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BIO-EFFICACY OF SOME NEWER INSECTICIDES AGAINST WHITEFLY, *BEMISIA TABACI (GENNADIUS)* AND THRIPS, *SCIRTOTHRIPS DORSALIS* (HOOD) INFESTING BT COTTON

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ABSTRACT
Field experiments were conducted at the District Seed Farm (A B - Block farm), Kalyani, Nadia, West Bengal during rabi season 2016-2017 and 2017-18 to evaluate the effectiveness some newer insecticides developed by different companies against cotton Whitefly and Thrips. Experiments were laid out in randomized block design (RBD) with nine treatments and three replications. The experimental data revealed that The treatment Diafenthiuron+ Acetamiprid in three different doses viz. 400, 500, 600g/ha was effective in suppressing whitefly population. The highest mortality (83.05%) of whitefly population was noticed from the treatment Diafenthiuron+ Acetamiprid @ 600g/ha which is statistically at par with Diafenthiuron+ Acetamiprid @ 500g/ha (81.89%) after 3 days of spraying. For the management of thrips, the treatment Diafenthiuron+ Acetamiprid @ 600g/ha and Diafenthiuron+ Acetamiprid @ 500g/ha was registered maximum thrips mortality of 72.01 % and 67.97 % respectively. From the study it was inferred that the combined insecticide Diafenthuron+ Acetamiprid @ 600g/ha was most effective in controlling the sucking pests such as Whitefly and thrips in cotton.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is the "King of Fiber" popularly known as "White Gold", an important cash crop in India and being the principal material for flourishing textile industries. Cotton comes under Family Malvaceae, and Tribe Gossypieae (Smith 1995). India occupies first place in area and second in production on global basis after China. However, the area under Bt cotton in India reached 7.6 million ha. in 2008-2009 (APCoAB,2009). Among the various causes of low productivity of cotton in India, the insect pests is one of the major and burning concern. About 200 insect pests are reported to attack cotton crop in India. The transgenic cotton showed great resistance against all the borer pests both under field and laboratory conditions (Kranthi and Kranthi, 2004). It can effectively control specific lepidoptera species, but lack of resistance against sucking insect pests (Hofs *et al.,* 2004; Sharma and Pampapthy, 2006). Amongst several factors responsible for low productivity due to the sucking pests, thrip (*Thrips tabaci,* Linn.) and whitefly (*Bemisia tabaci,* Genn.) are of regular occurrence on non-Bt as well as in Bt cotton. Cotton Whitefly and thrips are an alarming pest. Use of heavy doses of insecticides against leafhopper has revealed resistance against endosulfan, monocrotophos, phosphamidon and cypermethrin (Chalam and Subbaratanam, 1999). A moderate to high level of resistance against the neonicotinoids *viz.*, imidacloprid and acetamiprid (Kshirsagar *et al.,* 2012) has also been evidenced in Whitefly. cotton whitefly (*Bemisia tabaci,* Genn.) whose population is increasing in last ten years. Late season populations can cause decreased fiber quality as a result of stickiness and the development of sooty mould associated with honeydew dropped onto cotton fibers (Isely, 1946). The control failures might have been aggravated due to the development of resistance in the pest also. Bt cottons has been experienced that reduction in usage of insecticides lead to increased population of sucking insect pests (Men *et al.*, 2005). In the absence of transgenic genes targeting sucking pests, the cotton growers heavily depend on synthetic pesticides in India. At least 2-3 sprays are directed against sucking pests. Even with three rounds of protection sucking pests have caused 16% yield loss in Bt cotton in Punjab (Shera, 2012).

Novel insecticides including growth regulators and neonicotinoids proved most effective as compared with conventional insecticides on Bt cotton against cotton white fly, so far these insecticides are considered less toxic to the predators of sucking insects pests (Aheer *et al.*, 2000; Aslam *et al.*, 2004; Solangi and Lohar, 2007; Asi *et al.*, 2008; Frank, 2012). The neonicotinoids are a new class of insecticides, which includes the commercial products imidacloprid, acetamiprid, thiacloprid and thiamethoxam. These insecticides are important to agriculture because of their activity against sucking insects (Iwasa *et al.*, 2004; Anikwe *et al.*, 2009; Zhang *et al.*, 2011; Carvalho *et al.*, 2010).

