Field efficacy of various insecticides against major sucking pests of *Bt* cotton

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ABSTRACT

Ten insecticides were evaluated against major sucking pests infesting the *Bt* cotton. Among them five were of bio-pesticides (Neem oil 1.0 %, NSKE (Neem seed kernel extract) 5.0 %, Azadirachtin 0.0009 %, *Verticillium lecanii* (Zimmermann) @ 2.5 kg/ha and *Beauveria bassiana* (Balsamo.) @ 2.5 kg/ha) and five were chemical pesticides (Acetamiprid 0.004 %, Thiamethoxam 0.01 %, Imidacloprid 0.0089 %, Dinotefuran 0.008 % and Flonicamid 0.02 %) at KVK farm, JAU, Targhadia (Rajkot) during *Kharif*, 2012-13. The result on the field efficacy of newer insecticides against major sucking pests of *Bt* cotton (G Cot Hy 6 BG II) showed that the chemical pesticides caused higher mortality, while bio-pesticides caused moderate to lower mortality of sucking pests. Among the insecticidal treatments, flonicamid 0.02 per cent was found more effective against all major sucking pests, acetamiprid 0.004 per cent against aphid and whitefly, dinotefuran 0.008 per cent and imidacloprid 0.0089 per cent against jassid and thiamethoxam 0.01 per cent were found effective against thrips on *Bt* cotton. Among the bio-pesticides, neem oil 1.0 per cent, *V. lecanii* @ 2.5 kg/ha and azadirachtin 0.0009 per cent were found moderate effective against major sucking pests of *Bt* cotton. In case of toxicity of insecticides on predators (Coccinellids and *Chrysoperla*) of sucking pests, all the bio-pesticides were found safer to predators, while chemical pesticides were found moderate to higher toxic to predators on *Bt* cotton.

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INTRODUCTION

Cotton, known as "White Gold", is the premier commercial crop in India. Among the different constraints that limit the yield of cotton in India, insect pests are considered to be the most serious. Among the various insect pests listed by Davidson and Lyon (1978), aphid, jassid, thrips and whitefly are the major sucking pests of *Bt* cotton and limiting the profitable cultivation. The severe infestation of sucking pests resulted in the yellowing of leaves which inhibit the growth and development of plant and ultimately the plant dried up due to loss of cell sap. However, sucking insect pests causes damage throughout the crop period with considerable losses in yield. Dhawan and Sidhu (1986) estimated yield loss in cotton due to sucking pests' upto 21.2 per cent. While, Chavan *et al.* (2010) reported 28.13 per cent avoidable yield loss due to major sucking pests in cotton. Though Bt cotton has been found successful in the management of bollworms, however, it has invited other insect pests especially sucking pests due to reduction in pesticide sprays at early stage (Jeyakumar *et al*., 2008). Recently due to the increasing development of resistance to old and traditional insecticides, intensive research have been carried out for evaluating new insecticides with novel mode of action against sucking insects, with minimum hazards for mammals and natural enemies (Lobna T. M. Zidan, 2012). Farmers use more and more insecticide/pesticide to control sucking insect pests and due to this, more toxic effect is found on natural enemies and so also on environment, hence attempts were made to study the field efficacy of various insecticides against major sucking pests of *Bt* cotton.

MATERIALS AND METHODS

A field experiment was conducted to evaluate the relative efficacy of ten insecticides (five each biopesticides and chemical pesticides) against major sucking pests of *Bt* cotton at KVK Farm, Junagadh Agricultural University, Targhadia

(Rajkot) during *Kharif*, 2012-13, in randomized block design with eleven treatments of three replications. The cotton variety G Cot Hy 6 (BG II) was dibbled at 120 cm x 45 cm spacing. The gross plot size was 6.0 m x 4.5 m and net plot size was 3.6 m x 2.7 m. All the recommended package of practices were followed to raise the good crop. Two applications of the insecticides at 20 days interval were given when sufficient population of sucking pests (above ETL) developed on the crop. Five plants were randomly selected from each net plot and tagged for recording the observations. The number of major sucking pests per three leaves per five plants and predator/plant was recorded at 24 hrs before each insecticidal application and 3, 7 and 15 day after each spray was pooled and average population was calculated. Corrected per cent mortality of each sucking pest in each treatment was calculated by using the formula given by Abbott (1925) and modified by Henderson and Tilton (1955) and the data were analyzed statistically. The data on corrected per cent mortality were subjected to angular transformation before statistical analysis. The yield of seed cotton was recorded from each plot and economics of each insecticide was worked out.

