Screening of Some Promising Varieties of Sugarcane against Termites

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ABSTRACT

A field experiment was conducted at Regional Sugarcane Research Station (RSRS), Bangladesh Sugarcane Research Institute (BSRI) Gazipur during the cropping season 2010-11 to evaluate the termite tolerant and susceptible characters among ten BSRI released commercial sugarcane varieties. The varieties were Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39, Isd 40 and BSRI Akh 41. Among all tested varieties Isd 37, Isd 32, Isd 36 and Isd 33 were comparatively tolerant to bud damage and BSRI Akh 41 was found as the most susceptible to termite attack. The minimum termite population was observed in Isd 37 (38 per plot) and the maximum in BSRI Akh 41 (211 per plot). Germination percent at 45 days after planting were influenced by termite infestation where the highest germination was recorded in variety Isd 35 (55.73 %) and the lowest in BSRI Akh 41 (42.31%). The variety Isd 39 and Isd 35 produced the highest (86.67x103 ha^{-1}) and the lowest (64.5x103 ha^{-1}) number of millable cane, respectively. The variety BSRI Akh 41 showed the best performance in respect of yield (98.26 t ha^{-1}) among ten tested varieties due to its high per unit stalk weight, height and diameter though its germination was the lowest. In case of brix percent, Isd 38 (22.25%) performed the best compared to other varieties.

Key words: Sugarcane varieties, tolerant, susceptible, termites, infestation

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is the major source of white and brown sugar (gur) and the second most important cash crop in Bangladesh. It also forms essential item for industries like sugar, chip board, paper, confectionery, uses in chemicals, plastics, paints, synthetics, fiber, insecticides and detergents (Malik and Gurmani, 2005). It provides income to growers and employment for many farm workers throughout the year. Many factors affect the yield of this important crop including insect pests and diseases, which have significant role in this regards. Sugarcane pests like borers, suckers and underground feeders cause severe damage to cane crops every year. Of these, termite is the most concerned insect pest. Biswas *et. al.* (2007) reported that bud damage by termites may reach up to 60%, yield loss 2.543.1% and reduced recovery upto 4.5% in Bangladesh. Chemical insecticides are mostly used for the

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management of this insect pest of sugarcane. In order to reduce sole dependency on chemical pesticides, it is essential to search resistant/tolerant sources as a component of integrated pest management program of subterranean termites in agro-ecosystem of sugarcane. It is known that resistant varieties are sustainable, easy to transfer in the field and compatible to other management practices with no additional management costs. On the other hand, cultivating tolerant/resistant varieties could be one of the best ways of eco-friendly and cheapest method of management. Therefore, selection of resistant/tolerant variety may play a vital role in crop management which influences the yield directly. Resistance represents the ability of a certain variety to produce a crop of good quality than other varieties under the same level of insect infestation and comparable environment. The resistant variety can provide the basic components of IPM (Panda and Khush, 1995). Many reports are available about the screening sugarcane varieties against borer pests, white grubs, red mites etc. but no such report is available on termite in Bangladesh. Intensive crop for long periods may reduce soil fertility and structure which may lead to reduce crop vigor and increase susceptibility to termite attack. Presumably indigenous crops have evolved defense mechanisms against the local termite fauna. Cultivars of a particular crop may also differ in susceptibility to termites. This has prompted research on the selection of sugarcane cultivars resistant to termites. Different sugarcane varieties have different morphological and genetical characters. Varieties having good qualities may be picked up and selected from the field for further improvement, resistant breeding and development of resistant or tolerant varieties of sugarcane. On the other hand, the sugarcane variety that contains more sucrose and less fiber percent might be susceptible to any insect-pests. Termite may attack any part of cane sett, but literature reveals that in the hard-rinded varieties termites prefer to attack at the ends, eye buds and root bands (Choudhary *et. al.*, 1986 and Mill, 1992).