Bt cotton is specially developed for the bollworms but sucking pests are emerging as prime insect pests causing severe losses in yield. Hence it is necessary to reduce the losses caused by sucking pests with suitable chemical control methods for sucking pests in Bt cotton. Therefore, keeping the above

information in view, the present investigation was undertaken.

MATERIALS AND METHODS

Test insecticides

Difenthuron 50 per cent WP (Derby, Biostadt India Limited), Acetamiprid 50 per cent SP (Assail, E.I.DuPont India Private Limited) and Imidacloprid 17.8 per cent SL (Confidor, Bayer Crop Science)

Field experiments

The experiment was conducted during rabi season 2016-2017 and 2017-18 at the District Seed Farm (A B - Block farm), Kalyani, Nadia for consecutive two years. This farm is located at 22.56R□N latitude and 88.32R□E longitude and at altitude of 9.75 m above mean sea level. Experiments were laid out in randomized block design (RBD) with nine treatments and three replications. Bt-cotton (variety: Suraj) were transplanted in a plot size of 14.4 sq. m with a spacing of 20 × 15 cm during two consecutive years. All agronomic practices were followed as per recommended package of practices except plant protection to get good crop.

Observations

The data of target pests were recorded from randomly selected five plants in each plot. Observations of total number of Whitefly and thrips, were recorded from five top young leaves of each plant per plot. Treatments were imposed when the sucking pest population crossed the ETL. First count was taken one day before first spray and post treatment counts were recorded on 1,3, 7 and 10 days after spray. The data were subject to analysis after making necessary transformation and expressed on the basis of per cent reduction of these pests population.

$$\% \text{ mortality} = \frac{\text{No. of dead insects}}{\text{Total no. of insects}} \times 100$$

(Arivoli and Tennyson, 2013)

Data analysis

The data on pest damage was analysed in RBD after making necessary transformation to work out the critical difference (CD) at 5 per cent level of significance

Treatment details

Treatments	a.i /ha	Dosage formulation (g or ml/ha)
T_1 Difenthuron 40.5% + Acetamiprid 3.9% WP	81 + 312gm	400gm/ha
T_2 Difenthuron 40.5% + Acetamiprid 3.9% WP	101.25 + 3.90gm	500gm/ha
T_3 Difenthuron 40.5% + Acetamiprid 3.9% WP	121.5 + 4.68gm	600gm/ha
T_4 Imidacloprid 17.8% SL	22.5gm	150ml/ha
T_5 Difenthuron 50% WP	360gm	600gm/ha
T_6 Acetamiprid 20% SP	20gm	100gm/ha
T_7 Untreated control	-	-

RESULTS AND DISCUSSION

Efficacy of insecticides against whitefly (*Bemisia tabaci* Gennadius) infesting Bt cotton (cv. Suraj) during *Rabi* season 2016-17 and 2017-18

Population of whitefly showing an even distribution ranging from 15.33 to 17.67 per 3 leaves one day before spraying and it was statistically non-significant. It was observed from the data (Table-16) that Diafenthiuron + Acetamiprid in three different doses viz. 400, 500, 600g/ha was effective in suppressing whitefly population. The highest mortality (83.05%) of whitefly population was noticed from the treatment Diafenthiuron + Acetamiprid @ 600g/ha which is statistically at par with Diafenthiuron + Acetamiprid @ 500g/ha (81.89%) after 3 days of spraying. No statistical variation was observed on percent mortality of whitefly up to 10 days of spraying when these two treatments are concerned. Similar trend of mortality percent was observed at second round of spray as well as second year experiment (Table 1 and 2).

