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Management of sucking insect pest complex of *Bt* cotton by using dinotefuran – a 3rd generation neonicotinoid molecule

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ABSTRACT : Studies on the bioefficacy of dinotefuran 20 per cent SG was carried out against *Bt* cotton sucking pests at 15, 20, 25 and 30 g a.i/ha as compared with standard check *viz.,* imidacloprid 17.8 SL and thiamethoxam 25 WG. Effect of treatments at 3, 7, 10 and 14 days after application differed significantly over untreated control and standard checks. At 3 days after treatment, dinotefuran 20 per cent SG @ 30 g a.i/ha performed significantly superior by recording lowest population of 1.47, 4.72, 9.10 and 0.30 leafhopper, thrips, aphids and whitefly/leaf, respectively. As the observation period progressed the pest populations though started building up, the test compound kept the sucking pest population below ETL up to 14 days. This trend was followed same in second spray also. The chemical dinotefuran 20 per cent SG @ 30 and 25 g a.i/ha dosages did not cause adverse effect on predatory population and recorded highest yield of 27.04 and 24.33 q/ha, respectively.

Key words : Bioefficacy, *Bt* cotton, dinotefuran, sucking insect pests

Due to large scale adoption of *Bt* cotton, a change in pest scenario has been observed, especially sucking pests and diseases have assumed major status, affords protection only for lepidopteran pests. Amongst these sucking of pests leafhopper, *Amarasca biguttula biguttula* Ishida, whitefly, *Bemisia tabaci* (Genn.), thrips, *Thrips tabaci* Lind, and aphid, *Aphis gossypii* Glover are the important sucking insect pest complex. (Kannan *et al.,* 2004). Chemical control, being rapid method of pest control, is an important practice of integrated pest management (IPM) programme. Kshirasagar *et al.,* (2012) reported moderate to high level of resistance in leafhopper against the neonicotinoids (imidacloprid and acetamiprid) as compared to dimethoate.

Dinotefuran acts as an agonist of insect nicotinic acetylcholine receptors, but it is postulated that dinotefuran affects the nicotinic acetylcholine binding in a mode that differs from other neonicotinoid insecticides. Its mechanism of action involves disruption of the insect's nervous system by inhibiting nicotinic acetylcholine receptors, which is unique as compared to other previous CNIs.

MATERIALS AND METHODS

The field experiment was carried out on bioefficacy studies of dinotefuran 20 per cent SG were carried out during the *kharif,* 2010-2011 and 2011-2012 in a randomized block design of plot sizes 50 sqm by using RCH 2 (BG II) variety of *Bt* cotton under irrigated deep black soil conditions with a spacing of 90x60 cm at Main Agricultural Research Station, Raichur located in the north rastern dry zone (Zone II) of Karnataka between 16^0 15' N latitude and 77^0 20' E longitude with an altitude of 389 m. The annual average rainfall was 660 mm with a mean maximum temperature of more than 30°C throughout the year except December. The treatments as per Table 1-3 were given twice using about 500 l of spray solution/ha every time. The leafhopper, thrips, aphids, whiteflies and natural enemies (predators) were recorded on 5 randomly selected and tagged plants on top 3 leaves in each plant at each spray and data recorded were subjected for statistical analysis.

Treatments were imposed when the population of sucking insect pests crossed Economic Threshold (ET). Observations on

sucking pests *viz*., leafhopper, thrips, aphids, whiteflies and natural enemies population were recorded pre treatment and at 3, 7, 10 and 14 days after treatment. The yield of the crop was also recorded and subjected to DMRT.

RESULTS AND DISCUSSIONS

Bioefficacy of dinotefuran 20 per cent SG

Leafhoppers : At 3 days after treatment, lowest leafhopper population (1.47/ leaf) differed significantly with other lower dosage treatments as well as with standard check *i.e*. imidacloprid (3.18/leaf) and thiamethoxam (3.45/ leaf). All these treatments differed significantly over untreated control which suffered heavily leafhopper damage (6.60 leafhoppers/leaf) at 14 days after application (Table 1). Singh and Kumar (2006) revealed that imidacloprid 70 WG @ 40 g a. i. /ha and acetamiprid 20 SP @ 50 g a. i. /ha are effective on *Amrasca biguttula biguttula* on cotton. Similarly, Abbas *et al.,* (2012) reported that 1 day after application imidachloprid 25 per cent WP and thiomethoxam 24 WG resulted in more than 90 per cent reduction.

