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Bio-efficacy of insecticide imidacloprid 600FS as seed treatment against termite infesting on wheat

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ABSTRACT

Field experiments were conducted for testing the bio-efficacy of imidacloprid 600FS as seed treatment against termite infesting on wheat. The result showed none of the insecticidal treatments under study affect seed germination and plant stand. Seed treatment of imidacloprid 600FS @ 8.4 g a.i./ kg was highly effective against termite followed by treatment with lower dose of imidacloprid 600FS @ 4.2 g a.i./kg. The result of pooled data for per cent damaged effective tiller/m row showed that imidacloprid 600FS @ 8.4 g a.i./kg was have lowest per cent damage as compared to untreated check and it was at par with treatment with imidacloprid 600FS @ 4.2 g a.i./kg. Pooled data on grain yield indicated that higher yield was recorded in all above treatments of imidacloprid 600FS. The phytotoxicity study indicated no adverse effect of insecticides on any foliar part of wheat.

Key words: *Odontotermes abesus*, Microtermes obesi, bio efficacy, imidacloprid

Termite is the major pest of agricultural crops in tropical and sub-tropical regions of the world along with South Asia (Geddes and Iles, 1991; Kishor *et al.*, 2017). *Odontotermes obesus* (Rambur) and *Microtermes obesi* are the most destructive predominant species of termite infecting in wheat mainly in loamy and sandy loam soils (Chhillar *et al.*, 2006; Peterson *et al.*, 2006 and Potter, 2011). But, Gadhiya *et al.* (2012) reported that *Odontotermes obesus* (Rambur) was found as the dominant species of termite infesting in wheat. Presence of sandy loam soil moisture regime in Rajasthan provides more favorable condition for termite infestation as reported by Parihar, 1981. Termite damage was around 20 to 40 per cent in wheat crop was reported mostly in rainfed field condition (Misra *et al.*, 2003). The yield losses ranged from 43 to 80 per cent due to termite infestation in wheat as reported by Roonwal, 1979; Sattar and Salihah, 2001; Chhillar *et al.*, 2006 and Kakde *et al.*, 2006. Since, termites are extremely difficult to manage chemical pesticides are the only means for their management (Rathour *et al.*, 2014). Chemicals insecticides like chlorpyrifos, endosulfan, cypermethrin, imidacloprid, carbosulfan and triazophos were being recommended for control of termite (Kumawat, 2001 and Rana *et al.*, 2001). The efficacy of insecticide like imidacloprid showed nonsignificant difference in soil types of sandy loam and silty clay loam, but termiticide quantity increased with depth from injection point (Davis and Kamble, 2008) while in loamy soil, the higher application rates of insecticides like imidacloprid, fipronil and bifenthrin has resulted with greater efficiency of these insecticides against termite (Saran and Kamble, 2008). Thus, considering the importance of management of this pest, the present investigation was carried out to evaluate for bio-efficacy of imidacloprid 600FS as seed treatment against termite of wheat in field condition.

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MATERIALS AND METHODS

Field experiments were conducted during *Rabi* seasons of 2015-16 and 2016-17 for evaluating the bio-efficacy of imidacloprid 600FS as seed treatment against termite of wheat on cv. GW 496 at Wheat Research Station, S.D. Agricultural University, Vijapur, Gujarat. Experiments were laid out in Randomized Block Design (RBD) in three replications. The net plot size was 1.6m x 4m with row to row spacing of 20 cm. Eight treatments including different doses of imidacloprid @ 1.5, 1.8, 2.1, 4.2, 8.4 g a.i./kg,

thiamethoxam 30%FS @ 0.99 g a.i./kg, chlorpyrifos 20%EC @ 0.8 g a.i./kg and untreated control were evaluated against termite of wheat in field condition (Table 1). Germination percentage and number of plant population in all the treatment was recorded at 25 days after sowing along with seedling health and vigour of plants were also recorded during both the years of study. Observations of termite affected plants per plot at 25, 35, 45 days after sowing and at maturity were recorded and per cent damaged effective tiller/m row was calculated by using the formula given below.

