

Effects of Neem Leaf and Seed Extract in Controlling Termites and Yield Components of Sugarcane

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ABSTRACT

Termite is one of the major insect pests which dramatically reduce the production of sugarcane. The study was conducted with different doses of neem leave and seed extract to determine the effectiveness against sugarcane termites and their effects on the growth and yield parameter of sugarcane in growers field during the cropping season 2010-11 and 2011-12 at Sreepur, Gazipur, Bangladesh. The extracts were made by boiling the grinded neem leaves and seeds in water for 30 minutes with the ratio 1:10 then cool it and applied them at 40 litre ha⁻¹, 60 litre ha⁻¹ and 80 litre ha⁻¹ & thrice during plantation, after 60 days and 120 days of plantation. All the treatments were found effectively controlled termite population compared to the control treatment. Among the treatments, neem leaf extract @ 80 litre ha⁻¹ showed better performance on termite infestation in pool percent efficacy (72.94%) in 2010-2011 and 43.73% efficacy in 2011-2012 over untreated plot which corresponding produced the highest (106.90x10³) tillers, highest (88.11x10³) millable cane, highest yield (96.11 t ha⁻¹) in 2010-11 and highest (167.00x10³) tillers, highest (130.00x10³) millable cane, highest (96.17 t ha⁻¹) yield in 2011-2012. The number of termites was found higher in control plot than neem leaves and seed extract treated plot. Number of tiller, millable cane and yield were increased in neem leaves and seed extract treatment over control plot. Neem leaves extract @ 80 litre ha⁻¹ performed better compared to Regent 3GR (standard) treatment in respect to number of tiller, millable cane and yield of sugarcane. This study revealed that neem seed and leaves extract had the influence on reduction of termite infestation as well as enhanced the production of tiller, millable cane and yield of sugarcane.

Key words: Sugarcane, neem extract, termite, infestation, yield

INTRODUCTION

Termite, *Microtermes obesi* Holm (*Termitidae: Isoptera*) is one of the serious pests of sugarcane. It is found in wide range of terrestrial environments and distributed throughout the tropical, subtropical and temperate region of the world (Freise, 1949; Krishna and Weesner, 1970; Pearce, 1997). Some termite species extend their range of occurrence to the relatively cool zones to temperate regions (Emerson, 1955; Araujo, 1970; Wood and Johnson, 1986; Eggleton, 1999). Subterranean termites are the major problem which affect the sugarcane crop from its germination through shoot

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emergence and finally on the quality of cane. Termite infestation at germination stage goes up to 90-100% have been recorded in sugarcane (Salihah *et al.*, 1988; Sattar and Salihah, 2001 and Ahmed *et al.*, 2007). It may also cause 30-60% destruction of buds reported by Singh and Kishan (1946), Teotia *et al.* (1963) and Roonwal (1981) while Avasty (1967) reported it to be 40%, which results in yield loss of 33 percent. Alam and Miah (1997) reported that there are five species of termite have been identified destructive to sugarcane in Bangladesh. Termite lives in the soil and damage sugarcane by excavating through the cane setts, leading to the death of buds and young shoots (Koto *et al.*, 2000). Termite may attack any part of sett, but in the hard-rinded varieties, they prefer to attack the ends, eye buds and root bands (Choudhary *et al.*, 1986 and Mill, 1992). As many as 13 species of termites are reported to cause damage to sugarcane in India. The species which cause most frequently damage are *Odontotermes obesus* and *Microtermes obesi* and they are major species in various sugarcane growing parts of the country (Chhotani, 1967). Generally the accepted method of termite control over the years has been chemical pesticides. The toxic materials are accumulated in fatty tissues of insects and other living organisms including mammals which results in resistance to insect and fatal to human (Cremlyn, 1979). However, chemicals are expensive, laborious and much harmful.

Neem (*Azadirachta indica*) is a tree belongs to the family *Meliaceae*. It is one of the source of environment friendly botanical pesticide. Among the isolated neem constituents, limonoids (such as *Azadirachtin*) are effective in insect growth regulating activity. The unique feature of neem products is that they do not directly kill the pests, but alter the life processing behaviour in such a manner that the insect can no longer feed, breed or undergo metamorphosis (Ganguli, 2002; Siddiqui, 1942). Neem (Emulsifiable Concentrate) is well suited for an "Integrated Pest Management (IPM)" program because of the following salient features: is a natural product, absolutely nontoxic, 100% biodegradable and environment friendly, compatible with other synthetic pesticide, does not destroy natural predators and parasites of pests thereby allowing these natural enemies to keep a check on the pest population, is harmless to non target and beneficial organisms like pollinators, honey bees, mammals and other vertebrates. Neem emulsifiable concentrate have effects on suppressing hormonal activity, feeding deterrence and oviposition deterrence. Neem cake also acts as a natural fertilizer with pesticidal properties. The bitter principles of the soil and cake have been reported to have seven types of activities; (a) antifeedant (b) attractant (c) repellent (d) insecticide (e) nematocide (f) growth disruptor and (g) antimicrobial. Plant parts and plant extracts can be used effectively because these are less expensive and less hazardous to environments. Therefore, the main purpose of this study was to find out the effectiveness of neem leaves and seed extract against termite instead of synthetic chemicals that are detrimental to the environment due to their hazardous effect.