Efficacy of insecticides against Thrips (*Scirtothrips dorsalis,* Hood) infesting Bt cotton (cv. Suraj) during *Rabi* season 2016-17 and 2017-18

One day before the imposition of treatment, population of thrips was quit uniform. Significant reduction of thrips population was noticed in all the treatments over untreated control. After 3 days spray, Diafenthiuron + Acetamiprid @

Table 1: Management whitefly by using of different insecticides in Bt-cotton during the experimental period 2016-17

Treatment	Dosage g or ml/ha	Pre-treated population/ 3 leaves	% mortality of whitefly after 1st round spray			% mortality of whitefly after 2nd round spray		
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T_1 = Diafenthiuron + Acetamiprid	400	15.33	76.77(61.53)*	68.89(56.41)	42.26(40.84)	72.3(58.6)	70.3(57.3)	62.1(52.3)
T_2 = Diafenthiuron + Acetamiprid	500	15.93	81.89(65.19)	75.01(60.34)	65.34(54.24)	79.3(63.3)	75.5(60.7)	68.3(56.0)
T_3 = Diafenthiuron + Acetamiprid	600	16.67	83.05(66.07)	78.29(62.58)	66.03(54.65)	80.8(64.4)	77.1(61.8)	71.2(57.8)
T_4 = Imidacloprid 17.8% SL	150	17.67	72.54(58.72)	73.29(59.21)	54.58(47.91)	72.1(58.5)	69.8(57.0)	60.6(51.4)
T_5 = Diafenthiuron 50%WP	600	16.93	66.75(55.09)	59.86(50.58)	42.68(41.08)	70.3(57.3)	62.8(52.7)	47.0(43.6)
T_6 = Acetamiprid 20% SP	100	16.73	58.27(50.05)	53.59(47.35)	40.94(40.07)	68.4(56.1)	57.8(49.8)	47.0(43.5)
T_7 = Control plot	-	15.87	0.00(4.05)	0.00(4.05)	0.00(4.05)	0.0(4.05)	0.0(4.05)	0.0(4.05)
S. Em. ±		-	1.47	1.41	1.07	1.02	1.67	1.15
CD (0.05)			4.53	4.34	3.30	3.14	5.15	3.53
CV(%)			0.66	0.71	0.65	0.45	0.84	0.64

*Values in the parentheses are angular transformed, DAS: Days after spray

Table 2: Management whitefly by using of different insecticides in Bt-cotton during the experimental period 2017-18

Treatment	Dosage g or ml/ha	Pre-treated population/ 3 leaves	% mortality of whitefly after 1st round spray			% mortality of whitefly after 2nd round spray		
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T_1 = Diafenthiuron + Acetamiprid	400	13.33	71.83(58.27)*	64.77(53.89)	50.66(45.67)	74.39(59.93)	65.17(54.13)	54.06(47.62)
T_2 = Diafenthiuron + Acetamiprid	500	12.00	77.21(61.83)	69.13(56.56)	57.56(49.64)	77.32(61.90)	65.93(54.59)	59.98(51.05)
T_3 = Diafenthiuron + Acetamiprid	600	12.67	79.61(63.51)	72.78(58.87)	63.13(52.91)	81.14(64.63)	74.51(60.00)	67.02(55.25)
T_4 = Imidacloprid 17.8 % SL	150	13.00	69.89(57.03)	65.03(54.05)	51.45(46.12)	70.85(57.64)	64.20(53.55)	56.73(49.16)
T_5 = Diafenthiuron 50%WP	600	11.67	71.77(58.22)	61.37(51.87)	46.37(43.21)	73.24(59.17)	61.96(52.21)	49.91(45.24)
T_6 = Acetamiprid 20% SP	100	11.33	58.73(50.32)	49.72(45.13)	42.29(40.86)	54.63(47.95)	45.11(42.48)	40.71(39.94)
T_7 = control plot	-	12.33	0.00(4.05)	0.00(4.05)	0.00(4.05)	0.00(4.05)	0.00(4.05)	0.00(4.05)
S. Em. ±		-	1.29	1.34	1.82	1.32	1.32	1.07
CD (0.05)		-	3.98	4.13	5.59	4.07	4.06	3.31
CV(%)			1.60	0.71	1.11	0.60	0.71	0.63