Thrips: Thrips population varied greatly across the treatments from 4.72 to 27.50/leaf. Lowest being recorded in dinotefuran 20 per cent SG @ 30 g a.i./ha at 3 days after treatment and highest being in untreated control at 14 days after treatment. Dinotefuran 20 per cent SG @ 30, 25, 20 and 15 g a.i./ha registered 4.72, 8.70, 12.18 and 13.17 thrips/leaf, respectively. Imidacloprid and thiamethoxam registered 11.62 and 13.4 thrips/leaf, respectively, at 3 days after application. The observations recorded on 7, 10 and 14 days after application followed the same trend. However, there was increase in the population of thrips as the days progressed, however the trend remained same during second spray also (Table 1). Abbas *et al.* (2012) reported that imidachloprid 25 per cent WP, thiomethoxam 24 WG and acetamiprid 20 per cent SL showed excellent performance against thrips. Among them imidachloprid proved to be highly effective with more than 90 per cent reduction in thrips.

Aphid: Aphids population varied greatly across the treatments, lowest (9.10/ leaf) in dinotefuran 20 per cent SG @ 30 g a.i./ha at 3 days after treatment and highest being 48.26/ leaf in untreated control at 14 days after treatment. Dinotefuran 20 per cent SG @ 25, 20 and 15 g a.i./ha treatments registered 13.60, 21.10 and 23.10 aphids/leaf, respectively. Imidacloprid and thiamethoxam recorded 18.84 and 17.89 aphids/leaf, respectively at 3 days after application. The observations recorded on 7, 10 and 14 days after application followed the same trend. The trend remains same during second spray also (Table 2). Shivanna *et al.*, (2011) reported that dimethoate and imidacloprid were most effective against aphid at 3 days after spraying.

Whitefly: Minimum population of 9.3/ leaf was registered in dinotefuran @ 30g a.i/ha and highest being 27.05 /leaf in untreated control at 14 days after treatment. Imidacloprid (17.40 whiteflies/leaf) and thiamethoxam (16.59 whteflies/leaf) differed non significantly with each other. The observations recorded on 7, 10 and 14 days after application followed the same trend. However, there was increase in the population as days progressed. The trend remains same during second spray also (Table 2). Singh and Kumar (2006) reported that acetamiprid 20 SP 20 @ g a.i. /ha was effective in controlling whiteflies on cotton. Brar and Naveen (2005) reported bio efficacy of acetamiprid 20 SP @ 100, 150 and 200 g a.i. /ha to be as good as the recommended dosages of oxydemeton methyl 25EC at 750 ml/ha, triazophos 40 EC at 1500 ml/ ha and ethion 50 EC at 2000 ml/ha, in controlling whitefly, *Bemisia tabaci* and leafhopper (*Amrasca biguttula* on cotton Abbas *et al.,* (2012) reported that imidachloprid 25 per cent WP at 1 day post application caused maximum whitefly population reduction (91%).