MATERIALS AND METHODS

In sugarcane field, the effect of neem leaf and seed extract against termite population was evaluated through conducting the experiment at Sreepur, Gazipur during 2010-11 and 2011-12 cropping season following randomized complete block design with three replications. Neem leaves and seed were grinded by an electric blender then boiled in water for 30 minutes with the ratio 1:10 for getting extract. The extracts were used in thrice- one during planting and rest two splits were applied 60 days and 120 days interval after planting. The variety Isd 36 was planted in 6 m x 5 m plot. Line to line distance was 1 m and plot to plot 2 m. Two eyed setts were prepared and placed in the trenches. Then extracts were applied @ 40, 60 and 80 litre ha⁻¹ in trenches after placement of setts and then setts were covered with soil. Intercultural operation like weeding, earthing up, mulching, and irrigation were done as per schedule. Data on termite population were collected twice in mid April and mid July. Also data were collected on growth and yield parameter i.e. tillers at tillering stage, millable cane and yield of sugarcane at harvesting. Statistical analysis was done with MSTAT-C program and treatment means were compared with the control. Percent efficacy of insecticides was calculated by the following formula:

$$\text{Efficacy (\%)} = \frac{P_u - P_t}{P_t} \times 100$$

Where, P_u = Population of termite in untreatment

P_t = Population of termite in treatment

RESULTS AND DISCUSSION

Sugarcane production is diminishing due to the infestation of different insect pest. Among them termites are one of the most destructive which damages sugarcane from plantation (sett) to harvesting. The results were presented as following:

Termite infestation

It is observed that during data collection in April 2011 showed some reduced trend in termite population in all treatments except Neem leaves extract @ 40 litre ha⁻¹ followed by Neem seed extract @ 40 litre ha⁻¹ over control plot. The reduction efficacy of termite population ranged from 14.36% to 77.42% in different treatments. The highest (77.42%) reduction was observed in Regent 3GR @ 16.66 kg ha⁻¹ treated plot and the lowest (14.36%) reduction was obtained in Neem leaves extract @ 40 litre ha⁻¹ treated plot. But none showed 80% reduction efficacy over control plots. However in July data, all the treatment showed reducing trend of termite population over control plot and those are almost statistically similar. The highest (83.46%) reduction efficacy was observed in Regent 3 GR @ 16.66 kg ha⁻¹ followed by Neem leaves extract @ 80 litre ha⁻¹ were the efficacy reached (81.10%). Pooled efficacy percent showed that only Regent 3 GR @ 16.66 kg ha⁻¹ reached 80.44% efficacy over control plot, the desired level of reduction of termite population (Table 1).

Data presented in Table 2 showed that termite population in April 2012 was almost similar in all treatments showing no difference over control plot, rather in some treatments higher (94.00%) population of termite is observed in Neem seed extract @ 60 kg ha⁻¹ followed by Neem seed extract @ 40 kg ha⁻¹ (92.00). The efficacy in April 2012 showed a range from 8.17% to 58.46% in termite control. The highest (58.46%) reduction is observed in Regent 3 GR @ 16.66 kg ha⁻¹ treated plot. Similar reduction trend of termite population in July 2012 data observed in all the treatments including control plot. The highest (80.73%) reduction efficacy was noticed in Regent 3 GR @ 16.66 kg ha⁻¹ treated plot. None of the treatments showed highest efficacy of 80.00% reduction of termite in pooled percent efficacy. Delate and Grace (2009) found in their study that neem bark caused significantly termite mortality (56.40%) and the neem (*A. indica*) is a source of natural compounds with potent insecticidal feeding deterrent and insect growth regulator activities. Deka and Singh (2002) also reported the reduction of termite infestation in sugarcane with neem seed extracts. The neem cake contains salannin, nimbin, azadirachtin and azadiradione as the major components. Of these, azadirachtin and meliantriol are used as locust antifeedants while salannin is used as an antifeedant for the housefly (Schmutterer, 2002; Tewari, 1992; Vietmeyer, 1992 and Puri, 1999).

