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FIELD EVALUATION OF SOME SUGARCANE VARIETIES AGAINST MAJOR INSECT PEST

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Abstract

An attempt was made to evaluate ten released sugarcane varieties viz., Isd 31, Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40 against their tolerances to major insect pests. The study was conducted at the experimental farm of Bangladesh Sugarcane Research Institute, Ishwardi, Pabna during the cropping season of 2009-2010. The tolerant characteristic was measured by observing their infestation level against four major insect pests such as rootstock borer, stem borer, top shoot borer and white grubs. The lowest infestation of stem borer (21.46% on stock basis; 17.63% on internode basis) was recorded in Isd 36, rootstock borer (17.48%) in Isd 39 and top shoot borer (7.68%) in Isd 37, suggesting their higher tolerance against these major insect pests. The variety Isd 34 had the highest infestation of stem borer (54.66%), followed by rootstock borer (39.58%), top shoot borer (35.62%) and white grub (6.00%). These indicated higher susceptibility of the variety Isd 34 to insect pest attack. The lowest infestation of stem borer was found in the sugarcane variety Isd 36 which indicated its higher resistance to insect pests especially the most devastating stem borer insect pest of sugarcane.

Keywords: Stem borer, top shoot borer, rootstock borer, white grub, tolerant

Introduction

Sugarcane (*Saccharum officinarum* L.) has been growing in many countries of the world. The yield and yield potentials of sugarcane in Bangladesh are lower compared to other counties of the world. The average highest yield of sugarcane is 132.9 t ha^{-1} and average yield is 99.1 t ha^{-1} in Bangladesh (Miah *et al.* 2010). The world's per capita average annual consumption of sugar is 22.53 kg while it is still below than 10 kg in Bangladesh (Khatun, 2012). A number of limiting factors are responsible for less production and consumption in the country. One of the important limiting factors is the attack of different major insect pests in sugarcane setts. In Bangladesh, about 70 species of insects have so far been recorded as sugarcane pests (Anon., 2000) which caused 20 to 60% damage under field conditions (Alam, 1967). The insect pests reduce about 20% of cane yield and 15% of sugar recovery (Avasthy, 1983). The use of resistant variety with improved management strategy could be an effective tool for controlling stem borer in most sugarcane-growing regions all over the world (Mathes and Charpentier, 1969). All the pest species of sugarcane are grouped into borers, sap suckers, leaf feeders and underground feeders according to their feeding nature or dwelling habitats (Rao and Rao, 1965). Among the major sugarcane insect pests, stem borer (*Chilo tumidicostalis* Hampson), top shoot borer (*Scirpophaga excerptalis* Walker), rootstock borer (*Emmalocera depressella* Swinhoe), white grub (*Holotrichia seticollis* Moser), early shoot borer (*Chilo infuscatellus* Snellen), mealy bug (*Saccharicoccus sacchari* Cockerell) and scale insect (*Melanaspis glomerata* Green) are notable but stem borer alone has been considered number one insect pest (Rao and Rao, 1965; Abdullah, 2012).

Stem borer damages the crop soon after the infestation in internodes and its activity continues till harvest. At initial stage, the larvae feed gregariously inside the top internodes (80% noticed in the first five internodes) of the canes resulting in dried crown of leaves. In case of mature plant, the plant may be died due to the severe infestation of stem borer. This symptom is called dried up (Khanna *et al.* 1957). The attack of stem borer reduces 8.2 to 70.0% sugarcane production and 3.0 to 48.6% sugar extraction (Abdullah, 2012).

The activity of the top shoot borer starts with the onset of the monsoon rains. Caterpillars damage the cane beyond 3 months age. Young plants attacked by this pest show characteristics whitish streaks on the midribs and also show a number of shot holes in the leaves. At tillering or active growth stage of the crop, the attacked shoot die, resulting in

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the formation of side tillers. As the larva feeds by boring into the growing point the leaf immediately dries up surrounding the feeding region. This leaf turns brown forming dead heart when the fourth instar larva cuts the growing point. Formation of dead heart induces sprouting of the lateral buds giving a "bunchy top" appearance (Biswas *et al.* 2007). The attack of top shoot borer reduces 4.0 to 48.0% sugarcane production and 2.0 to 62.0% sugar extraction (Abdullah, 2012).

Rootstock borer is primarily destructive to young plants. They feed on the internal contents of the plant. As they feed, they cut right across the stem, reaching the adjoining tillers. Central leaves of the attacked plants dry up and form dead hearts before the cane formation stage. Plants attacked after the formation of canes are not killed, although their weight and sugar content are reduced (Karim and Islam, 1977). The attack of rootstock borer reduces 1.3 to 73.0% sugarcane production and 0.3 to 16.0% sugar extraction (Abdullah, 2012).