RESULTS AND DISCUSSION

A perusal of the data presented in Table 1 revealed that significant difference in mortality of aphid was found due to insecticidal treatments after 3, 7 and 15 days of their applications. The treatments with flonicamid caused significantly maximum mortality of aphid after 3, 7 and 15 days of their applications and it was statistically at par with treatments of acetamiprid and thiamethoxam after 3 days of the application. The treatment of acetamiprid was statistically at par with flonicamid after 7 days of the application. In case of bio-pesticides, Neem oil and azadirachtin was effective treatments after 3 days of the application. Neem oil was effective treatment after 7 days of the application. *V. lecanii* @ 2.5 kg/ha and *B. bassiana* @ 2.5 kg/ha) were effective treatments after 15 days of the application.

Flonicamid and dinotefuran were newer chemicals; therefore research reviews were not available in literature on their effectiveness against aphid on *Bt* cotton. Kolhe *et al*. (2009) reported that acetamiprid 0.003 per cent and thiamethoxam 0.008 per cent were the most effective against aphid on cotton. The biopesticides (botanical and microbial) were less effective over the chemical pesticides. Neem oil 1.0 per cent showed 63 per cent reduction of aphid on okra which was reported by Bhavani Sankara Rao *et al*. (1991). However more than 70 per cent reduction of aphid with treatment of imidacloprid @ 0.3 ml/litre, followed by *V. lecanii* @ 5.0 g/litre, *B. bassiana* @ 5.0 g/litre and Azadirachtin 1500 ppm @ 4 ml/litre with 50 to 70 per cent reduction of aphid, *A. gossypii* was reported by Ghelani *et al.* (2006). These findings matched more or less with the present findings.

A perusal of the data presented in Table 1 revealed that significant difference in mortality of jassid was found due to insecticidal treatments after 3, 7 and 15 days of their applications. After 3 days of application, flonicamid caused significantly maximum mortality of jassid and it was statistically at par with dinotefuran and imidacloprid. After 7 days of application, dinotefuran caused significantly maximum mortality of jassid and it was statistically at par with flonicamid. After 15 days of application, flonicamid caused significantly maximum mortality of jassid and it was statistically at par with dinotefuran. In case of bio-pesticides, NSKE (5.0 per cent) and Neem oil were effective treatments after 3 days of application. *V. lecanii* @ 2.5 kg/ha was effective treatment after 7 and 15 days of the application.

Foliar spray of thiamethoxam 25 WS @ 24 gm/acre and imidacloprid 17.8 SL @ 250 ml/acre against cotton jassid was found effective up to 7 days after the spray was examined by Saleem *et al*. (2001). Two sprays of NSKE on cotton at 38 and 60 DAS reduced the sucking pests (aphid, jassid, thrips and whitefly) of cotton which was recorded by Hanumantharaya *et al.* (2008). These findings confirm the results of present study.

A perusal of the data presented in Table 2 revealed that significant difference in mortality of thrips was found due to insecticidal treatments after 3, 7 and 15 days of their applications. After 3, 7 and 15 days of application, flonicamid caused significantly maximum mortality of thrips. Imidacloprid and thiamethoxam were statistically at par with flonicamid after 3 days of application. After 7 days of application, thiamethoxam was statistically at par with flonicamid. In case of bio-pesticides,

Table 1. Average per cent mortality of major sucking pests of *Bt* cotton during *Kharif* -2012-13

Treatments	Per cent mortality of aphid			Per cent mortality of jassid		
	3 DAS	7 DAS	15 DAS	3 DAS	7 DAS	15 DAS
Neem oil (1.0 %)	48.2	45.5	37.7	46.1	42.5	38.5
NSKE (5.0 %)	42.29	40.34	31.8	46.3	45.5	41.6
Azadirachtin 1500 ppm (0.0009 %)	45.00	41.81	33.2	41.9	42.7	40.4
V. lecanii @ 2.5 kg/ha	37.67	41.94	48.2	38.8	50.2	50.3
B. bassiana @ 2.5 kg/ha	34.84	41.31	44.6	35.2	45.5	42.7
Acetamiprid 20 SP (0.004 %)	74.40	69.38	50.5	66.5	63.3	52.2
Thiamethoxam 25 WG (0.01 %)	71.35	63.41	43.2	67.7	65.5	52.7
Imidacloprid 17.8 SL (0.0089 %)	62.33	58.69	43.2	71.9	66.9	55.1
Dinotefuran 20 SG (0.008 %)	61.77	61.33	51.3	78.4	72.9	60.1
Flonicamid 50 WG (0.02 %)	74.70	69.69	57.8	78.4	72.8	61.9
S.Em. ±	2.20	2.11	1.91	2.33	2.12	2.43
C.D. at 5%	6.32	6.03	5.49	6.69	6.08	6.99
C. V. %	9.76	9.64	10.6	9.99	9.14	12.0