Table 1. Efficacy of different doses of botanical products in controlling sugarcane termites, Sreepur, Gazipur, 2010-11

Treatments	April 2011		July 2011		Pool efficacy (%)
	Termite pop ⁿ (Mean)	Efficacy (%)	Termite pop ⁿ (Mean)	Efficacy (%)	
Neem leaves extract @ 40 litre ha ⁻¹	147.00	14.36	17.00	59.05	36.70
Neem leaves extract @ 60 litre ha ⁻¹	86.00	49.98	11.00	74.79	62.38
Neem leaves extract @ 80 litre ha ⁻¹	60.00	64.78	8.00	81.10	72.94
Neem seed extract @ 40 litre ha ⁻¹	104.00	39.28	16.00	61.42	50.35
Neem seed extract @ 60 litre ha ⁻¹	51.00	70.22	10.00	76.37	73.29
Neem seed extract @ 80 litre ha ⁻¹	92.00	46.29	15.00	64.56	55.42
Regent 3 GR @ 16.66 kg ha ⁻¹	39.00	77.42	7.00	83.46	80.44
Control	171.00	-	42.00	-	-
LSD (0.05)	35.87	-	9.80	-	-

NB: Popⁿ=Population

Table 2. Efficacy of different doses of neem leaf and seed extract in controlling sugarcane termites, Sreepur, Gazipur, 2011-12

Treatments	April 2012		July 2012		Pool efficacy (%)
	Termite pop ⁿ (Mean)	Efficacy (%)	Termite pop ⁿ (Mean)	Efficacy (%)	
Neem leaves extract @ 40 litre ha ⁻¹	79.00	8.17	11.00	45.63	26.90
Neem leaves extract @ 60 litre ha ⁻¹	76.00	13.21	10.00	47.36	30.28
Neem leaves extract @ 80 litre ha ⁻¹	60.00	29.57	8.00	57.89	43.73
Neem seed extract @ 40 litre ha ⁻¹	92.00	7.40	16.00	15.78	11.59
Neem seed extract @ 60 litre ha ⁻¹	94.00	10.12	11.00	43.89	27.00
Neem seed extract @ 80 litre ha ⁻¹	51.00	40.46	12.00	38.63	39.54
Regent 3 GR @ 16.66 kg ha ⁻¹	39.00	58.46	4.00	80.73	69.59
Control	86.00	-	19.00	-	-
LSD (0.05)	28.02	-	5.54	-	-

NB: Popⁿ=Population**Yield parameters**

Results presented in table 3 revealed that the highest number of tiller ($106.90 \times 10^3 \text{ ha}^{-1}$) was observed in Neem leaves extract @ 80 litre ha⁻¹ treatment which was almost similar with Regent 3GR ($105.6 \times 10^3 \text{ ha}^{-1}$) and Neem seed extract @ 80 litre ha⁻¹ ($103.7 \times 10^3 \text{ ha}^{-1}$). Other treatments like Neem leaves extract @ 40 litre ha⁻¹ ($88.33 \times 10^3 \text{ ha}^{-1}$), Neem leaves extract @ 60 litre ha⁻¹ ($92.89 \times 10^3 \text{ ha}^{-1}$), Neem seed extract @ 40 litre ha⁻¹ ($93.77 \times 10^3 \text{ ha}^{-1}$), Neem seed extract @ 60 litre ha⁻¹ ($94.55 \times 10^3 \text{ ha}^{-1}$) produced tillers are at par with control ($88.55 \times 10^3 \text{ ha}^{-1}$) treatment. Similarly, the highest number of millable cane ($90.66 \times 10^3 \text{ ha}^{-1}$) was found in Regent 3 GR treated plot which are followed by Neem leaves extract @ 80 litre ha⁻¹ ($88.11 \times 10^3 \text{ ha}^{-1}$), Neem seed extract 40 litre ha⁻¹ ($86.22 \times 10^3 \text{ ha}^{-1}$), Neem seed extract 60 litre ha⁻¹ ($81.44 \times 10^3 \text{ ha}^{-1}$) and Neem seed extract @ 80 litre ha⁻¹ ($87.78 \times 10^3 \text{ ha}^{-1}$) and are statistically alike, and produced higher number of millable canes over control ($71.11 \times 10^3 \text{ ha}^{-1}$) treatment. However, the highest (96.11 t ha^{-1}) cane yield was found in Neem leaves extract @ 80 litre ha⁻¹ treatment followed by Regent 3GR (91.89 t ha^{-1}) and Neem seed extract @ 80 litre ha⁻¹ (94.55 t ha^{-1}) which are statistically similar. The treatments Neem leaves extract @ 60 litre ha⁻¹ (81.23 t ha^{-1}), Neem seed extract 40 litre ha⁻¹ (83.91 t ha^{-1}), Neem seed extract 60 litre ha⁻¹ (82.27 t ha^{-1}) showed higher yield over control (72.88 t ha^{-1}) treatments.