Seed cotton yield Dinotefuran 20 per

Table 1. Bio efficacy of Dinotefuran (20 % SG) on cotton leafhopper and thrips

Treatment details	Dosage (g a.i./ ha)	Population of leafhopper / leaf									Population of thrips / leaf								
		I Spray**					II Spray**				I Spray**					II Spray**			
		1 DBA	3 DAA	7 DAA	10 DAA	14 DAA	3 DAA	7 DAA	10 DAA	14 DAA	1 DBA	3 DAA	7 DAA	10 DAA	14 DAA	3 DAA	7 DAA	10 DAA	14 DAA
Dinotefuran SG (20%)	15.0	4.69	3.04	3.05	3.32	3.47	2.80	2.89	3.10	3.32	19.35	13.17	13.82	14.67	16.57	11.47	12.15	13.75	13.99
		(2.39)	(2.01)	(2.01)	(2.08)	(2.11)	(1.95)	(1.97)	(2.02)	(2.08)	(4.51)	(3.76)	(3.85)	(3.96)	(4.19)	(3.53)	(3.63)	(3.84)	(3.87)
Dinotefuran SG (20%)	20.0	5.11	2.85	2.90	3.18	2.70	2.37	2.67	2.77	3.00	19.60	12.18	12.48	13.62	14.67	9.22	9.95)	11.39	11.42
		(2.47)	(1.96)	(1.97)	(2.04)	(1.92)	(1.83)	(1.91)	(1.94)	(2.00)	(4.54)	(3.63)	(3.67)	(3.82)	(3.96)	(3.20)	(3.31	(3.52)	(3.52)
Dinotefuran (20%) SG	25.0	4.87	2.20	2.12	2.14	2.52	1.55	1.60	1.89	2.07	21.25	8.70	8.49	9.57	10.89	6.31	6.90	7.75	8.25
		(2.42)	(1.79)	(1.77)	(1.77)	(1.87)	(1.60)	(1.61)	(1.70)	(1.75)	(4.72)	(3.11)	(3.08)	(3.25)	(3.45)	(2.70)	(2.81)	(2.96)	(3.04)
Dinotefuran (20%) SG	30.0	5.15	1.47	1.59	1.67	1.83	1.00	1.12	1.45	1.80	21.75	4.72	4.75	5.43	8.43	4.19	4.32	4.59	4.57
		(2.48)	(1.57)	(1.61)	(1.63)	(1.68)	(1.41)	(1.45)	(1.57)	(1.67)	(4.77)	(2.39)	(2.40)	(2.54)	(3.07)	(2.28)	(2.31)	(2.36)	(2.36)
Imidacloprid (17.8%) SL	22.5	5.21	3.18	3.29	3.57	3.67	2.94	3.10	3.25	3.55	21.25	11.52	13.32	14.39	14.07	9.32	11.20	12.14	12.34
		(2.49)	(2.04)	(2.07)	(2.14)	(2.16)	(1.98)	(2.02)	(2.06)	(2.13)	(4.72)	(3.54)	(3.78)	(3.92)	(3.88)	(3.21)	(3.49)	(3.62)	(3.65)
Thiamethoxam (25%) WG	25.0	4.91	3.45	3.77	3.88	4.09	3.67	3.84	3.95	4.29	21.75	13.26	14.59	15.35	15.57	11.34	12.97	13.74	14.15
		(2.43)	(2.11)	(2.18)	(2.21)	(2.25)	(2.16)	(2.20)	(2.22)	(2.30)	(4.77)	(3.78)	(3.95)	(4.04)	(4.07)	(3.51)	(3.74)	(3.84)	(3.89)
Untreated control	—	5.32	6.06	6.17	6.49	6.60	6.44	6.79	7.02	7.20	21.95	23.37	25.10	25.93	27.50	21.32	23.05	23.57	25.34
		(2.51)	(2.66)	(2.68)	(2.74)	(2.76)	(2.73)	(2.79)	(2.83)	(2.86)	(4.79)	(4.94)	(5.11)	(5.19)	(5.34)	(4.72)	(4.90)	(4.96)	(5.13)
CV (%)		10.72	11.16	8.89	8.70	11.64	9.19	9.56	8.70	16.75	9.65	9.86	10.09	11.89	10.98	9.09	7.22	9.51	9.65
S.Em ±		0.08	0.06	0.09	0.06	0.14	0.12	0.10	0.10	0.25	0.26	0.24	0.26	0.26	0.25	0.17	0.14	0.20	0.20
CD (p=0.05)		NS	0.16	0.22	0.20	0.41	0.35	0.32	0.30	0.77	NS	0.72	0.78	0.79	0.77	0.53	0.44	0.60	0.62

DBA - Days before application, DAA - Days after application, * Figures in the parentheses are square root (“X + 1) transformed values, ** Average of two seasons data

