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Assessment of the Damaged and Population of Termites (*Odontotermes* & *Unicolor*) under Various Methods of Insecticide Application

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ABSTRACT

Effect of insecticides on germination, bud damage and population of termites was observed by planting a variety HSF 240 of sugarcane at Pir Ghazi Shah Farm, Shakarganj Sugar Mills, Ltd. Jhang, under Randomized Complete Block Design having seven treatments (imaidacloprid 50 SC @ 125 mL; imidacloprid 50 SC @ 250 mL; thiamethoxam 25 WG @ 25 g; thiamethoxam 25 WG @ 50 g; flufenoxuron 10 DC @ 200 mL; flufenoxuron 10 DC @ 400 mL acre^{-1}; control) with three replications. Effect of chemicals on the foraging of the termites was determined by sowing a sugarcane variety FSH-185 was sown (September, 2005) at above farm having four treatments (chlorpyrifos 40 EC @ 1 L, bifenthrin 10 EC @ 250 mL, thiamethoxam 25 WG @ 50 g & Control) with five replications. Thiamethoxam (50 g acre^{-1}) treated plots had 42.37 and 43.83% germination at 60 and 75 days after sowing. However, imidacloprid at 125 and 250 mil acre^{-1} proved repellent towards the termites as it showed the lowest termites' count among other treatments. In the second experiment, foraging termites were, though non-significantly different from other treatments, restricted by thiamethoxam as less number of termites was counted from thiamethoxam treated plots either setts treatment or soil application in connection with irrigation. From these results, it is concluded that thiamethoxam and imidicloprid could be a good alternate of the chlorpyrifos and bifenthrin.

Key Words: Termites; Chemical control; Foraging; Germination; Sugarcane

INTRODUCTION

Chlorpyrifos, imidacloprid and bifenthrin along with insect growth regulators (hexaflumuron & fenoxycarb) have been used to manage/suppress subterranean termites in sugarcane particularly and maize, wheat and groundnut as well (Singla & Singh, 1998; Mishra, 1999; Rana *et al*., 2001; Singh & Singh, 2001; Santharam *et al*., 2002; Singh & Singh, 2002a, b & c; Saroj-Jaipal & Singh, 2003; Singh & Singh, 2003; Ahmed *et al*., 2006).

Sugarcane is vulnerable to termites at initial and later stages of growth (Miranda *et al*., 2004). Major infestation of termites on setts at the time of sowing results in total failure of germination, if left un-protected. Mode of application of the insecticides are either spraying various insecticide concentrations on setts or using dose per acre in flood irrigation. The success of these applications is highly variable depending upon the soil type and compaction and termites' infestation level. Soils with good retention provide better protection with insecticides than soils with loose structure, which allows faster infiltration and less availability/persistence of insecticides (Gold *et al*., 1996). The rate and methods of application under these circumstances are important factors, which affect the control of subterranean termites (Madan & Singh, 1998).

The major constraint in termites' management through these new chemicals in sugarcane was what would be appropriate method and frequency of application in the area of the problem? The present study was conducted at the Farms of Shakarganj Sugar Mills Ltd. Jhang. The soil of the farms is sandy, with pH, organic matter and available Nitrogen and phosphorus in the range, respectively of 7.5 - 7.74, 0.84 - 0.94%, 0.035 - 0.04%, 11.5 - 12 ppm, 125 - 130 ppm. Press mud has been added into these farms in continuous terms as fertilizer. In two separate experiments the control of termites was sought out in two seasons of the crop sowing i.e., February and September. In the first experiment, the best insecticides for setts' treatment was determined and in second experiment the foraging of termites as suppressed by the insecticide treatments was investigated to formulate the year round management of termites at the Farms.

MATERIALS AND METHODS

Effect of insecticides on germination and bud damage and population of termites. Sugarcane crop of variety HSF 240 was sown (Mid February, 2005) at Pir Ghazi Shah Farm, Shakarganj Sugar Mills, Ltd. Jhang, under Randomized Complete Block Design having seven treatments with three replications. Plot size for each was 7.27 m x 9.69 m with 6 rows of sugarcane by keeping row-to-row distance of 1.21 m.

Detail of insecticide treatments (rate per acre) is as follows; imaidacloprid 50 SC @ 125 mL; imidacloprid 50 SC @ 250 mL; thiamethoxam 25 WG @ 25 g;

thiamethoxam 25 WG @ 50 g; flufenoxuron 10 DC @ 200 mL; flufenoxuron 10 DC @ 400 mL; control Buds on setts at different places were observed randomly by removing the soil over the setts carefully from each plot of a treatment. Damaged buds and total buds observed were pooled from three plots of treatments. The observation on bud damage was started 15 days after application of insecticide until germination.

