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Field evaluation of Dinotefuran 20SG against sucking insect pests on *Bt* cotton

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ABSTRACT: Dinotefuran 20SG was evaluated @ 15, 20, 25 and 30 g a.i./ha against sucking pests in 3 different experiments at farmers' field on *Bt* cotton along with untreated control and standard checks *viz.,* imidacloprid 17.8 SL @ 25 g a.i./ ha and thiamethoxam 25 WG @ 25 g a.i./ha for leafhopper and ethion 50 EC @ 1000 g a.i./ ha for whitefly during 2010 and 2011. Dinotefuran 20 SG @ 25 and 30 g a.i./ha gave effective control of leafhopper and thrips population on *Bt* cotton. However, against whitefly, this insecticide was inferior as compared to standard check, ethion 50 EC. The seed cotton yield at both doses was *at par* with imidacloprid 17.8 SL and ethion 50 EC.

Key words: *Bt* cotton, dinotefuran, leafhopper, sucking insect pests, whitefly

Cotton ecosystem harbours a wide variety of arthropods and consequently requires a constant protection from insect pests. Though, *Bt* cotton provides effective management of bollworms but it is not effective against sucking pests (Mann *et al.*, 2010) which still pose a great threat to its cultivation and necessitate insecticidal applications to avoid yield losses (Dhawan *et al.*, 2008 ; Shera, 2012). The excessive and indiscriminate use of insecticides against these pests has resulted in development of insecticidal resistance (Anonymous, 2010). Therefore, need of the hour is to explore the possibility of utilizing new chemistry insecticides which can fit in the IPM strategies on *Bt* cotton.

Among the most recent novel insecticides, dinotefuran (1-methyl-2-nitro-3-(tetrahydro-3-furylmethyl) guanidine) is classified as a furanicotinyl third generation neonicotinoid. It has an especially high insecticidal activity against a broad range of hemipterous insects and a low mammalian toxicity. The present study was, therefore, conducted to evaluate dinotefuran 20 SG against sucking insect pests on *Bt* cotton under field conditions.

MATERIALS AND METHODS

The efficacy of dinotefuran 20 SG (a product of P. I. industry) was evaluated @ 15, 20, 25 and 30 g a.i./ha for the control of sucking insect pests, *viz.,* leafhopper [*Amrasca biguttula biguttula* (Ishida)], whitefly [*Bemisia tabaci* (Gennadiaus)] and thrips [*Thrips tabaci* (Lindeman)] in 3 different experiments at farmers' field on *Bt* cotton along with untreated control and standard checks *viz.,* imidacloprid 17.8 SL @ 25 g a.i./ ha and thiamethoxam 25 WG @ 25 g a.i./ha for leafhopper and ethion 50 EC @ 1000 g a.i./ ha for whitefly during 2010 and 2011 in a randomized block design replicated thrice in a plot size of 150 sq. m. The crop was sprayed once with manually operated knapsack sprayer using 350 l of water/ ha. The observations were recorded on the population of leafhopper nymphs, whitefly adults and thrips from 3 fully formed leaves of 10 plants selected

at random before spray, 3, 7 and 10 days after spray (DAS).

RESULTS AND DISCUSSION

Efficacy against leafhopper, *A. biguttula biguttula*: The pre treatment population of leafhopper did not differ significantly among different treatments (Table 1). During 2010, population of leafhopper nymphs was significantly lower in thiamethoxam 25 WG (0.73/ 3 leaves) and it was *at par* with dinotefuran 20 SG @ 30 g a.i./ha (1.53/ 3 leaves) after 3 days of spray. After 7 days of spray, lower leafhopper population was recorded in dinotefuran 20 SG @ 25 and 30 g a.i/ha (0.27 and 0.23/ 3 leaves, respectively) and it was statistically *on par* with dinotefuran 20 SG @ 20 g a.i./ha followed by imidacloprid 17.8 SL (1.40/ 3 leaves) and thiamethoxam 25 WG (1.53/ 3 leaves). Similar trend was observed after 10 days of spray. Significantly higher leafhopper population was recorded in untreated control in all the observations.