Results presented in table 4 revealed that in Neem leaves extract @ 80 litre ha⁻¹ treatment showed the highest (167.0x10³ ha⁻¹) number tiller, highest (130x10³ ha⁻¹) number of millable canes and highest (96.17 t ha⁻¹) yield over control. Regent 3GR treated plot showed similar response in the said parameters. Neem leaves extract @ 40 litre ha⁻¹ (119.00x10³ ha⁻¹), Neem leaves extract @ 60 litre ha⁻¹ (112.00x10³ ha⁻¹), Neem seed extract @ 40 litre ha⁻¹ (124.00x10³ ha⁻¹), Neem seed extract @ 60 litre ha⁻¹ (128.50x10³ ha⁻¹), Neem seed extract @ 80 litre ha⁻¹ (125.00x10³ ha⁻¹) showed similar response in tiller production which is at par with control (116.00x10³ ha⁻¹) treatments. Similarly, the highest (130.00x10³ ha⁻¹) number of millable cane was found in Neem leaves extract @ 80 litre ha⁻¹ treatment which is not significantly different from that of Regent 3GR (116.50x10³ ha⁻¹). All other treatments like Neem leaves extract @ 40 litre ha⁻¹ (64.00x10³ ha⁻¹), Neem leaves extract @ 60 litre ha⁻¹ (90.00x10³ ha⁻¹), Neem seed extract @ 40 litre ha⁻¹ (93.00x10³ ha⁻¹), Neem seed extract @ 60 litre ha⁻¹ (96.50x10³ ha⁻¹), Neem seed extract @ 80 litre ha⁻¹ (95.00x10³ ha⁻¹) produced tillers are similar to control (98.50x10³ ha⁻¹) treatments. Highest (96.17 t ha⁻¹) cane yield in Neem leaves extract @ 80 litre ha⁻¹ was achieved followed by Regent 3GR (87.81 t ha⁻¹) giving better response over control (71.82 t ha⁻¹). Other treatments showed yield response ranged from 66.80 to 71.40 t ha⁻¹, which are statistically alike giving no difference with control treatment (71.82 t ha⁻¹).

Table 3. Effects of neem leaf and seed extract on growth and yield parameters of sugarcane, Sreepur, Gazipur, 2010-11

Treatments	Tiller (x10 ³ ha ⁻¹)	Millable cane (x10 ³ ha ⁻¹)	Yield (t ha ⁻¹)
Neem leaves extract @ 40 litre ha ⁻¹	88.33	70.66	72.70
Neem leaves extract @ 60 litre ha ⁻¹	92.89	76.11	81.23
Neem leaves extract @ 80 litre ha ⁻¹	106.90	88.11	96.11
Neem seed extract @ 40 litre ha ⁻¹	93.77	86.22	83.91
Neem seed extract @ 60 litre ha ⁻¹	94.55	81.44	82.27
Neem seed extract @ 80 litre ha ⁻¹	103.70	87.78	94.55
Regent 3 GR @ 16.66 kg ha ⁻¹	105.60	90.66	91.89
Control	88.55	71.11	72.88
LSD (0.05)	11.08	11.05	8.90

The results indicated that neem seed and leaves extract had the influence on reduction of termite infestation as well as enhanced the production of tiller, millable cane and yield of sugarcane. Neem leaves extract @ 80 litre ha⁻¹ performed better than other treatments. Regent 3GR treated plot gave similar response like Neem leaves extract @ 80 litre ha⁻¹. Therefore, over viewing the results it can be concluded that termites can be controlled effectively with neem leaves and seed extract without any hazardous effect to environment. Thus, the botanicals neem leave and seed extract can be used for controlling of termite population, but further research should be needed for determining the more accuracy of this botanicals.

Table 4. Effects of different doses of neem leaf and neem seed extract on sugarcane yield parameters, Sreepur, Gazipur, 2011-12

Treatments	Tiller (x10 ³ ha ⁻¹)	Millable Cane (x10 ³ ha ⁻¹)	Yield (t ha ⁻¹)
Neem leaves extract @ 40 litre ha ⁻¹	119.00	64.00	70.29
Neem leaves extract @ 60 litre ha ⁻¹	112.00	90.00	66.80
Neem leaves extract @ 80 litre ha ⁻¹	167.00	130.00	96.17
Neem seed extract @ 40 litre ha ⁻¹	124.00	93.00	68.11
Neem seed extract @ 60 litre ha ⁻¹	128.50	96.50	71.40
Neem seed extract @ 80 litre ha ⁻¹	125.00	95.00	71.40
Regent 3 GR @ 16.66 kg ha ⁻¹	154.16	116.50	87.81
Control	116.00	98.50	71.82
LSD (0.05)	26.56	28.70	18.01

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