Table 2. Bio efficacy of Dinotefuran (20 %) SG on cotton aphids and whiteflies

S. No.	Treatment details	Dosage (g a.i./ ha)	Population of leafhopper / leaf									Population of thrips / leaf								
			I Spray**					II Spray**				I Spray**					II Spray**			
			1 DBA	3 DAA	7 DAA	10 DAA	14 DAA	3 DAA	7 DAA	10 DAA	14 DAA	1 DBA	3 DAA	7 DAA	10 DAA	14 DAA	3 DAA	7 DAA	10 DAA	14 DAA
	Dinotefuran (20%) SG	15.0	41.38	23.10	24.24	25.40	26.34	16.00	16.30	17.50	18.00	23.66	19.27	18.29	20.19	21.95	13.00	14.00	14.20	14.10
			(6.51)	(4.91)	(5.02)	(5.14)	(5.23)	(4.12)	(4.16)	(4.30)	(4.36)	(4.97)	(4.50)	(4.39)	(4.60)	(4.79)	(3.74)	(3.87)	(3.90)	(3.89)
	Dinotefuran (20%) SG	20.0	39.54	21.10	22.07	23.32	24.10	15.40	15.40	15.30	15.80	23.97	18.05	16.97	18.35	19.70	11.50	11.80	12.30	12.20
			(6.37)	(4.70)	(4.80)	(4.93)	(5.01)	(4.05)	(4.05)	(4.04)	(4.10)	(5.00)	(4.30)	(4.24)	(4.40)	(4.55)	(3.54)	(3.58)	(3.65)	(3.63)
	Dinotefuran (20%) SG	25.0	40.19	13.60	14.25	15.32	16.47	7.50	8.00	9.10	10.30	23.82	14.37	15.42	16.60	18.49	7.50	8.30	8.60	8.60
			(6.42)	(3.82)	(3.91)	(4.04)	(4.18)	(2.92)	(3.00)	(3.18)	(3.36)	(4.98)	(3.92)	(4.05)	(4.20)	(4.41)	(2.92)	(3.05)	(3.10)	(3.10)
	Dinotefuran (20%) SG	30.0	42.81	9.10	10.57	10.57	11.89	6.80	6.60	7.00	7.80	23.55	9.30	10.02	11.02	11.89	6.50	7.00	7.50	7.30
			(6.62)	(3.18)	(3.40)	(3.40)	(3.59)	(2.79)	(2.76)	(2.83)	(2.97)	(4.95)	(3.21)	(3.32)	(3.47)	(3.59)	(2.74)	(2.83)	(2.92)	(2.88)
	Imidacloprid (17.8%) SL	22.5	40.74	18.84	21.19	22.19	22.79	16.50	16.80	17.00	18.30	23.69	17.40	18.35	19.67	21.07	12.30	12.40	13.40	13.40
			(6.46)	(4.45)	(4.70)	(4.82)	(4.88)	(4.18)	(4.22)	(2.24)	(4.39)	(4.97)	(4,.29)	(5.40)	(4.55)	(4.70)	(3.65)	(3.66)	(3.79)	(3.79)
	Thiamethoxam (25%) WG	25.0	40.28	17.89	19.35	20.42	21.52	15.20	15.00	15.10	17.20	24.67	16.59	17.69	18.37	21.09	12.00	12.50	12.50	12.40
			(6.42)	(4.35)	(4.51)	(4.63)	(4.74)	(4.02)	(4.00)	(4.01)	(4.27)	(5.07)	(4.19)	(4.32)	(4.40)	(4.70)	(3.61)	(3.67)	(3.67)	(3.66)
7	Untreated control	—	41.23	42.60	44.42	46.11	48.26	27.00	30.08	30.30	31.70	23.89	23.09	25.30	26.50	27.05	18.10	19.70	20.30	20.30
			(6.50)	(6.60)	(6.74)	(6.86)	(7.02)	(5.29)	(5.57)	(5.59)	(5.72)	(4.99)	(4.91)	(5.13)	(5.20)	(5.30)	(4.37)	(4.55)	(4.62)	(4.62)
	CV (%)		7.47	8.94	7.71	7.20	7.65	8.24	7.04	7.32	6.27	3.73	13.52	12.74	12.78	13.29	7.18	7.40	6.90	6.19
	S.Em ±		0.22	0.23	0.21	0.22	0.22	0.18	0.16	0.17	0.15	0.41	0.30	0.27	0.28	0.28	0.14	0.15	0.14	0.13
	CD (p=.05)		NS	0.72	0.64	0.66	0.66	0.56	0.49	0.52	0.46	NS	0.90	0.83	0.81	0.83	0.44	0.46	0.44	0.39

DBA - Days before application, DAA - Days after application, * Figures in the parentheses are square root (“X + 1) transformed values, ** Average of two seasons data

Table 3. Bio efficacy of Dinotefuran 20 per cent SG on predatory population and seed cotton yield

Treatment details	Dosage (g a.i./ha)	Number of predators/plant			Seed cotton yield (q/ha)**
		1 DBS	5 DAS	10 DAS	
Dinotefuran (20 %) SG	15.0	0.81 (1.35)	0.74 (1.32)	0.78 (1.33)	21.30 (4.72)
Dinotefuran (20 %) SG	20.0	0.76 (1.13)	0.66 (1.29)	0.72 (1.31)	22.48 (4.85)
Dinotefuran (20 %) SG	25.0	0.64 (1.28)	0.59 (1.26)	0.67 (1.29)	24.33 (5.03)
Dinotefuran (20 %) SG	30.0	0.73 (1.32)	0.62 (1.27)	0.65 (1.28)	27.04 (5.29)
Imidacloprid (17.8 %) SL	22.5	0.73 (1.32)	0.67 (1.29)	0.72 (1.31)	22.52 (4.85)
Thiamethoxam (25 %) WG	25.0	0.81 (1.35)	0.66 (1.29)	0.74 (1.32)	22.00 (4.80)
Untreated control	—	0.83 (1.35)	0.90 (1.38)	0.95 (1.40)	7.75 (2.96)
CV (%)	-	-	-	9.05	
S.Em ±	0.04	0.11	0.1	1.09	
CD (p=0.05)	NS	N.S	0.28	3.36	

DBA - Days before application, DAA - Days after application, * Figures in the parentheses are square root ("X + 1) transformed values., ** Average of two seasons data

cent SG @ 30 g a.i/ha registered highest seed cotton yield (27.04 q/ha) differed significantly with rest of the lower dosages *viz*., @ 25, 20 and 15 g a.i/ha treatment by recording 24.33, 22.48 and 21.30 q/ha, respectively, as well as with standard check imidacloprid and thiamethoxam recorded 22.52 and 22.00 q/ha, respectively.

Effect on natural enemies: Before application of treatments, predatory population *viz*. *Coccinellids*, spiders and *Chrysoperla* population was uniform among all treatments. The dinotefuran at any dosages did not cause adverse effect on predatory population at 5 and 10 days after application (Table 3).

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