DAS= Days after spraying

azadirachtin and Neem oil were effective treatments after 3 days of the application. *V. lecanii* @ 2.5 kg/ha was effective treatment after 7 and 15 days of the application. Foliar spray of thiamethoxam 0.008 per cent and imidacloprid 0.003 per cent were found effective against thrips on cotton and imidacloprid was found up to 7 days after the spray was recorded by Saleem *et al*. (2001). Lower population of thrips per leaf of cotton by neem oil 0.5 per cent compared to untreated check was recorded by Natarajan *et al. (*1991). Kapadia *et al.* (2009) recorded the highest mortality with *V. lecanii* @ 7 g/l, followed by *B. bassiana* @ 8 g/l, *V. lecanii* @ 6 g/l, *B. bassiana* @ 7 g/l and *V. lecanii* @ 5 g/l against *Thrips tabaci* Lindeman infesting garlic. The results also indicated that the mortality of thrips was comparatively higher in the treatment of *V. lecanii* as compared to *B. bassiana*. A perusal of the data presented in Table 2 revealed that significant difference in mortality of whitefly was found due to insecticidal treatments after 3, 7 and 15 days of their applications. After 3 days of application, acetamiprid caused significantly maximum mortality of whitefly and it was statistically at par with imidacloprid and flonicamid. After 7 days of application, flonicamid caused significantly maximum mortality of whitefly and it was statistically at par with acetamiprid and imidacloprid. After 15 days of application, acetamiprid caused significantly maximum mortality of whitefly and it was statistically at par with flonicamid (0.02 per cent) and imidacloprid. In case of bio-pesticides, NSKE and azadirachtin were effective treatments after 3 days of the application. *B. bassiana* @ 2.5 kg/ha was effective treatment after 7 and 15 days of application.

Six sprays of acetamiprid 0.003 per cent were effective in reducing whitefly population in cotton as reported by Ulaganathan and Gupta (2004). These findings matched more or less with the present findings. The bio-pesticides (botanical and microbial) were less effective than the chemical pesticides. NSKE 5.0 per cent and neem oil 5.0 per cent caused 93.7 and 90.3 per cent mortality of nymphal stage of *B. tabaci* respectively and were found effective up to 7 days of spraying as reported by Jayaraj *et al*. (1986).

Effect of various insecticides (Table 3) on field population of natural enemies of cotton sucking pests revealed that the treatments with bio-pesticides *viz.*, Neem oil 1.0 per cent, NSKE 5.0 per cent, azadirachtin 0.0009 per cent, *V. lecanii* and *B. bassiana* @ 2.5 kg/ha were found safer against Coccinellid and *Chrysoperla* because population of the Coccinellid and *Chrysoperla* was not reduced after their application in the cotton field.

The treatments with chemical pesticides *viz.*, flonicamid 0.02 per cent, imidacloprid 0.0089 per cent and acetamiprid 0.004 per cent were found moderately safer against population of Coccinellid and *Chrysoperla* at 3, 7 and 15 DAS during both sprays and were statistically at par with each other, while the treatments *viz.*, dinotefuran and thiamethoxam were found with lower population of Coccinellid and *Chrysoperla* at 3, 7 and 15 DAS during both sprays which indicated toxic effect on the predator. Anitha (2007) studied the effect of botanicals and mycopathogens against coccinellid and *Chrysoperla* predator of okra sucking pests and revealed that the treatment neem oil 2.0 per cent, NSKE 5.0 per cent, azadirachtin and *V. lecanii*

were found safer against population of Coccinellid and *Chrysoperla* because predator population in all these treatments was found at par with control. These findings matched more or less with the present findings.