During 2011 also, in the first experiment, significantly lower leafhopper population was recorded in thiamethoxam 25 WG (1.07/ 3 leaves) and it was *at par* with imidacloprid 17.8 SL (1.67 nymphs/3 leaves) and dinotefuran 20 SG @ 25 and 30 g a.i./ha (1.87/ 3 leaves) after 3 days of spray. However, after 7 days of spray, population of leafhopper nymphs was significantly lower in the dinotefuran 20 SG @ 30 g a.i/ha (0.43/ 3 leaves) and dinotefuran 20 SG @ 25 g a.i/ha (0.47/ 3 leaves). These were statistically *on par* with dinotefuran 20 SG@ 20 g a.i/ha (1.07/ 3 leaves) which was *at par* with dinotefuran 20 SG @ 25 g a.i/ha, imidacloprid 17.8 SL (1.30/ 3 leaves) and thiamethoxam 25 WG (1.33/ 3 leaves). Similarly, after 10 days of spray, population of leafhopper nymphs was significantly lower in dinotefuran 20 SG @ 25 and 30 g a.i./ha (0.40 and 0.37/ 3 leaves, respectively). It was followed by dinotefuran 20 SG @ 20 g a.i/ha (0.93/ 3 leaves) and was *at par* with thiamethoxam 25 WG (1.13/ 3 leaves) and

Table 1. Efficacy of dinotefuran 20 SG against leafhopper, *A. bigutulla bigutulla* on *Bt* cotton

Treatment	Dose (g a.i./ ha)	Population of leafhopper nymphs / 3 leaves											
		2010				2011							
		Experiment				Experiment1				Experiment 2			
		Before spray	3 DAS	7 DAS	10 DAS	Before spray	3 DAS	7 DAS	10 DAS	Before spray	3 DAS	7 DAS	10 DAS
Dinotefuran 20 SG	15	3.53	2.20 (1.79)	1.53 (1.59)	1.53 (1.59)	4.90	2.47 (1.86)	1.67 (1.63)	1.47 (1.57)	4.67	2.20 (1.79)	1.80 (1.67)	1.47 (1.57)
	20	4.00	1.93 (1.71)	1.07 (1.43)	0.67 (1.29)	4.53	2.20 (1.78)	1.07 (1.43)	0.93 (1.39)	5.33	2.07 (1.75)	1.33 (1.52)	1.07 (1.44)
	25	4.13	1.60 (1.61)	0.27 (1.12)	0.60 (1.26)	5.13	1.87 (1.69)	0.47 (1.21)	0.40 (1.18)	4.73	1.53 (1.59)	0.80 (1.34)	0.73 (1.31)
	30	4.07	1.53 (1.59)	0.23 (1.11)	0.37 (1.16)	4.73	1.87 (1.69)	0.43 (1.16)	0.37 (1.16)	5.40	1.47 (1.57)	0.73 (1.31)	0.67 (1.29)
Imidacloprid 17.8 SL	25	4.73	1.60 (1.60)	1.40 (1.53)	1.53 (1.59)	5.07	1.67 (1.62)	1.30 (1.50)	1.20 (1.48)	5.73	1.53 (1.59)	1.07 (1.43)	1.07 (1.44)
Thiamethoxam 25 WG	25	6.13	0.73 (1.29)	1.53 (1.59)	1.00 (1.41)	6.40	1.07 (1.43)	1.33 (1.53)	1.13 (1.46)	5.40	1.47 (1.57)	1.00 (1.41)	0.93 (1.39)
Untreated control	-	5.53	6.80 (2.79)	7.80 (2.96)	8.47 (3.07)	6.20	6.83 (2.80)	7.80 (2.95)	8.40 (3.06)	5.60	6.07 (2.66)	6.40 (2.72)	7.27 (2.87)
CD (p=0.05)	-	NS	(0.30)	(0.34)	(0.15)	NS	(0.27)	(0.35)	(0.21)	NS	(0.20)	(0.22)	(0.15)

Figures in parenthesis are square root transformed values; DAS-days after spray

imidacloprid 17.8 SL (1.20/ 3 leaves). Similar trend was observed in the second experiment conducted during 2011. The population of leafhopper nymphs was significantly lower in all the insecticidal treatments as compared to untreated control during both the experiments in 2011.

Efficacy against whitefly, *B. tabaci*: The population of whitefly adults varied from 18.20 to 21.47/3 leaves during both the years and it did not differ significantly among different treatments before spray (Table 2). During 2010, significantly lower whitefly adults were recorded in ethion 50 EC (7.33/ 3 leaves) after 3 days of spray. It was followed by dinotefuran 20 SG @ 30 g a.i./ha (9.93/ 3 leaves) which was *at par* with its lower doses, *i.e.* 25 g a.i./ha (10.07/ 3 leaves) and 20 g a.i./ha (10.27/ 3 leaves) and with thiamethoxam 25 WG (11.73/ 3 leaves). Similarly, after 7 days of spray, the population of whitefly adults was also significantly lower in ethion 50 EC (5.73/ 3 leaves) which was followed by dinotefuran 20 SG @ 25 and 30 g a.i./ha (8.27 and 8.07/ 3 leaves), both were *at par* with each other. Similar trend was observed after 10 days of spray. Significantly, higher whitefly population was recorded in untreated control (18.87 to 23.53/ 3 leaves).