White grubs damage sugarcane by feeding on roots and underground stems. The first symptom is a yellowing (chlorosis) of the leaves. This is usually followed by stunted growth, dense browning, lodging, plant uprooting and death in heavily infested areas. Symptoms may be seen as early as September. Damage is usually more severe in ratoon crops and is most evident around the edges of a field. Grub damage is also worse on muck soils than sandier soils (Miah *et al.* 1986). Thus it cuts the central leaf spindle, which eventually dries forming a dead heart. The dead heart can be easily pulled out. It emits an offensive odour (Biswas *et al.* 2007).

Different management methods (e.g., cultural, mechanical, biological, chemical etc.) have been recommended for controlling sugarcane pests. Among various management techniques, the use of chemical toxic control is common but expensive and environmentally not safe (Alam *et al.* 2005). It is well-established that the continuous use of sub lethal dose of pesticides often causes resistance to the target pests. As such, alternative method(s) of chemical pesticides needs to be developed. The resistant variety could be an important component of integrated pest management (Panda and Khush, 1995). Selection of insect resistant variety has been reported to be the first step of integrated insect management (Bessin *et al.* 1990). Because most sugarcane insect pests are monophagous, there is a wide scope of developing one or more pest resistant varieties. Clones having high potential of sugar yield with considerable tolerance to major insect pests attack could be economically viable method in Bangladesh. In this context, the study was undertaken to explore the insect pest resistant suitable variety/varieties through field screening of ten sugarcane varieties against major insect pests.

Materials and Methods

The study was conducted at the experimental farm of Bangladesh Sugarcane Research Institute (BSRI), Ishwardi, Pabna during the cropping season of 2009-2010. The study site was located between 24.8^0 North latitude and 89.4^0 East longitudes with an elevation of 15.5 m above sea level. The site represents high Ganges flood plain soils under the AEZ 11. The climate of the experimental site is subtropical characterized by heavy rainfall from May to October and scanty in other months.

Ten sugarcane varieties viz., Isd 31, Isd 32, Isd 33, Isd 34, Isd 35, Isd 36, Isd 37, Isd 38, Isd 39 and Isd 40 were collected from Plant Breeding Division, BSRI, Ishwardi, Pabna and considered treatment variables (Table 1). The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The unit plot was 5 m × 5 m. Plot to plot distance was 1m and block to block distance was 2m. Every unit plot had 5 rows and 35 setts were placed in each row. The total number of setts placed per plot was 175.

As conventional planting method, setts containing at least two buds were cut from the upper two-third portion of cane stalk to get healthy setts. The setts were soaked thirty minutes with Bavistin solution (1:1000) for controlling soil borne fungal diseases (Talukder *et al.* 2005). The setts were allowed to pre-germinate and then planted in the main field. Planting was done through conventional method of placing setts in the trenches. Cowdung and other chemical fertilizers were applied as per recommendation made in FRG (2005). Intercultural operations such as irrigation, weeding, mulching, thinning, earthing-up and tying were done throughout the cropping season for achieving proper growth and development of the sugarcane plants. All the newly released sugarcane varieties were subjected to natural infestation. No insecticide was applied in the experimental plots during the study. Besides, other pest control measures were not adopted.

Table 1. Major characteristics of the ten sugarcane varieties used as experimental variables

Parameters	Isd 31	Isd 32	Isd 33	Isd 34	Isd 35	Isd 36	Isd 37	Isd 38	Isd 39	Isd 40
Year of release	2000	2002	2002	2002	2003	2003	2006	2007	2009	2009
Highest yield	99 t ha^{-1}	147 t ha^{-1}	151 t ha^{-1}	143 t ha^{-1}	104 t ha^{-1}	99 t ha^{-1}	114 t ha^{-1}	182 t ha^{-1}	140 t ha^{-1}	150 t ha^{-1}
Average yield	93 t ha^{-1}	104 t ha^{-1}	99 t ha^{-1}	93 t ha^{-1}	95 t ha^{-1}	89 t ha^{-1}	101 t ha^{-1}	113 t ha^{-1}	101 t ha^{-1}	103 t ha^{-1}
Sugar content (Pol%)	9.60	12.60	14.55	12.83	10.27	14.60	14.42	14.68	14.23	14.86
Yield potential	High	High	High	High	High	High	High	High	High	High
High quality gur	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable
Flood and drought	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	
Flood	Moderatel y tolerant	Moderately tolerant	Moderately tolerant	Moderately tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Highly tolerant
Drought and salinity	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Highly tolerant
Water-logging	Moderatel y tolerant	Moderately tolerant	Moderately tolerant	Tolerant	Moderately tolerant	Tolerant	Tolerant	Moderately tolerant	Tolerant	
Red rot disease	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant	Tolerant
Char land cultivation	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable
Maturity and flowering	Mid-maturing	Mid-maturing	Early maturing	Mid-maturing and sparse flowering	Mid-maturing	Early maturing and non flowering	Early maturing and non flowering	Early maturing and non flowering	Early maturing and non flowering	Early maturing;
Ratoon crop	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	Suitable	