Information is necessary about sugarcane varieties through screening that would minimize termite damage in sugarcane. So, the present experiment has been designed to identify some tolerant varieties as an IPM tool and a susceptible variety for further study as a favorable planting material against termites.

MATERIALS AND METHODS

Experimental site, climate and duration

The experiment was conducted in the research farm of Regional Sugarcane Research Station, Bangladesh Sugarcane Research Institute, Joydebpur, Gazipur under a Ph.D. work during the cropping season 2010-11. It is situated in the subtropical climatic zone, characterized by heavy rainfall during the month of May to September and scanty rainfall during the rest of the year. The soil of the experimental field was clay loam in texture and acidic with pH of around 5.8. It belongs to the Agro Ecological Zone (AEZ)-28 designated as Madhupur Tract situated at 24.09^0N latitude and 90.26^0E longitude (Rahman, 2001). Sugarcane is affected by termites in this area

Collection of sugarcane varieties and plantation

Ten BSRI released sugarcane varieties including one local chewing variety were collected from the museum plot of Regional Sugarcane Research Station, Gazipur namely Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39, Isd 40 and BSRI Akh 41 (locally collected Amrita) (Plate-1). The upper two-third portion of 10 month old sugarcane stalk were collected and cut into two budded setts and planted in the prepared trenches through conventional method (Matin *et al*, 1989) on 20 December, 2010.

Design of experiment

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. A land of 60m x 17m was prepared at the last week of November, 2010. The whole plot was divided into three blocks of equal size having 1.5m space between the blocks and 1m between the plots. The dimension of unit plot size was 5m 4m having 4 rows of 5 meters long trenches per plot. Twenty setts were placed in each trench, as such total 80 setts were planted in each plot.

Fertilization and Intercultural operations

The recommended doses of fertilizers were applied for the cropping season 2010-2011 as per Fertilizer Recommendation Guide of BARC (2005) for the Agro-Ecological Zone- 28 (AEZ-28). Necessary intercultural operations like weeding, mulching, irrigation, earthing-up, tying and detrashing of leaves and fertilization were done as and when required as per recommendation (Matin *et. al.*, 1998).

Data collection

Damage of buds/settlings

Bud damage by termite was assessed by exposing the setts. The buds in the big gap in the furrows between two settlings were supposed to be attacked by termites. Damaged buds and total buds were observed from each plot. The damaged settlings were easily up-rooted, having eaten lower portion. The observation on buds/settlings damage was taken at three times starting from 30 days after planting till 90 days (January, February and March). January data were considered as bud damage, February and March data were considered as settlings damage. The buds/settlings damage was calculated by using following formula:

$$\% \text{ Damage of buds/settlings} = \frac{\text{Damaged buds/settlings}}{\text{Total buds /settlings}} \times 100$$

