1%)	0.14 (0.37)	0.18 (0.43)	0.14 (0.37)	0.15 (0.38)	0.27 (0.51)	0.20 (0.44)	0.28 (0.53)	0.25 (0.50)
T_9	Dimethoate 30 EC (0.03%)	0.16 (0.40)	0.23 (0.48)	0.18 (0.43)	0.19 (0.44)	0.23 (0.47)	0.20 (0.44)	0.21 (0.45)	0.21 (0.45)
T_{10}	Control	0.17 (0.41)	0.45 (0.67)	0.18 (0.43)	0.27 (0.52)	0.36 (0.59)	0.43 (0.65)	0.38 (0.61)	0.39 (0.62)
	F test	NS	Sig	NS	Sig	Sig	Sig	Sig	Sig
	SE (m) ±	-	0.028	-	0.027	0.037	0.052	0.04	0.036
	C.D. (P=0.05)	-	0.085	-	0.081	0.111	0.155	0.12	0.108
	CV	18.68	11.63	9.49	11.99	11.79	19.44	11.20	15.3

AKL :Cotton Research Unit, Dr. PDKV, Akola, AMT: Regional Research Center, Amravati
YTM: Zonal Agriculture Research Station, Yeotmal Figures in parenthsis are $\sqrt{x+0.5}$ transformed values.

significant results at Akola and Yavatmal center whereas Amravati center showed significant results at 3 DAT whereas Akola, Amravati and Yeotmal recorded significant reaction at 7 DAT. Pooled data from three locations at 7 DAT showed that maximum predator population was recorded in untreated control plot. The results revealed that all the insecticidal treatments were at par with each other did not showed any detrimental effect on predator's population (Table 2).

Yield:

Highest seed cotton yield was recorded in application of the treatment fipronil 5 SC (0.075%), diafenthiuron 50 WP (0.08%) and imidacloprid 30.5 SL (0.005%) with 17.263, 16.824 and 16.465 quintal per hectar, respectively. The next best treatments are buprofezin 25 SC (0.05%) and acephate 75 SP (0.15%). The lowest yield of 7.299 quintal per hectar was observed in untreated control plot (Table 3).

Net profit and ICBR :

Among the insecticidal treatments highest monetary returns was observed in the application of treatment fipronil 5 SC (0.075%) *i.e.* Rs. 35,094 per ha followed by imidacloprid 30.5 SL (0.005%) (Rs. 32,579 per ha) and diafenthiuron 50 WP (0.08%) (Rs. 30,396 per ha) whereas in terms of higher incremental cost benefit ratio, imidacloprid 30.5 SL (0.005%) (1: 10.3) was found superior followed by fipronil 5 SC (0.075%) (1: 9.3), acetamiprid 20 SP (0.008%) (1: 6.7) and acephate 75 SP (0.15%) (1: 5.5). Lowest ICBR of 1:0.4 was observed in the treatment of dimethoate 30 EC (0.03%) (Table 3).

Present studies on management of cotton leaf hopper, *A. biguttula bigutulla* are in confirmation with the work of Patil *et al*. (2009) who reported that Fipronil 5 per cent SC @ 800g/ha registered least number of leaf hoppers, aphids and thrips and harvested significantly highest seed cotton yield proving them to be at par with acetamiprid 20 SP. Raghuramn *et al*. (2008) reported

Table 3: Yield and ICBR for treatments

Tr. No.	Treatments	Pooled yield (q/ha)	Increase in yield over control (q/ha)	Cost of increased yield (Rs.)	Plant protection cost (Rs./ha)	Net profit (Rs./ha)	ICBR
T_1	Imidacloprid 30.5 SL (0.005%)	16.465	9.166	35748	3169	32579	1 : 10.3
T_2	Fipronil 5 SC (0.075%)	17.263	9.964	38859	3765	35094	1 : 9.3
T_3	Acetamiprid 20SP (0.008%)	11.980	4.681	18255	2364	15891	1 : 6.7
T_4	Acephate 75SP (0.15%)	12.442	5.143	20058	3105	16953	1 : 5.5
T_5	Diafenthiuron 50WP (0.08%)	16.824	9.525	37146	6750	30396	1 : 4.5
T_6	Buprofezin 25SC (0.05%)	13.464	6.165	24044	4680	19364	1 : 4.1
T_7	Triazophos 40 EC (0.16%)	10.233	2.934	11444	3900	7544	1 :1.9
T_8	Azadirachtin 10000 PPM (1%)	8.888	1.589	6197	2520	3677	1 : 1.5
T_9	Dimethoate 30 EC (0.03%)	8.363	1.065	4152	3039	1113	1 : 0.4
T_{10}	Control	7.299	-	-	-	-	-
	F test	Sig					
	S.E. (m) $\pm$	0.689					
	C.D. (P=0.05)	2.048					
	CV	16.79					

- Standard spray volume - 500 lit of water/ha.
- Labour charges for spraying - 5 labour per ha @ Rs. 120 per day for spraying.
- 3 Knapsack spray pump rent - @ Rs. 25/day = 75 Rs./ha
- Av. Market price of Cotton - @ Rs. 3900 per quintal (MSP 2013)
- Imidacloprid 30.5 SL @ Rs. 1490 / lit.
- Fipronil 5 SC @ Rs. 840 / lit.
- Acetamiprid 20 SP @ Rs. 940 /kg
- Acephate 75 SP @ Rs. 410 /kg
- Diafenthiuron 50 WP @ Rs. 2200/kg
- Buprofezin 25 SC @ Rs. 1200/ lit.
- Triazophos 40 EC @ Rs. 350 / lit.
- Azadirachtin 10000 PPM @ Rs. 480/lit.
- Dimethoate 30 EC @ Rs. 250/ lit.

that, efficacy of acetamiprid 20 per cent SP at three doses (20, 40, 80 g a.i./ha) against jassids upto nine days. Similarly, Singh *et al*. (2002) and Sinha *et al*. (2007) reported that Fipronil @ 50 g ai/ha at fortnightly interval was found to be the best treatment against the leafhoppers. Shashikant *et al*. (2010) reported the new formulation of imidacloprid (Confidor 350 SC) @ 26.25 q a.i./ha was found to be superior in reducing the population of jassids from 3.09 to 0.9. Choudhary *et al*. (2005) noticed that, three foliar sprays of imidacloprid (Confidor) 17.8 SL offered very good protection against sucking pests of cotton. The reports on the bioefficacy of the nicotineoides molecules *viz*., imidacloprid, thiomethoxam and acetamiprid in spray and seed dressing formulation against sucking pests of cotton and other crops has been well proved (Vastrad, 2003, Patil and Rajanikanth, 2004). So, the present findings clearly indicated that application of neonecotinide new formulation imidacloprid 30.5 SL (0.005%) @ 1.64 ml and fipronil 5 SC (0.075%) @ 15 ml in 10 liters of water were found more effective in terms of management of leaf hoppers on Bt cotton and should be included in IPM of sucking pests Bt cotton as a promising component.

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