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Efficacy of newer insecticides against aphids (*Aphis gossypii* Glover) in Bt cotton

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Abstract

Nine newer insecticides were evaluated against cotton aphids, *Aphis gossypii* during Kharif 2018 and 2019. The results revealed that all the insecticidal treatments were significantly effective against aphids over control. The results indicated that among all insecticides clothianidin 50 WDG, diafenthiuron 50 WP and thiamethoxam 25 WG was found most effective in reducing aphid population whereas lambda cyhalothrin 5 EC was found less effective in controlling aphid population.

Keywords: Efficacy, aphids, *Aphis gossypii*, Bt cotton, insecticides, clothianidin, diafenthiuron, thiamethoxam

Introduction

Cotton popularly known as one of the most important commercial cash and fiber crop of global significance cultivated in more than seventy countries with an enormous potential of employment generation both in rural and urban sectors (Singh, 2018) [9]. It is important cash crop grown in India and plays a vital role in agricultural, industrial, social and monetary affairs of the country. In India, it is cultivated on 124.44 lakh ha with a production of 370 lakh bales and the average productivity is 524 kg lint per ha (Anonymous, 2019) [1]. The major biotic constraint in attainment of desired productivity levels in Bt cotton production due to the sucking pests, aphid (*Aphis gossypii* G.) is of regular occurrence on non-Bt as well as the Bt cotton. Aphid cause decreased fiber quality as a result of stickiness and the development of sooty mould associated with honeydew dropped onto cotton fibers (Isely, 1946) [6]. Among the arthropod pests, sucking insect viz., jassids, *Amrasca biguttula biguttula* (Ishida); whiteflies, *Bemisia tabaci* (Genn.); aphids, *Aphis gossypii* (Glover) and thrips, *Thrips tabaci* (Linn.) are the serious pests and cause losses in tune of 21.20 to 22.86 per cent (Dhawan *et al.*, 1998) [4]. Cotton growers in India depend heavily on synthetic pesticides to combat sucking pests. At least 2-3 sprays are directed against sucking pests. Due to continuous and indiscriminate use of synthetic insecticides, there is resistance and hence the efficacy has become less reliable. To overcome this problem discovery of novel substances with different biochemical targets are needed. Novel molecules are effective at low doses and have less exposure in the environment. Keeping in mind the potential of these insecticides in management of sucking pests of Bt cotton, the present study was carried out to evaluate the efficacy of newer insecticides for effective management of these insect pests so that these products can be precisely used to develop an effective IPM module in coming future.

Materials and Methods

The field experiment was laid out in a randomized block design at department of Agril. Entomology, VNMKV, Parbhani during Kharif 2018 and 2019 seasons. The experiment consisted of 10 treatments replicated thrice. Nine insecticides viz., clothianidin 50 WDG @ 20 g.a.i./ha, acetamiprid 20 SP @ 20 g.a.i./ha, thiamethoxam 25 WG @ 25 g.a.i./ha, imidacloprid 17.8 SL @ 25 g.a.i./ha, diafenthiuron 50 WP @ 300 g.a.i./ha, buprofezin 25 SC @ 250 g.a.i./ha, spinosad 45 SC @ 73 g.a.i./ha, lambda cyhalothrin 5 EC @ 15 g.a.i./ha and fipronil 5 SC @ 50 g.a.i./ha were tested at different intervals. A cotton hybrid, RCH 659 raised in plots of 4.5 x 3.6 meter with 90 x 60 cm row to row and plant to plant spacing. All agronomic practices were followed as per the recommended package of practices except plant protection to get good crop.

The treatments were imposed when the sucking pest population crossed ETL a total of three sprays were taken up. Observations were recorded a day before and 1, 3, 7 and 14 days after each spray from five randomly selected and tagged plants in each plant three leaves were selected from top, middle and bottom of the plant and expressed as mean number of hopper per three leaves. The data obtained from the different treatments were computed to determine the mean values. The mean values after suitable transformation were subjected to statistical analysis to test significance as per Gomez and Gomez (1984) [5].

Results and Discussion

Pooled data of Kharif 2018 and 2019 after first spray regarding incidence of aphids are presented in Table 1. The pre-treatment count of aphids before initiation of the spray treatments was in the range of 20.31 to 27.83 aphids/3 leaves. The data recorded at 1, 3 and 7 DAS after first spray revealed that clothianidin treated plants showed minimum incidence (3.63, 2.76 and 2.25 aphids/3 leaves, respectively). Diafenthiuron (4.15, 3.14 and 2.31 aphids/3 leaves, respectively) and thiamethoxam (5.79, 4.42 and 2.48 aphids/3 leaves, respectively) were next effective treatments. The data recorded on 14 DAS showed that clothianidin, diafenthiuron, thiamethoxam and spinosad were equally effective statistically. The pooled data of two years indicated that clothianidin (86.20%), diafenthiuron (84.52%) and thiamethoxam (83.28%) were the most effective insecticides for reduction in aphid population which were at par with each other.