After that damage on seedlings, germination was observed by randomly observing 25 seedlings from each plot of the treatment. The damaged seedlings were easily up-rooted, having eaten lower portion.

Termites' count was estimated by digging the soil (15 x 15 x 15 cm) between furrows. Soil was spread on a black cloth, observed carefully for termites counting.

Insecticides were sprayed on setts in furrows at sowing time.

Effect of chemicals on the foraging of the termites. Sugarcane variety FSH-185 was sown (September, 2005) in Pir Ghazi Shah Farm Shakarganj Sugar Mills, Jhang under Randomized Complete Block Design having four treatments (including control) with five replications. Size of each plot was 43 ft x 44 ft with 11 rows having row-to-row distance of 4 ft.

The detail of insecticide treatments (rate acre^{-1}) was as follows: chlorpyrifos 40 EC @ 1 L, bifenthrin 10 EC @ 250 mL, thiamethoxam 25 WG @ 50 g and Control Insecticide was sprayed on setts in furrows at sowing time. Termites' counts were estimated by digging the soil (15 x 15 x 15 cm^3) between furrows. Soil was spread on a black cloth, observed carefully for termites. Later on application was done keeping in view the termite population and damage in the field. Data for population was taken with ten days interval (from September to April). Later on application was done keeping in view the termites' population and damage in the field. Data were taken at ten days intervals.

Percentage germination. In order to determine the Percentage germination of sugarcane setts number of buds was calculated before sowing the crop and number of germinated bud 15 days after sowing to determine the percentage germination of sugarcane setts for each pesticide treatment as termites lower the germination by damaging. It was determined by following formula:

$$\text{Germination percentage} = \frac{\text{No. of germinated bud}}{\text{Total Buds}} \text{x100} = \text{Damage on buds}$$

Damage on seedling. Percentage of damaged seedlings was determined by following formula:

$$\text{Damage seedling percentage} = \frac{\text{Damaged seedling}}{\text{Total seedling}} \text{x100}$$

One monitor (holed PVC pipe filled with corrugated card board) was installed in order to monitor the termites in treated plots.

Statistical analysis. The comparison of treatments percentage germination and damage on seedling was done by Duncan's Multiple Range Test at p = 0.05. Comparison of the means for population count was done with Mann-Whitney's test.

RESULTS

Effect of insecticides on germination and bud damage and population of termites. The germination percentage of sugarcane was non-significantly different among the treatments at 15 and 30 days after sowing (P > 0.05).

The difference in germination became statistically significant at 45 days after sowing. Thiamethoxam (50 g acre^{-1}) with mean value of 37.47% was at par with thiamethoxam (25 g acre^{-1}) (31.81%). Thiamethoxam (50 g acre^{-1}) treated plots had 42.37 and 43.83% germination at 60 and 75 days after sowing and were followed by thiamethoxam (25 g acre^{-1}). Imidacloprid, flufenoxuron at two rates of application had non-significant difference with control treatments at three time points. The low rate of application of thiamethoxam had non-significant difference with imidacloprid and flufenoxuron (Table I).

Damage and Population: No damage and population was found in all the treated and un-treated plots up to 120 days after sowing. Table II shows the termites' counts taken at this time point. Imidacloprid (125 mL acre^{-1}) and imidacloprid (250 mL acre^{-1}) with median 2.37 and 3.33 were at par with thiamethxom at two application rates (25 g & 50 g acre^{-1}). Flufenoxuron at both rates had non-significant difference with thiamethxom (25 g acre^{-1}) (Table II).

Table I. Germination percentage of sugarcane at various post treatment intervals

Treatments	Rate acre^{-1}	45 days	60 days	75 days
Imidacloprid	125ml	23.40cd	27.70bc	30.60bc
Imidacloprid	250ml	26.33bc	31.26bc	32.13b
Thiamethoxam	25g	31.81ab	35.03ab	38.10ab
Thiamethoxam	50g	37.47a	42.37a	43.83a
Flufenoxuron	200ml	28.83bc	29.77bc	31.09bc
Flufenoxuron	400ml	24.73bc	32.97abc	33.87b
Control		17.53d	22.27c	22.51c
	LSD	6.656	9.869	8.677

Means sharing same letters are not significantly different at p=0.05.