(Miah et al., 2010)

Infestation data of top shoot borer, rootstock borer and white grub were recorded at harvest and then transformed into percent infestation. In white grub, the grub feeds on the roots and underground portion of stalk rendering the plants looking pale and sickly, ultimately the affected shoot/cane dries up. The affected clumps showing the symptom of wilting and uneven growth of sugarcane and the clumps can be pulled out easily. In case of rootstock borer (RSB), the larvae bore into the underground basal portion of the plant and feed them showing the thick dead heart symptom. The dead heart cannot be easily pulled out and it does not give any offensive smell. For white grub and rootstock borer, data were taken from 5 randomly selected clumps per plot. An area of 60 cm × 60 cm was dug up from a depth of 40 cm with spade. Larval population was counted in roots and in soils of these pits. In case of rootstock borer, up-rooted stocks were dissected to observe rootstock borer (RSB) infestation. The collected data were converted to percent infestation to measure the larval incidence and analyze for comparison. The attack of stem borer first started in the month of July (180 Days after Transplanting, DAT) when stem formation of sugarcane just started. The infestation of stem borer continued up to October. Data were collected at four different occasions (i.e., 180 DAT, 210 DAT, 240 DAT and 270 DAT). In case of stem borer (internode) infestation, 10 stem borer infested plants were randomly splitted to count infested internodes. The total number of canes was collected from the unit area of 5 m × 5 m (25 m^2) from each plot to calculate the percentage of infestation by sugarcane borer. Data of sugarcane stem borer were recorded by counting the total number of sugarcane and the number of stem borer infested sugarcane per plot and percent infestation was also calculated. The infestation of the insect pest was expressed in percentage based on total number of sugarcane and infested cane (number/number) and yield (w/w) of sugarcane using the following formula:

$$\text{Percent infestation of stem borer} = \frac{\text{Number of borer infested sugarcane}}{\text{Total number of sugarcane}} \times 100$$

All data were analyzed statistically and means were separated by using LSD test.

Results and Discussion

Percent infestation of rootstock borer, white grub and top shoot borer

The maximum infestation (39.58%) of rootstock borer was found in Isd 34 followed by Isd 31 (32.39%) and Isd 32 (31.52%) (Table 1). The minimum infestation (17.48%) of rootstock borer was found in Isd 39 followed by Isd 36. In case of white grub, the highest percent infestation (6.00%) was found in Isd 34. The minimum infestation (2.00%)

was recorded in Isd 32 which was followed by Isd 33, Isd 38, Isd 39 and Isd 40. In case of top shoot borer, the maximum infestation (35.62%) was found in Isd 34 followed by Isd 39 (20.66%) and Isd 35 (20.54%). The present results are in agreement with the findings of Abdullah *et al.* (2006) who found some varieties/promising clones showing infestation from 4.55 to 53.58% by top shoot borer, 3.33 to 10.33% by white grub and 6.40 to 40.55% by rootstock borer at BSRI farm, Ishwardi, Pabna, Bangladesh. The results also revealed that infestation varied with type of insect pest indicating some have resistance against particular insect pest while others don't have.

Table 2. Percent infestation of root stock borer, white grub and top shoot borer of the tested sugarcane varieties at BSRI farm, Ishwardi, Pabna during July-October, 2010

Variety	Root Stock Borer	White Grub	Top Shoot Borer
Isd 31	32.39 (3.147)	5.00 (2.236)	17.64 (2.322)
Isd 32	31.52 (3.104)	2.00 (1.414)	10.59 (1.799)
Isd 33	21.48 (2.562)	2.00 (1.414)	10.63 (1.802)
Isd 34	39.58 (3.479)	6.00 (2.499)	35.62 (3.300)
Isd 35	19.57 (2.445)	3.00 (1.732)	20.54 (2.505)
Isd 36	19.63 (2.449)	3.33 (1.824)	10.53 (1.793)
Isd 37	24.56 (2.740)	3.00 (1.732)	7.68 (1.531)
Isd 38	24.69 (2.747)	2.00 (1.414)	8.47 (1.608)
Isd 39	17.48 (2.311)	2.00 (1.414)	20.66 (2.513)
Isd 40	20.43 (2.499)	2.00 (1.414)	8.41 (1.603)
$LSD_{(0.05)}$	0.562	0.314	0.441
CV (%)	7.78	6.09	8.17