The pre-treatment count of aphids before initiation of the second spray treatments was in the range of 20.31 to 27.83 aphids/3 leaves (Table 1). After second spray the data recorded at 1, 3 and 7 DAS revealed that clothianidin treated plants showed minimum incidence (3.63, 2.76 and 2.25 aphids/3 leaves, respectively). Diafenthiuron (4.15, 3.14 and 2.31 aphids/3 leaves, respectively) and thiamethoxam (5.79, 4.42 and 2.48 aphids/3 leaves, respectively) were next effective treatments. The data recorded on 14 DAS showed that clothianidin, diafenthiuron, thiamethoxam and spinosad were equally effective statistically. The pooled data of two years indicated that clothianidin, diafenthiuron and thiamethoxam recorded maximum per cent reduction in aphid population (91.85%, 90.01% and 88.67%, respectively).

The aphid population on untreated plants showed gradual increase from 25.50 to 30.08 aphids/3 leaves during a span of 14 days. After third spray all insecticidal treatments were significantly superior over control in minimizing the pest incidence. The data recorded at 1, 3, 7 and 14 DAS revealed that clothianidin 50 WDG treated plants showed minimum infestation (2.69, 1.33, 1.12 and 7.29 aphids/3 leaves, respectively) followed by diafenthiuron (3.26, 1.69, 1.19 and 8.36 aphids/3 leaves, respectively) and thiamethoxam (3.41, 2.29, 1.35 and 10.89 aphids/3 leaves, respectively) which were statistically at par with each other and significantly superior over other test insecticides. After third spray aphids were most effectively managed by clothianidin (92.42% reduction) followed by diafenthiuron and thiamethoxam (90.86 and 88.78% reduction).

The present results are compared with the reports of earlier researchers on chemical control of Bt cotton aphids (*A. gossypii*) infesting many field crops and are discussed here. Dhandapani *et al.* (2002) [3], documented that seed treatment of cotton with the new insecticides, clothianidin (Poncho 600 FS) at 9 ml/kg seed and imidacloprid (Gaucho 600 FS) at 12 ml/kg seeds, effectively controlled the sucking pests *viz.*, aphids, thrips and leaf hoppers. Patil *et al.* (2014) [8] indicated that increased dose of clothianidin 50% WDG (Dantop) @ 25 g.a.i./ha was quite effective in checking the aphid population in cotton crop. Reports of Kadam *et al.* (2014), emphasized that nitenpyram 10 WSG @ 100 g.a.i./ha, dinotefuran 20 SG @ 50 g a.i./ha and clothianidin 50 WDG @ 20 g.a.i./ha were the most effective treatments in reducing incidence of sucking pests of Bt cotton as compared to acetamiprid 20 SP @ 20 g.a.i./ha, imidacloprid 17.8 SL, thiamethoxam 25 WG @ 25 g.a.i./ha and thiacloprid 21.7 SC @ 30 g.a.i./ha. Bhardwaj *et al.* (2014) [2], documented that imidacloprid 17.8 SL @ 0.008%, acetamiprid 20 SP @ 0.01%, thiamethoxam 25 WG @ 0.0125% and diafenthiuron 50 WP @ 0.05% were found more effective against sucking insect pests infesting Bt cotton and produced higher yield. Whereas, Zala *et al.* (2014) [11], said that diafenthiuron 50 WP @ 300 g.a.i./ha was most effective against major sucking pests in Bt cotton and Surwase *et al.* (2017) [10], indicated that diafenthiuron 50WG @ 300 g.a.i./ha and imidacloprid 17.8 SL @ 25 g.a.i./ha were found most effective in reducing aphid population.

Table 1: Efficacy of newer insecticides against cotton aphid and per cent reduction (Pooled data Kharif 2018 and 2019).