*Values in the parentheses are angular transformed, DAS: Days after spray

Table 3: Management thrips by using of different insecticides in Bt-cotton during the experimental period 2016-17

Treatment	Dosage g or ml/ha	Pre-treated population/ 3 leaves	% mortality of thrips after 1st round spray			% mortality of thrips after 2nd round spray		
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T_1 = Diafenthiuron + Acetaamiprid	400	17.33	75.69(60.79)*	60.94(51.61)	56.46(49.00)	74.86(60.24)	64.00(53.43)	58.09(49.94)
T_2 = Diafenthiuron + Acetamiprid	500	17.84	78.31(62.59)	67.94(55.82)	63.28(53.00)	77.69(62.16)	70.79(57.60)	65.55(54.36)
T_3 = Diafenthiuron + Acetamiprid	600	16.43	81.58(64.95)	72.01(58.38)	66.48(54.93)	81.92(65.21)	72.36(58.61)	67.16(55.34)
T_4 = Imidacloprid 17.8 % SL	150	18.23	75.18(60.45)	60.50(51.35)	57.38(49.53)	73.36(59.25)	62.27(52.40)	59.47(50.75)
T_5 = Diafenthiuron 50%WP	600	16.70	69.10(56.54)	56.43(48.99)	45.60(42.76)	65.55(54.36)	54.89(48.09)	41.36(40.31)
T_6 = Acetamiprid 20% SP	100	16.33	62.65(52.63)	49.96(45.26)	35.70(36.99)	60.97(51.63)	50.61(45.64)	31.40(34.39)
T_7 = control plot	—	17.17	0.00(4.05)	0.00(4.05)	0.00(4.05)	0.0094.05)	0.00(4.05)	0.00(4.05)
S. Em. ±		—	1.20	1.33	1.20	1.15	1.28	2.99
CD (0.05)		—	3.70	4.09	3.69	3.55	3.95	9.21
CV(%)			0.54	0.73	0.71	0.53	0.69	1.79

*Values in the parentheses are angular transformed, DAS: Days after spray

Table 4: Management thrips by using of different insecticides in Bt-cotton during the experimental period 2017-18

Treatment	Dosage g or ml/ha	Pre-treated population/ 3 leaves	% mortality of thrips after 1st round spray			% mortality of thrips after 2nd round spray		
			3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS
T_1 = Diafenthiuron + Acetamiprid	400	16.44	80.91(64.46)*	66.12(54.71)	59.33(50.70)	80.08(63.85)	68.54(56.19)	64.49(53.72)
T_2 = Diafenthiuron + Acetamiprid	500	15.33	85.44(67.98)	72.30(58.56)	62.57(52.59)	85.85(68.32)	73.41(59.29)	71.32(57.94)
T_3 = Diafenthiuron + Acetamiprid	600	16.40	89.27(71.35)	77.61(62.11)	70.15(57.06)	87.66(69.87)	76.50(61.34)	75.65(60.77)
T_4 = Imidacloprid 17.8 % SL	150	16.47	77.77(62.21)	60.49(51.35)	54.00(47.58)	77.58(62.08)	70.64(57.50)	58.53(50.20)
T_5 = Diafenthiuron 50%WP	600	15.20	70.58(57.47)	59.05(50.51)	49.80(45.20)	66.68(55.05)	60.29(51.23)	43.64(41.63)
T_6 = Acetamiprid 20% SP	100	15.67	67.36(55.46)	52.12(46.50)	39.63(39.26)	65.97(54.61)	58.85(50.39)	42.22(40.81)
T_7 = control plot	-	16.93	0.0(4.05)	0.0(4.05)	0.0(4.05)	0.00(4.05)	0.00(4.05)	0.0(4.05)
S. Em. ±			1.22	1.74	2.10	1.10	2.57	1.50
CD (0.05)			3.74	5.07	6.47	3.38	7.90	4.63
CV(%)			0.52	0.90	1.21	0.47	1.30	0.84