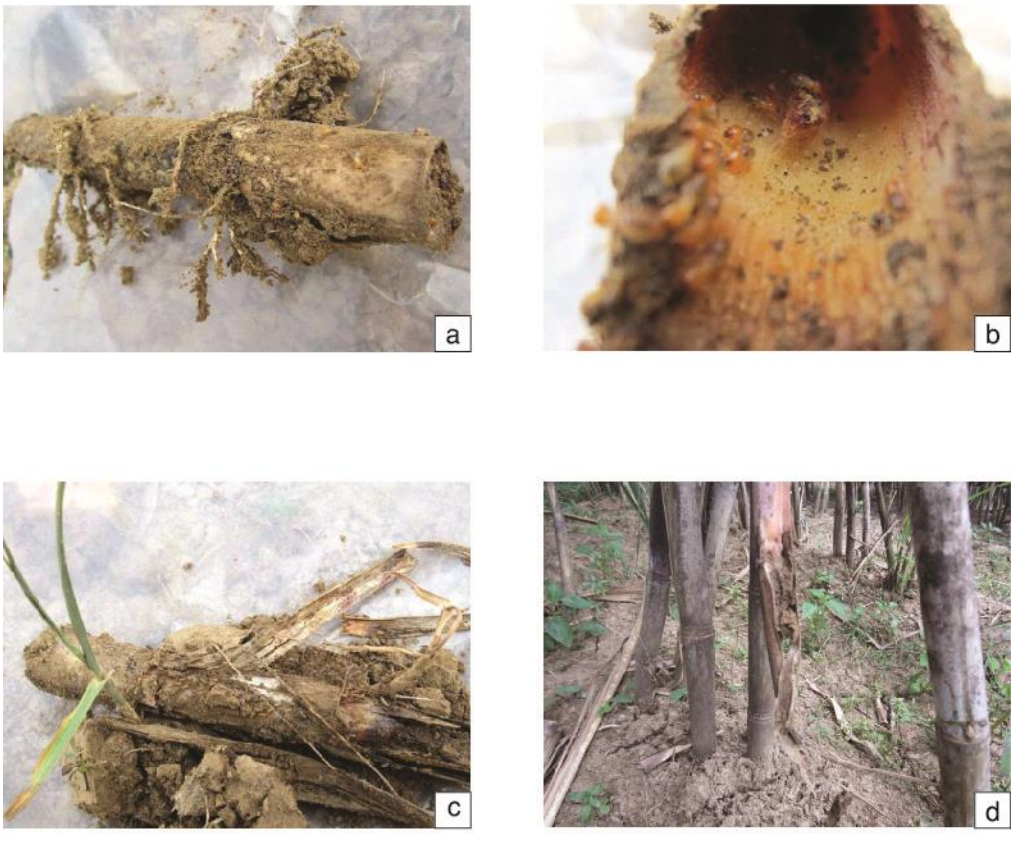

Plate 1. Photographs showing a. damaged buds, b. damaged setts c. damaged settlings and d. damaged mature cane by termites

Germination percentage

In order to determine the germination percentage of sugarcane setts, number of buds per plot was counted before planting. The number of settlings from each plot was counted after 45 days of planting (6 February, 2011). The number of settlings was converted into germination percentage by using following formula:

$$\text{Germination percentage (bud basis)} = \frac{\text{No. of settlings}}{\text{Total buds}} \times 100$$

Population of termites

Data on termites population was taken at three times from 30 days interval after planting till 90 days (January, February and March). For counting the population (in number) of termites, 5 infested clumps per plot were randomly uprooted by digging with the help of a spade and splitting with a knife on a polythene sheet. The numbers of termites were counted both from the infested uprooted clumps and from its adjacent soils.

Data on millable cane, yield, stalk height, cane diameter and brix percent

The numbers of total millable cane from each plot were recorded on 15 October and stalk height (m), cane diameter (cm), brix (%) (total soluble solids) was recorded in cane at maturity stage following the standard field procedure recommended by BSRI (Jabber *et al*, 2005). Yield data was recorded at the time of harvest on 29 November 2011. Twenty sugarcane stalks were collected randomly from each plot and their weight was recorded in kilogram (kg) and converted into ton per hectare.

Statistical analysis

All recorded data on damage buds, termites population, germination percentage, number of millable cane, total yield and brix percent were analyzed using MSTAT-C software for analysis of variance (ANOVA) after transformation as and when was necessary. The mean separation was done using Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

RESULTS AND DISCUSSION

Percent bud damage

Bud damage by termites occurred in sugarcane setts (Plate -2.a) at three different times, January, February and March during 2010-11 cropping season among ten tested sugarcane varieties is presented in Table 1. It was observed that bud damage in sugarcane setts by termites ranged from 1.56% to13.54%. The