$$\text{Per cent plant damage} = \frac{\text{No. of plant damage per meter row}}{\text{Total no. of plants per meter row}} \times 100$$

All the percentage data in all the treatments were subjected to angular transformations and analyzed statistically. The critical difference and standard error mean were calculated for the comparison of treatments and control. Moreover, observations for development of any adverse effects of phytotoxicity with different higher dosages of imidacloprid 600FS on wheat were recorded at 1, 3, 5, 7 and 15 days after germination by using scale given below.

0	No Phytotoxicity
1-10%	Phytotoxicity = 1 Scale
11-20	Phytotoxicity = 2 Scale
21-30	Phytotoxicity = 3 Scale
31-40	Phytotoxicity = 4 Scale
41-50	Phytotoxicity = 5 Scale
51-60	Phytotoxicity = 6 Scale
61-70	Phytotoxicity = 7 Scale
71-80	Phytotoxicity = 8 Scale
81-90	Phytotoxicity = 9 Scale
91-100	Phytotoxicity = 10 Scale

RESULTS AND DISCUSSION

During 2015-16 crop seasons, plant population per meter row counts made after 3 weeks of sowing revealed nonsignificant differences among all the treatments. Similarly, in confirmative test on germination, the results showed nonsignificant differences so none of the insecticidal treatments under study affected seed germination. Likewise, there were nonsignificant differences amongst all the insecticidal treatments in plant height and root length (Table 1). The data on per cent damaged effective tillers per meter row showed nonsignificant differences amongst the treatments. However, minimum damage (3.20 and 3.68) was observed in imidacloprid 600FS @ 2.1 g a.i./kg and imidacloprid 600FS @ 1.8 g a.i./kg. On the basis of number of damaged effective tillers/ha, the highest damage (4030) was recorded in untreated check. While, the lowest damage (3458) was recorded in imidacloprid 600FS @ 8.4 g a.i./kg followed by treatments of imidacloprid 600FS @ 2.1 g a.i./kg and imidacloprid 600FS @ 4.2 g a.i./kg (Table 2).

During 2016-17 crop seasons, similar result for germination, plant stand as mentioned above were observed (Table 1). The data on per cent damaged effective tillers per meter row showed significant differences among the treatments. No termite damage (0.00) was observed in treatments of imidacloprid 600FS @ 8.4 g a.i./kg and it was at par with imidacloprid 600FS @ 4.2 g a.i./kg. While, on the basis of number of damaged effective tillers/ha, there were no damage recorded in imidacloprid 600FS @ 8.4 g a.i./kg and it was at par with lower doses of imidacloprid 600FS @ 4.2 g a.i./kg (Table 2).

The result based on the pooled data on per cent damaged effective tillers/m row showed that minimum damage (2.01) was observed in treatment of imidacloprid 600FS @ 8.4 g a.i./kg followed by imidacloprid 600FS @ 4.2 g a.i./kg as compared to untreated control where highest damage (22.28) was recorded. Similarly, the pooled data on number of effective tillers/ha showed that treatment imidacloprid 600FS @ 8.4 g a.i./kg was found with minimum damage (1856) of termite in the field condition and it was at par with treatment of imidacloprid 600FS @ 4.2 g a.i./kg (Table 2).