Tr. No.	Treatments	Conc. (%)	No. of aphids/3 leaves																		
			Pre-count	1 st spray				Mean	% Reduction	2 nd spray				Mean	% Reduction	3 rd spray				Mean	% Reduction
				1 DAS	3 DAS	7 DAS	14 DAS			1 DAS	3 DAS	7 DAS	14 DAS			1 DAS	3 DAS	7 DAS	14 DAS		
T ₁	Clothianidin 50 WDG	0.005	27.83 (5.32)	3.63 (2.03)	2.76 (1.81)	2.25 (1.66)	11.33 (3.44)	4.99	86.20	2.69 (1.79)	1.33 (1.35)	1.12 (1.27)	7.29 (2.79)	3.11	91.85	2.13 (1.62)	1.66 (1.47)	1.05 (1.24)	6.73 (2.69)	2.89	92.42
T ₂	Acetamiprid 20 SP	0.002	23.60 (4.91)	7.27 (2.79)	6.94 (2.73)	5.72 (2.49)	17.91 (4.29)	9.46	69.14	5.74 (2.50)	4.75 (2.29)	3.56 (2.01)	13.52 (3.74)	6.89	78.71	5.52 (2.45)	5.39 (2.53)	4.92 (2.33)	12.75 (3.64)	7.15	77.90
T ₃	Thaimethoxam 25 WG	0.005	26.20 (5.17)	5.79 (2.51)	4.42 (2.22)	2.48 (1.72)	12.02 (3.54)	5.69	83.28	3.41 (1.98)	2.29 (1.67)	1.35 (1.36)	10.89 (3.37)	4.07	88.67	3.90 (2.10)	2.36 (1.69)	1.79 (1.51)	8.79 (3.05)	4.03	88.78
T ₄	Imidacloprid 17.8SL	0.004	23.51 (4.90)	7.62 (2.85)	7.16 (2.77)	6.75 (2.69)	18.19 (4.32)	9.93	67.48	6.69 (2.68)	5.12 (2.37)	4.38 (2.21)	14.12 (3.82)	7.58	76.49	6.35 (2.62)	6.25 (2.60)	5.56 (2.46)	13.22 (3.70)	7.85	75.64
T ₅	Diafenthiuron 50 WP	0.06	26.51 (5.20)	4.15 (2.16)	3.14 (1.91)	2.31 (1.67)	11.71 (3.49)	5.33	84.52	3.26 (1.94)	1.69 (1.48)	1.19 (1.30)	8.36 (2.98)	3.63	90.01	2.75 (1.80)	2.11 (1.62)	1.21 (1.31)	7.22 (2.78)	3.32	90.86
T ₆	Buprofezin 25 SC	0.05	23.24 (4.87)	7.76 (2.87)	7.95 (2.91)	8.25 (2.96)	18.83 (4.40)	10.70	64.55	7.25 (2.78)	7.28 (2.79)	5.23 (2.39)	14.25 (3.84)	8.50	73.33	6.89 (2.72)	6.57 (2.66)	6.90 (2.72)	14.09 (3.82)	8.61	72.97
T ₇	Spinosad 45 SC	0.018	25.49 (5.10)	6.30 (2.61)	5.75 (2.50)	4.55 (2.55)	16.57 (4.11)	8.17	75.32	5.11 (2.37)	3.56 (2.01)	2.80 (1.82)	12.15 (3.56)	5.89	83.15	4.29 (2.19)	4.18 (2.16)	3.25 (1.94)	11.08 (3.40)	5.70	83.69
T ₈	Lambda cyhalothrin 5 EC	0.003	20.99 (4.64)	8.91 (3.07)	9.65 (3.19)	12.20 (3.56)	20.72 (4.61)	12.87	52.79	8.19 (2.95)	9.25 (3.12)	10.31 (3.29)	16.64 (4.14)	11.10	61.43	7.72 (2.87)	9.43 (3.15)	10.25 (3.28)	15.25 (3.97)	10.66	62.95
T ₉	Fipronil 5 SC	0.015	24.83 (5.03)	6.99 (2.74)	6.63 (2.67)	5.04 (2.35)	17.28 (4.22)	8.99	72.12	5.33 (2.41)	3.86 (2.09)	3.13 (1.91)	12.54 (3.61)	6.22	81.73	4.88 (2.32)	4.80 (2.30)	4.58 (2.25)	11.54 (3.47)	6.45	81.05
T ₁₀	Untreated control	-	20.31 (4.56)	20.92 (4.63)	27.08 (5.25)	27.91 (5.33)	29.60 (5.49)	26.38	-	25.50 (5.10)	30.08 (5.53)	28.03 (5.34)	27.80 (5.32)	27.85	-	27.10 (5.25)	27.85 (5.32)	28.33 (5.37)	28.09 (5.35)	27.84	-
S.E.±			0.30	0.17	0.22	0.19	0.22	-	-	0.18	0.15	0.12	0.21	-	-	0.15	0.17	0.16	0.22	-	-
C.D. at 5%			NS	0.54	0.66	0.58	0.68	-	-	0.56	0.47	0.38	0.66	-	-	0.46	0.52	0.51	0.69	-	-
C.V.			11.09	10.76	13.42	12.17	9.18	-	-	11.90	10.71	9.28	9.99	-	-	10.03	11.52	11.71	10.86	-	-

Figures in parentheses are $\sqrt{x + 0.5}$ transformed values

DAS: Days after Spray

NS: Non Significant

Conclusion

Cotton remains a vital cash crop globally, especially in India, where its cultivation supports both the agricultural and industrial sectors. Sucking pests, particularly aphids, pose a significant challenge to achieving optimal productivity, especially in Bt cotton. The study demonstrated that among the tested insecticides, clothianidin, diafenthiuron, and thiamethoxam were highly effective in managing aphid populations, with clothianidin showing the highest reduction. The findings highlight the importance of incorporating novel insecticides with different biochemical targets into integrated pest management (IPM) strategies. These results provide valuable insights for developing effective IPM modules for sustainable cotton cultivation and pest management in the future.

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