During 2011, in the first experiment, the population of whitefly adults was recorded in ethion 50 EC (8.40/ 3 leaves) after 3 days of spray (Table 2). It was followed by dinotefuran 20 SG @ 20, 25 and 30 g a.i./ha (11.20, 11.40 and 13.27/ 3 leaves, respectively). Similar trend was observed after 7 and 10 days of spray. In the second experiment also, significantly lower whitefly adult population was recorded in ethion 50 EC in all the observations after 3 days of spray and it was followed by dinotefuran 20 SG @ 30 g a.i./ha (10.40/ 3 leaves). Similarly, after 7 days of spray, whitefly population was lowest in ethion 50 EC (6.40/ 3 leaves) and dinotefuran 20 SG @ 30 g a.i./ha (6.40/ 3 leaves), which were *at par*

Table 2. Efficacy of dinotefuran 20 SG against whitefly, *B. tabaci* on *Bt* cotton

Treatment	Dose (g/a.i./ ha)	Population of leafhopper nymphs / 3 leaves											
		2010				2011							
		Experiment				Experiment1				Experiment 2			
		Before spray	3 DAS	7 DAS	10 DAS	Before spray	3 DAS	7 DAS	10 DAS	Before spray	3 DAS	7 DAS	10 DAS
Dinotefuran 20 SG	15	18.53	12.87 (3.72)	10.67 (3.41)	10.20 (3.34)	20.60	14.60 (3.95)	12.40 (3.66)	11.07 (3.46)	21.27	13.27 (3.77)	11.73 (3.57)	10.67 (3.41)
	20	18.20	10.27 (3.50)	9.60 (3.25)	8.93 (3.15)	20.27	13.27 (3.78)	11.53 (3.54)	10.20 (3.35)	19.93	11.53 (3.54)	10.53 (3.39)	9.87 (3.29)
	25	19.00	10.07 (3.32)	8.27 (3.04)	7.33 (2.89)	20.33	11.40 (3.52)	9.20 (3.19)	8.33 (3.04)	21.33	10.47 (3.82)	6.53 (2.74)	5.80 (2.61)
	30	18.33	9.93 (3.30)	8.07 (3.00)	7.40 (2.89)	20.73	11.20 (3.49)	9.13 (3.18)	8.27 (3.04)	20.40	10.40 (3.37)	6.40 (2.72)	5.53 (2.55)
Imidacloprid 17.8 SL	25	20.67	15.53 (4.06)	11.67 (3.55)	14.33 (3.90)	20.93	17.87 (4.32)	16.07 (4.13)	15.60 (4.07)	21.27	16.87 (4.22)	15.00 (3.99)	15.13 (4.00)
Thiamethoxam 25 WG	25	19.07	11.73 (3.56)	13.53 (3.81)	18.40 (4.40)	21.47	14.40 (3.92)	14.87 (3.98)	15.13 (4.02)	20.80	13.40 (3.79)	14.53 (3.94)	14.70 (3.96)
Ethion 50 EC	1	19.61	7.33 (2.88)	5.73 (2.59)	4.93 (2.43)	20.33	8.40 (3.06)	6.40 (2.72)	4.27 (2.29)	20.00	8.73 (3.11)	6.40 (2.72)	4.07 (2.25)
Untreated control	-	18.87	19.47 (4.52)	21.13 (4.70)	23.53 (4.95)	20.20	20.93 (4.68)	23.13 (4.91)	24.40 (5.04)	19.87	20.53 (4.64)	22.80 (4.88)	24.53 (5.05)
CD (p=0.05)	-	NS	(0.34)	(0.36)	(0.30)	NS	(0.36)	(0.20)	(0.36)	NS	(0.29)	(0.21)	(0.30)

Figures in parenthesis are square root transformed values; DAS-days after spray

with dinotefuran 20 SG @ 25 g a.i./ha (6.53/ 3 leaves). Similar trend was observed after 10 days of spray. The population of whitefly adults was significantly higher in untreated control (20.53 to 24.53/3 leaves) during both the experiments during 2011.

Efficacy against thrips, *T. tabaci*: The data presented in Table 3 revealed that population of thrips varied from 10.60 to 14.60/ 3 leaves during both the years and it did not differ significantly in all the treatments before spray. After 3 days of spray, the population of thrips was

Table 3. Efficacy of dinotefuran 20 SG against thrips, *T. tabaci* on *Bt* cotton