The grain yield on the basis of gram per meter row and q per ha recorded during 2015-16 crop season revealed that the highest yield (51 g/m and 23.65 q/ha) was recorded in treatments of imidacloprid 600FS @ 8.4 g a.i./kg and it was at par with imidacloprid 600FS @ 4.2 g a.i./kg followed by imidacloprid 600FS @ 2.1 g a.i./kg. Similarly, the grain yield recorded in gram per meter and q per ha during 2016-17 crop seasons revealed that the highest yield (52 g/m and 27.08 q/ha) was noticed in treatment of imidacloprid 600FS @ 8.4 g a.i./kg and it was at par with imidacloprid 600FS @ 4.2 g a.i./kg followed by imidacloprid 600FS @ 2.1 g a.i./kg. In the same way, pooled data on grain yield on both gram per meter row and q per ha indicated that higher yield was recorded in the all treatments of imidacloprid 600FS as compared to rest of treatments (Table 2).

During the both the experimental years of study, the observations on phytotoxicity recorded at 1, 3, 5, 7 and 15 days after germination showed that there were no visible development of phytotoxicity symptoms on foliar part of wheat in all the insecticidal treatments

Table 1 Effect of insecticidal treatments on germination and plant stand recorded at 25 days after sowing

SN	Treatments	Dose (g a.i. /kg)	Germination %			Plant stand			Seedling health and vigour					
			2015 -16	2016 -17	Pooled	2015 -16	2016 -17	Pooled	2015-16		2016-17		Pooled	
									PH	RL	PH	RL	PH	RL
1	Untreated control	-	85.67	81.00	83.34	39.00	39.00	39.00	22.20	5.13	22.58	5.23	22.39	5.18
2	Imidacloprid 600 FS	1.50	84.33	87.00	85.67	36.00	36.00	36.00	21.40	4.87	21.76	4.80	21.58	4.84
3	Imidacloprid 600 FS	1.80	84.33	86.33	85.33	36.00	37.00	36.50	21.86	4.77	23.54	5.07	22.70	4.92
4	Imidacloprid 600 FS	2.10	83.67	88.00	85.84	38.00	39.00	38.50	22.18	5.70	22.14	5.73	22.16	5.72
5	Thiamethoxam 30% FS	0.99	83.00	84.33	83.67	38.00	38.00	38.00	20.89	5.27	22.56	5.27	21.73	5.27
6	Chlorpyrifos 20% EC	0.80	83.33	87.67	85.50	40.00	40.00	40.00	21.85	4.93	21.87	5.13	21.86	5.03
7	Imidacloprid 600 FS	4.20	85.00	87.00	86.00	40.00	41.00	40.50	22.69	4.63	22.62	4.70	22.66	4.67
8	Imidacloprid 600 FS	8.40	82.67	85.67	84.17	35.00	35.00	35.00	22.47	5.70	21.58	5.30	22.03	5.50
	S.Em ± T		2.79	3.11	0.49	2.34	2.56	0.89	0.98	0.30	0.76	0.69	0.87	0.50
	Y × T		-	-	0.75	-	-	1.30	-	-	-	-	0.40	0.23
	C.D. at 5% T		NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
	Y × T		-	-	NS	-	-	NS	-	-	-	-	NS	NS

• PH= Plant height, RL= Root length

Table 2 Effect of insecticidal treatments on damage and yield against termite of wheat