The data on yield and economics revealed that significantly higher yield of seed cotton was recorded in the treatments with flonicamid 0.02 per cent and acetamiprid 0.004 per cent followed by imidacloprid 0.0089 per cent, dinotefuran 0.008 per cent and thiamethoxam 0.01 per cent. Further, it was also observed that acetamiprid 0.004 per cent was found most economic insecticidal treatment with C:B ratio of 1:42.59 followed by imidacloprid 0.0089 per cent, thiamethoxam 0.01 per cent and flonicamid 0.02 per cent for the control of major sucking pests of *Bt* cotton with high net return and C: B ratio.

However, it was reported that the foliar spraying of acetamiprid @ 15 gm a.i./ha gave the highest seed cotton yield with 21.68 per cent yield loss against the population of sucking pests (Anon, 1999-2000). Lavekar *et al.* (2004) reported that cotton sprayed with imidacloprid 200 SL reduced sucking pests population and gave the highest seed yield of 1651 kg/ha.

Table 2. Average per cent mortality of major sucking pests of *Bt* cotton during *Kharif* -2012-13

Treatments	Per cent mortality of thrips			Per cent mortality of whitefly		
	3 DAS**	7 DAS	15 DAS	3 DAS**	7 DAS	15 DAS
Neem oil (1.0 %)	45.75*	45.91	41.10	41.66*	44.33	42.63
NSKE (5.0 %)	41.07	42.14	38.75	46.48	45.71	42.46
Azadirachtin 1500 ppm (0.0009 %)	45.94	47.28	41.15	42.89	43.30	40.79
V. lecanii @ 2.5 kg/ha	39.06	51.28	45.56	35.54	44.10	40.79
B. bassiana @ 2.5 kg/ha	36.48	45.77	39.89	38.89	50.60	47.09
Acetamiprid 20 SP (0.004 %)	65.92	67.57	55.65	74.84	69.83	65.96
Thiamethoxam 25 WG (0.01 %)	68.95	72.17	60.24	64.85	62.76	56.33
Imidacloprid 17.8 SL (0.0089 %)	69.16	66.38	59.90	71.12	66.17	61.79
Dinotefuran 20 SG (0.008 %)	66.04	67.74	62.96	66.15	63.06	61.07
Flonicamid 50 WG (0.02 %)	73.76	74.33	68.83	71.04	71.47	65.43
S.Em. $\pm$	2.38	2.21	2.22	2.37	2.26	2.01
C.D. at 5%	6.84	6.33	6.38	6.80	6.49	5.77
C. V. %	10.58	9.30	10.59	10.49	9.87	9.38

DAS= Days after spraying

Table 3. Effect of various insecticides on field population of Coccinellids and *Chrysoperla* (Average of two sprays) on *Bt* cotton during *Kharif* -2012-13.

Treatments	No. of Coccinellids/ plant				No. of *Chrysoperla*/ plant			
	1 DBS*	3 DAS**	7 DAS	15 DAS	1 DBS*	3 DAS**	7 DAS	15 DAS
Neem oil 1.0 %	1.83	1.80	1.89	1.99	1.05	1.02	1.07	1.12
NSKE 5.0 %	1.80	1.79	1.84	1.94	1.07	1.05	1.08	1.14
Azadirachtin 0.0009 %	1.79	1.77	1.87	1.96	1.10	1.07	1.10	1.17
V. lecanii @ 2.5 kg/ha	1.77	1.77	1.90	1.97	0.98	0.95	1.01	1.13
B. bassiana @ 2.5 kg/ha	1.80	1.79	1.88	2.00	1.02	1.01	1.04	1.14
Acetamiprid 0.004 %	1.75	1.09	1.15	1.45	1.08	0.60	0.69	0.75
Thiamethoxam 0.01 %	1.81	0.96	0.89	1.32	0.99	0.45	0.50	0.59
Imidacloprid 0.0089 %	1.76	1.20	1.34	1.55	1.00	0.66	0.68	0.80
Dinotefuran 0.008 %	1.76	0.79	0.92	1.30	1.08	0.40	0.52	0.58
Flonicamid 0.02 %	1.80	1.23	1.29	1.59	1.03	0.75	0.80	0.90
Control	1.84	1.85	1.91	2.01	1.10	1.14	1.19	1.26
S.Em. $\pm$	0.03	0.09	0.08	0.06	0.08	0.07	0.06	0.09
C.D. at 5%	NS***	0.27	0.25	0.18	NS***	0.20	0.18	0.27
C. V. %	3.05	10.73	9.56	6.2	12.6	14.24	11.69	16.58

*DBS= Day before spraying, **DAS= Days after spraying and ***NS= Non-significant

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