Table II. Termites' counts in insecticides treated sugarcane plots

		Established median	
Treatments	Rate acre^{-1}	120 days	150 days
Imidacloprid	125ml	2.33d	4.00c
imidacloprid	250ml	3.33d	0.00c
Thiamethoxam	25g	33.33bcd	69.00bc
Thiamethoxam	50g	16.67cd	52.33bc
Flufenoxuron	200ml	120.0ab	191.70a
Flufenoxuron	400ml	108.70abc	136.70ab
Control		185.0a	216.00a

Table IIIa. Termites' count in plots with application of chlorpyrifos, bifenthrin and thiamethoxam on setts (2005 - 06)

	30/10	10/11	20/11	30/11	10/12	20/12	30/12
			Established median of termites' count				
Chlorpyrifos	0.00	0.00	41.25	23.25	37.13	18.00	29.38
Bifenthrin	0.00	0.00	80.75	55.75	42.37	32.00	32.87
Thiamethoxam	0.00	0.00	77.25	10.00	22.62	18.50	23.12
Control	0.00	0.00	83.75	94.00	95.38	61.50	57.13
p value	**0.57**	**1.00**	**0.41**	**0.15**	**0.23**	**0.08**	**0.06**

Table IIIb. Termites' count in plots with treatment of chlorpyrifos, bifenthrin and thiamethoxam as second application

	19/1	29/1	8/2	18/2	28/2	9/3	19/3	29/3	8/4	18/4	28/4
					Established median of termites' count						
Chlorpyrifos	-2.62	-2.38	0.62	0.00	22.25	13.12	11.63	28.87	0.00	13.50	2.38
Bifenthrin	14.38	14.63	29.63	0.00	30.75	24.63	34.12	45.12	0.00	16.25	26.12
Thiamethoxam	2.62	2.38	-0.62	13.25	26.75	6.87	45.88	41.87	0.00	12.50	9.87
Control	63.13	53.88	55.87	70.75	69.25	47.88	46.88	88.62	79.0	52.75	50.12
p value	**0.00**	**0.07**	**0.11**	**0.05**	**0.01**	**0.11**	**0.14**	**0.02**	**0.01**	**0.02**	**0.05**

Results of the effect of chlorpyrifos 40 EC, bifenthrin 10 EC and thiamethoxam 25 WG are given in Table IIIa and b.

The first treatment of insecticide was carried out on setts of sugarcane at the time of sowing and data was recorded from 30 - 10 - 2005 to 9 - 01 - 2006. The second treatment was done during 9 - 01 - 2006 to 19 - 01 - 2006, because number of termites after the first treatment started rising during 30 - 12 - 2005 to 9 - 01 - 2006. All treatments had non-significant difference among them in the latter period with p-value ranging from 0.06 to 1.00. The significant differences were observed among the treatments on 19/1, 28/2, 29/3, 8/4 and 18/4 ($p < 0.05$) in the second application. Chlorpyrifos and thiamethoxam showed less termites' count as compared to bifenthrin.

DISCUSSION

Termites are known to live in soil as subterranean pests and damage to sugar cane is caused by the excavation of the cane setts, leading to the death of the buds and young shoots. The seedlings of damaged cane setts are not established, because the primordial roots that developed do not function, due to destruction of the inner tissue of the cane setts. This probably explains the high incidence of termites observed on cane setts and seedlings. *Microtermes* and *Macrotermes* were both found at later stages of growth in sugarcane. They are known to be the most damaging species of termite in Pakistan (Ahmed *et al*., 2006).

Main emphasis for these experiments was to establish a base-line application rate for the maximum protection of the sugarcane at sowing and later stages of growth from the termites in the area of the study. The studies were therefore carried out through the year. The fields of the experiments were adjacent and had the history of the termites' infestation in the last three years. The managers of the farm are of the view that double the dose than that applied in the present study have been applied but termites reappeared and damaged the crops most of the time.

Maximum germination and less bud damage were observed in thiamethoxam (50 g acre^{-1}) treated plots, followed by dose level at 25 g (acre^{-1}). Thiamethoxam also showed fewer termites' count than bifenthrin in the application with irrigation. Delgrade and Rouland-lefevre (2002) showed efficacy of the thiamethoxam in the laboratory against african and brazilian strains of the termites. The efficacy of chlorpyrifos and bifenthrin has been reported elsewhere (Singla & Singh, 1998 & 2002; Santharam *et al*., 2002; Jaipal & Singh, 2003) and on that basis the results of the present studies are being confirmed.

Flufenoxuron is a growth regulator (chitin synthesis inhibitor). There is no scientific information about its use in the field as soil application. An unpublished data from our laboratory reveal the LT_{50} (2.51 & 4.59 h) of flufenoxuron against *Microtermes obesi* and *Odontotermes obesus* (Ramb.). It is difficult to state that flufenoxuron was not lethal to termites as it has been statistically similar to other insecticides in preventing the damage. Flufenoxuron has been used in baits and it was found that baits treated with fenoxycarb and flufenoxuron have been accepted by foraging termites in the field for a minimum of 3 weeks (Su, 2002). Further studies are suggested to investigate the potential of flufenoxuron as termiticides in different types of soils and habitats.

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