S N	Treatments	Dose (g a.i. /kg)	% damaged effective tillers/m row			No. of damaged effective tillers/ha			Grains yield g/m row			Grains yield q/ha		
			2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled	2015-16	2016-17	Pooled
1	Untreated control	-	15.52*** (12.18)	29.03*e (23.55)**	22.28*g (17.86)**	4030^{+}c (592543)$^{++}$	2963^{+}e (123061)$^{++}$	3497^{+}g	22e (357802)$^{++}$	27d	25d	15.35	18.33	16.84
2	Imidacloprid 600 FS	1.50	5.02	6.13c (0.82)	5.58de (1.14)	3774bc (0.98)	1927bcd (406743)	2851de (26719)	32cd (216731)	43abc	38bc	20.99	21.77	21.38
3	Imidacloprid 600 FS	1.80	3.68	5.41c (0.45)	4.55cd (0.89)	3654ab (0.67)	1752bc (340816)	2703c (20655)	39bc (180735)	45ab	42bc	22.14	23.39	22.76
4	Imidacloprid 600 FS	2.10	3.20	4.55bc (0.31)	3.88c (0.63)	3577ab (0.47)	1529b (304103)	2553b (14884)	44ab (159493)	47ab	46ab	22.50	24.06	23.28
5	Thiamethoxam 30% FS	0.99	4.17	9.46d (0.53)	6.82e (2.70)	3612ab (1.61)	2247cd (320125)	2930ef (42827)	36bcd (362952)	30cd	33cd	21.65	21.65	21.65
6	Chlorpyrifos 20% EC	0.80	4.24	14.80 (0.55)	9.52f (6.52)	3643ab (3.53)	2422de (335290)	3033f (55452)	27de (195371)	35b	31d	18.85	20.31	19.58
7	Imidacloprid 600 FS	4.20	4.83	1.61ab (0.78)	3.22bc (0.79)	3711ab (0.78)	470a (370442)	1964a (3125)	49a (129144)	50a	50ab	23.59	25.99	24.79
8	Imidacloprid 600 FS	8.40	4.02	0.00a (0.49)	2.01a (0.00)	3458a (0.24)	000a (255164)	1856a (0000)	51a (185221)	52a	52a	23.65	27.08	25.36
	S.Em. ± T		3.97	0.99	0.53	86.00	189.00	45	3.00	3.13	3.06	1.77	1.58	0.48
	Y × T		-	-	0.7	-	-	67	-	-	1.50	-	-	1.8
	C.D. at 5% T		NS	3.01	1.51	261.00	574.00	129	9.00	9.48	9.24	NS	4.79	1.72
	Y × T		-	-	NS	-	-	NS	-	-	NS	-	-	5.31
	C.V.%		123.50	19.38	65.00	4.05	19.71	9.23	14.4	13.17	12.77	14.49	12.00	2.40

Table 3 Pooled data of 2015-16 and 2016-17 crop seasons for phytotoxicity of higher dose of imidacloprid 600FS

S.N.	Treatments	Dose (g a.i./kg)	Phytotoxicity (%)					
			Leaf injury	Chlorosis	Necrosis	Wilting	Epinasty	Hyponasty
1.	Untreated check	-	0	0	0	0	0	0
2.	Imidacloprid 600FS	2.10	0	0	0	0	0	0
3.	Imidacloprid 600FS	4.20	0	0	0	0	0	0
4.	Imidacloprid 600FS	8.40	0	0	0	0	0	0

which indicated that seed treatment of imidacloprid 600FS was safe for controlling termite of wheat (Table 3).

Similar results were reported by Mishra *et al.* (2007) where maximum plant stand (77.7 plant/m^2), minimum damaged tillers (5 tillers/plot) and maximum grain yield (42.2 q/ha) were obtained with seed treatment of imidacloprid @ 2 ml/kg seed followed by chlorpyrifos @ 5 ml/kg seed against termite of wheat. The above finding also supported by Kishor *et al.* (2017) where significant control of termite in wheat was observed in treatment of imidacloprid 600FS @ 1.5 lit/ha. The data are closely related with the results recorded by Singh *et al.* (2015) where the minimum damaged number of effective tillers/ha were recorded in seed treatment of fipronil followed by imidacloprid and thiamethoxam as well as the reported grain yield in both g/m row and q/ha were significantly higher in treatment of fipronil followed by imidacloprid and thiamethoxam against termite of wheat. Moreover, the effectiveness of imidacloprid as seed treatment against internal feeders of sorghum and pest complex of pearl millet has also been reported (Kishore and Barman, 2003; Katole *et al.*, 2003; Noor, 2003). Likewise, seed treatment with imidacloprid 70WS @ 10 g/kg seed and imidacloprid 600FS @ 8 ml/kg seed were reported as effective against termite of pearl millet (Ameta *et al.*, 2006).

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