*Values in the parentheses are angular transformed, DAS: Days after spray

600g/ha recorded 81.58% mortality which was statistically at pat with Diafenthiuron+ Acetamiprid @ 500g/ha (78.31%). Diafenthiuron+ Acetamiprid @ 400g/ha (75.69 %) and imidacloprid 17. 8 SL showed the next best treatments. After 7 days, Diafenthiuron+ Acetamiprid @ 600g/ha and Diafenthiuron+ Acetamiprid @ 500g/ha was registered maximum mortality of 72.01 % and 67.97 % respectively. Lowest percentage of mortality (49.96 %) was observed in plots treated with Acetamiprid 20 SP @ 100g/ha followed by diafenthiuron @ 600 g/ha. A minor decrease in the efficacy of these insecticides was observed at 10 days after treatment as compared to 3 and 7 days. However, 10 days after treatment

Table 5: Cumulative lint yield in q/ha of Bt cotton

Treatments	Dosage (gm or ml /ha)	Yield of seed cotton in q/ha
T_1 = Diafenthiuron+ Acetamiprid	400	17.92
T_2= Diafenthiuron+ Acetamiprid	500	23.34
T_3= Diafenthiuron+ Acetamiprid	600	24.33
T_4 = Imidacloprid 17.8 % SL	150	22.98
T_5 = Diafenthiuron 50%WP	600	18.72
T_6 = Acetamiprid 20% SP	100	19.35
T_7 = Control plot	-	14.96
S. Em. ±		0.42
CD (0.05)		1.72
CV (%)		0.52

66.48 % mortality of thrips was noticed with Diafenthiuron+ Acetamiprid @ 600g/ha which was statistically at par with Diafenthiuron+ Acetamiprid @ 500g/ha (63.28%). Lowest percentage of mortality (35.70 %) was observed in acetamiprid 20% SP @ 100 g/ha. No thrips mortality was observed from untreated check plots. Similar trend of result has been noticed after 2nd round spray as well as second year experiment of Bt. cotton (Table 3 and 4).

Effect of different treatments on cotton yield

Cotton yield obtained from the different treatments were significantly superior compared to untreated control. The Higher dose of Diafenthiuron + Acetamiprid @ 600 g/ha was recorded maximum yield (24.33 q/ha) which was statistically at par with Diafenthiuron + Acetamiprid @ 500g/ha (23.34 q/ha) and Imidacloprid 17.8 SL @150 ml /ha (22.98 q/ha). The treatments Diafenthiuron 50%WP @ 600 g /ha (18.72 q/ha) and Acetamiprid 20% SP @ 100g/ha (19.35 q/ha) were the next best options. The treatment Diafenthiuron + Acetamiprid @400gm/ha along with untreated control was registered comparatively low yield (Table 5).

From the study of management of sucking pests in Bt-cotton, it was inferred that the combined insecticide Diafenthuron+ Acetamiprid @ 600g/ha was most effective in controlling the sucking pests such as Whitefly and thrips in cotton. It was also reported that the application of Diafenthuron significantly reduced sucking pest population and it agreed with the findings of (Hakim *et al.,* 2017; Thumar *et al.,* 2018: Bontha and Mallapur, 2017). Acetamiprid was also reported to be effective and relatively safe in controlling sucking pest population in cotton (Meghana *et al.,* 2018). The results also agrees with the findings of (Kranthi *et al.,* 2014; Mohammadali *et al.,* 2012; Ghosal *et al.,* 2013; Ahmed *et al.,* 2012; Kalyan *et al.,* 2012; Bharpoda *et al.,* 2014 and Zidan, 2012) which states that neonicotinoids are most effective in the management of sucking pests of cotton.

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