Treatment	Dose (g/a.i./ ha)	Population of leafhopper nymphs / 3 leaves							
		2010				2011			
		Experiment				Experiment1			
		Before spray	3 DAS	7 DAS	10 DAS	Before spray	3 DAS	7 DAS	10 DAS
Dinotefuran	15	11.53	9.47(3.23)	8.90(3.14)	7.67(2.94)	12.94	10.47(3.38)	9.30(3.21)	8.50(3.08)
20 SG	20	10.60	8.20(3.03)	7.10(2.84)	6.60(2.76)	12.20	9.27(3.20)	8.97(3.16)	8.10(3.14)
	25	10.87	7.07(2.84)	6.23(2.69)	5.87(2.62)	11.64	8.40(3.06)	6.60(2.76)	6.10(2.66)
	30	11.13	6.20(2.68)	5.93(2.63)	5.63(2.57)	12.55	8.20(3.03)	6.40(2.72)	6.07(2.66)
Imidacloprid 17.8 SL	25	11.20	9.27(3.20)	9.20(3.19)	9.03(3.17)	12.23	10.27(3.36)	10.57(3.44)	11.20(3.49)
Thiamethoxam 25 WG	25	12.60	8.80(3.12)	9.33(3.21)	9.33(3.19)	14.60	10.13(3.34)	10.67(3.41)	10.57(3.40)
Untreated control	-	10.70	11.67(3.56)	12.40(3.65)	13.03(3.74)	14.13	14.47(3.93)	15.20(4.02)	17.20(4.27)
CD (p=0.05)	-	NS	(0.32)	(0.38)	(0.39)	NS	(0.24)	(0.28)	(0.21)

Figures in parenthesis are square root transformed values**;** DAS-days after spray

lowest in dinotefuran 20 SG @ 30 g a.i./ha (6.20/ 3 leaves) and it was *at par* with its lower dose, *i.e.* 25 g a.i./ha (7.07/ 3 leaves) during 2010. Similarly 7 days after spray, dinotefuran 20 SG @ 30 g a.i./ha (5.93/ 3 leaves) recorded lowest thrips population and it was *at par* with its lower doses, 25 g a.i./ha (6.23/ 3 leaves) and 20 g a.i./ ha (7.10/ 3 leaves). Similar observations were recorded after 10 days of spray. Significantly, higher thrips population was recorded in untreated control (11.67 to 13.03/ 3 leaves). Similar trend was observed in an experiment conducted during 2011 also. The present studies, thus, indicated that dinotefuran 20 SG @ 25 and

Table 4. Effect of dinotefuran 20 SG against sucking insect pests on seed cotton yield

Treatment	Dose (g a.i./ ha)	Seed cotton yield (q/ha)			
		2010	2011		**Pooled mean**
		Experiment I	Experiment I	Experiment II	
Dinotefuran 20 SG	15	23.72	24.60	24.83	**24.41**
	20	24.27	24.93	25.67	**24.96**
	25	24.43	25.73	26.19	**25.45**
	30	24.93	25.90	26.50	**25.78**
Imidacloprid 17.8 SL	25	24.02	25.35	26.17	**25.17**
Thiamethoxam 25 WG	25	23.80	25.17	26.33	**25.07**
Ethion 50 EC	1000	24.76	25.43	26.67	**25.62**
Control	-	22.36	23.02	23.57	**22.98**
CD (p=0.05)	-	1.38	1.06	1.70	**0.50**

30 g a.i./ha rendered effective control of leafhopper and thrips population on *Bt* cotton. Both the doses were *at par* with standard check, imidacloprid 17.8 SL and thiamethoxam 25 WG for the control of leafhopper. The superiority of dinotefuran has also been reported by earlier workers against potato leafhoppers, *Empoasca fabae* (Harris) on ornamental tree, Red maple (*Acer rubrum* L.) in US (Oliver *et al.*, 2009), grape leafhoppers, *Erythroneura* spp. on grapes vines in Mexico (Maier *et al.*, 2013), lace bug and thrips on Avocado in California. However, against whitefly, it was inferior as compared to standard check ethion 50 EC. Therefore, use of this novel insecticide can fit ideally in IPM strategies on *Bt* cotton for the control of leafhopper and thrips as a potential component thereby reducing dependence on conventional insecticides.

Seed cotton yield : The seed cotton yield was significantly higher in the insecticidal treated plots in all the 3 experiments conducted during 2010 and 2011 (Table 4). In the first experiment conducted during 2010 revealed higher seed cotton yield in Dinotefuran 20SG @ 3 g a.i./ha being *at par* with its lower dosages. Similar trend was recorded in first and second experiment conducted during 2011. The pooled analysis of both the years revealed that dinotefuran 20 SG @ 25 and 30 g a.i. /ha (25.45 and 25.78 q/ha, respectively) recorded higher seed cotton yield and was *at par* with the imidacloprid 17.8 SL (25.17 q/ha) and ethion 50 EC (25.62 q/ha) than all other treatments. Significantly lower seed cotton yield was recorded in untreated control (22.98 q/ha). Dinotefuran 20 SG @ 25 and 50 g a.i/ha did not show any phytotoxicity to cotton in all the 3 experiments conducted during 2010 and 2011.

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