damage was recorded in Isd 32 (1.56%) identical to Isd 36 (1.82%), Isd 37 (1.82%), Isd 33 (3.65%) and Isd 34 (4.17%) and followed by Isd 35 (4.95%) in January. On the other hand, the highest bud damage was found in BSRI Akh 41 (11.20%) identical to Isd 40 (8.59%) and followed by Isd 38 and Isd 39. Observation in February had the similar trends with few exception where, the lowest settling damage were observed in Isd 32 (2.60%) similar to Isd 37 (2.61%) and Isd 36 (3.12%), the highest bud damage was recorded in BSRI Akh 41 (13.54%). But in March, Isd 37 showed the maximum tolerant (2.60%) to bud damage by termite when BSRI Akh 41 was the most susceptible (11.72%). The results of three months observation revealed that Isd 32, Isd 36 and Isd 37 were the most tolerant varieties to bud damage by termite attack. BSRI Akh 41 was the most susceptible variety and this might be due to less fibre content (13.5%) as compared to other sugarcane varieties (Anon., 2012). Painter (1958) reported that the intensity of attack as well as tolerance varied with the varietal resistance having higher fibre content.

Table 1. Percent bud/settlings damaged by termites in ten tested sugarcane varieties at RSRS farm, Gazipur during 2010-2011.

Treatments	Bud damage (%)	Settlings damage (%)		Pooled of total damage
	20-01-2011	20-02-2011	20-03-2011	
Isd 32	1.56 c (1.18)	2.60c (1.53)	3.39bc (1.82)	2.52
Isd 33	3.65c (1.86)	5.21bc (2.27)	5.73bc (2.39)	4.86
Isd 34	4.17c (2.03)	6.77bc (2.53)	7.03b (2.64)	5.99
Isd 35	4.95bc (2.20)	5.73bc (2.37)	6.48bc (2.53)	5.72
Isd 36	1.82c (1.30)	3.12c (1.76)	4.42bc (2.09)	3.12
Isd 37	1.82c (1.30)	2.61c (1.54)	2.60c (1.60)	2.34
Isd 38	8.07ab (2.83)	9.64ab (3.10)	7.29b (2.68)	8.33
Isd 39	8.33ab (2.87)	9.11ab (3.01)	6.77b (2.58)	8.07
Isd 40	8.59a (2.92)	10.16ab (3.16)	7.26b (2.68)	8.67
BSRI Akh 41	11.20a (3.35)	13.54a (3.67)	11.72a (3.42)	12.15
CV%	26.36	31.14	24.14	

Figures in parenthesis indicate the value of SQRT transformation Means having same letter(s) in a column are not significantly different by DMRT test

Termite population on different varieties

Results on termite population at three different times of 30 days interval are presented in Table 2. In January, the lowest number of termites was found in the variety Isd 32 (7.0 per plot), which was significantly different from Isd 38 and BSRI Akh 41. The highest number of termite population was recorded in the variety BSRI Akh 41 (209.0 per plot) followed by Isd 38 (116.7 per plot), Isd 40 (108.3 per plot) and Isd 39 (106.7 per plot) respectively. In February, the lowest termite population was observed in Isd 37 (21.0 per plot) and the highest (226.67 per plot) was observed in BSRI Akh 41. The variety Isd 40 performed second position (160.0 per plot) in terms of susceptibility. However, similar trend was observed in March, where the lowest number of termites (58.33 per plot) was recorded in Isd 37 and the highest (196.67 per plot) in BSRI Akh 41. The results indicated that the variety BSRI Akh 41 was most susceptible and Isd 37, Isd 32 and Isd 36 were the most tolerant varieties against termites attack compared to other varieties. These may be due to presence of low (13.5%) in BSRI Akh 41 and high (16.58%) fibre content in Isd 37 (Anon., 2012). On the basis of tolerant level against termite attack, the tested varieties may be ranked as: Isd 37 > Isd 32 > Isd 36 > I sd 33 > Isd 34 > Isd 35 > Isd 39 > Isd 38> Isd 40 > BSRI Akh 41.

Table 2. Termite population at 30 days intervals in ten tested sugarcane varieties at RSRS, Gazipur during 2010-11

Treatments	Number of termite per plot			
	20-01-2011	20-02-2011	20-03-2011	Mean
Isd 32	7.00 c (0.69)	52.67cd (1.71)	75.00b (1.85)	44.89
Isd 33	53.33bc (1.71)	103.33bcd (2.01)	93.33b (1.95)	83.33
Isd 34	65.00bc (1.63)	145.00abc (2.05)	68.33b (1.83)	92.78
Isd 35	46.67bc (1.63)	110.00bcd (2.03)	128.33ab (2.11)	95.00
Isd 36	20.00bc (1.26)	91.67bcd (1.92)	90.00b (1.91)	67.22
Isd 37	34.67bc (1.33)	21.00d (1.19)	58.33b (1.76)	38.00
Isd 38	116.7ab (2.06)	133.33abc (2.06)	123.33ab (2.09)	124.45
Isd 39	106.7abc (1.99)	113.33bcd (2.05)	90.00b (1.94)	103.34
Isd 40	108.3abc (2.02)	160.00ab (2.19)	130.00ab (2.08)	132.77
BSRI Akh 41	209.0a (2.30)	226.67a (2.35)	196.67a (2.29)	210.78
CV%	52.77	46.97	32.14	

Figures in parenthesis indicate the value of arcsine transformation. Means having same letter(s) in a column are not differ significantly different by DMRT test

Germination percentage

Figure 1 represents the germination percentage of ten tested sugarcane varieties at 45 days after planting (DAP). All varieties showed significant differences on germination and ranged from 36.98 to 55.73. The variety Isd 35 showed the highest germination (55.73%) with statistically similar to Isd 36 and Isd 37. The lowest germination (36.98%) was found in the variety BSRI Akh 41, which is statistically different from others. The varieties Isd 33 and Isd 40 showed moderate level in germination. The findings of present study is supported by Ananthanarayana and David (1986) who reported that the early attack of termites to setts cause failure in germination and may cause as high as 33% loss in cane yield.

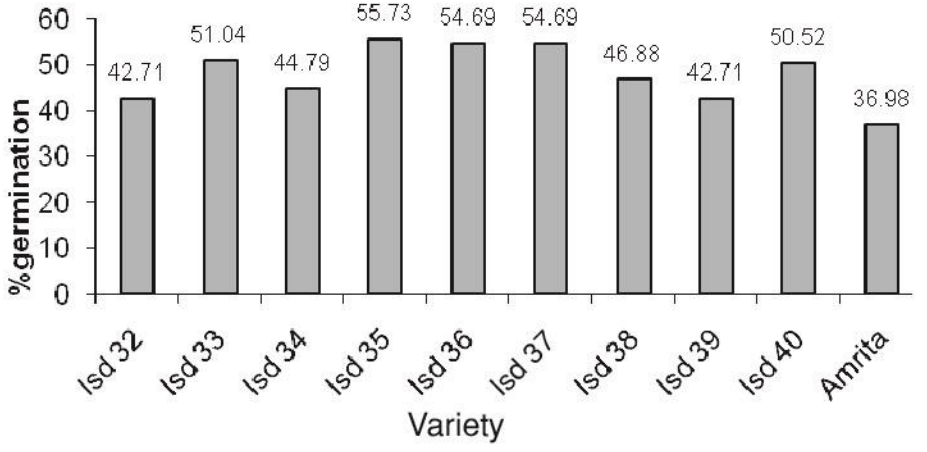

Figure 1. Germination percent at 45 DAP of ten BSRI released varieties at RSRS, Gazipur during 2010-11.

Yield, yield components and brix percent indices

The number of millable cane production ranged from 69.50 ($x10^3ha^{-1}$) to 86.67($x10^3ha^{-1}$) among ten varieties. The highest millable cane was recorded in Isd 39 ($86.67x10^3ha^{-1}$) followed by Isd 34 ($85.50x10^3ha^{-1}$), which were statistically similar. The lowest millable cane was obtained from Isd 35 ($64.50 x10^3ha^{-1}$) followed by Isd 32 and Isd 33, which were 69.50 ($x10^3ha^{-1}$) and 69.83 ($x10^3ha^{-1}$) respectively. The varieties Isd 37, Isd 40 and BSRI Akh 41 performed moderate level of millable cane production (Table 3). The findings of present findings in agreement with Miah *et. al.* (1986) who studied the comparative performance in millable cane production among different promising sugarcane varieties.

Table 3. Yield parameters, cane height, diameter and brix percent of ten varieties at RSRS Gazipur during 2010-11

Treatments	Millable cane ($x10^3 ha^{-1}$)	Cane height (m)	Stalk diameter (cm)	Yield (t ha^{-1})	Brix (%)
Isd 32	69.50cd	2.56c	2.05e	64.13bcd	18.25de
Isd 33	69.83cd	2.84bc	2.29cd	58.80cd	20.34bc
Isd 34	85.50ab	3.14ab	2.60b	70.72bc	16.71e
Isd 35	64.50d	2.79bc	2.11de	54.05d	17.11e
Isd 36	75.83bc	3.18ab	2.13de	63.59bcd	19.95cd
Isd 37	81.33ab	3.29ab	2.33c	73.48b	18.51de
Isd 38	77.33abc	3.06abc	2.48bc	62.77bcd	22.25a
Isd 39	86.67a	3.05abc	2.34c	71.30b	21.36abc
Isd 40	81.67ab	2.98abc	2.12de	72.18b	20.65abc
BSRI Akh 41	84.17ab	3.47a	2.93a	98.26a	21.89ab
CV%	4.77	7.00	3.27	6.88	3.71

Means having same letter(s) in a column are not significantly different by DMRT test

The highest stalk was obtained in BSRI Akh 41 (3.47 m) followed by Isd 37 (3.29 m) and the lowest was harvested from Isd 32 (2.56 m) followed by Isd 35 (2.79 m). Stalk diameter varied 2.05-2.93 cm among the varieties. The highest stalk diameter was found in BSRI Akh 41 and the lowest in Isd 32 (Table 3). Rahman *et al* (2012) found the variation in cane height and diameter among different sugarcane varieties. Significantly the highest cane yield (98.26 t ha^{-1}) was obtained from BSRI Akh 41 which might be due to higher unit stalk weight, height and girth though the germination percent was lower as compared to other varieties. On the other hand, the lowest yield was recorded in Isd 35 (54.05 t ha^{-1}). Isd 37 (73.48 t ha^{-1}) and Isd 40 (72.17 t ha^{-1}) showed statistically similar result but significantly different from BSRI Akh 41. The findings of the present study were in agreement with the findings of Singh *et al.* (1999) and Arvind *et al* (1997) where they found a variation in cane yield among the different released varieties.

Brix percent of ten tested sugarcane varieties varied from 16.71 -22.26%. The highest brix was found in variety Isd 38 (22.25%) followed by BSRI Akh 41 (21.89%) and Isd 39 (21.36%). The lowest brix was found in the variety Isd 34 (16.71%). Islam *et al.* (2011a) stated that the highest brix per cent (19.70%) was found in BSRI Akh 41 among seven tested varieties in ratoon cane. The results are similar to the findings of Islam *et. al.* (2011b) and Islam *et. al.* (2007) who studied the brix per cent of different sugarcane varieties/clones and found different levels of brix. From the present study it may be concluded that the chewing variety BSRI Akh 41 was most susceptible to termite attack among ten BSRI released varieties and the varieties Isd 37, Isd 32, Isd 36 and Isd 33 were comparatively tolerant to bud infestation.

CONCLUSION

Tolerant characters of the varieties found may be exploited for breeding program with an aim to accumulate other good characters for better variety development. From the results it may be concluded that varieties lsd 37, lsd 32, lsd 36 and lsd 33 were comparatively tolerant to bud damage and BSRI Akh 41 was found as the most susceptible to termite attack however it showed the best performance in respect of yield among ten tested varieties due to its high per unit stalk weight, height and diameter though its germination was the lowest. In case of brix percent, lsd 38 performed the best compared to other varieties.

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