LSD value denote the significant difference between treatments (Tukey's HSD, P<0.05). Analysis was performed after transformation (Arcsine for root stock and top shoot borer, Square root for white grub) of data. Transformation values are shown in parenthesis.

Percent infestation of stem borer

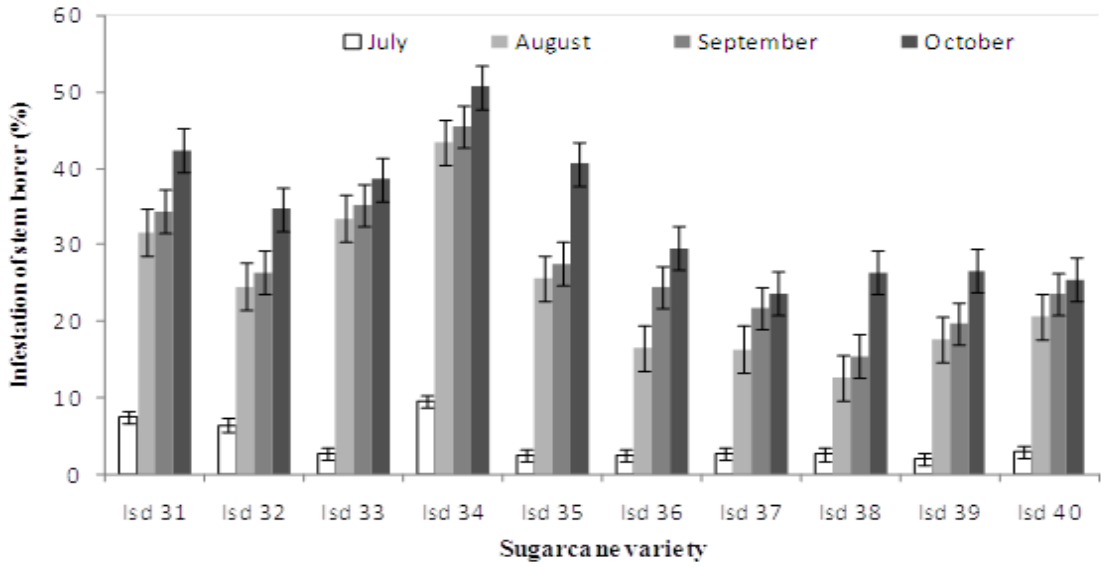

Fig. 1. Month wise incidence of stem borer in the tested sugarcane varieties at BSRI farm, Ishwardi, Pabna during July-October, 2010 (Standard error, SE ± 1)

Among the tested varieties, percent infestation differed during July-October, 2011 (Fig. 1). The cumulative percent infestation in October ranged from 23.70 to 50.64%. The maximum infestation (50.64%) was observed in Isd 34 followed by Isd 31 (42.30%) and Isd 35 (40.63%) and minimum (23.70%) was in Isd 37. In September, the maximum infestation was found in Isd 34 (45.45%) and the minimum was found in Isd 38 (15.50%). In August, the

maximum infestation (43.41%) was found in Isd 34 and the minimum in Isd 38 (12.67%). In July, the maximum infestation (9.58%) was found in Isd 34 and minimum (2.09%) in Isd 39. Begum *et al*. (2005) reported lower percent stem borer infestation in all the promising clones during April to September (0.13 to 7.00%) with maximum infestation from 25.63 to 50.87% in October.

Percent infestation of stem borer (stalk and internode basis)

On the basis of stalk, the minimum stem borer infestation (21.46%) was observed in Isd 36 while the infestation was maximum in Isd 34 (54.66%) followed by Isd 31 (46.53%) (Fig. 2). Likewise, on the basis of internode the minimum stem borer infestation (17.63%) was also recorded in Isd 36 while the infestation was maximum (45.44%) in Isd 34. The present results are in agreement with the findings of Begum *et al.* (2011) who reported that stem borer infestation both on stalk and internodes basis had ranged from 10.40 to 17.95 % and 16.25 to 20.42 %, respectively.

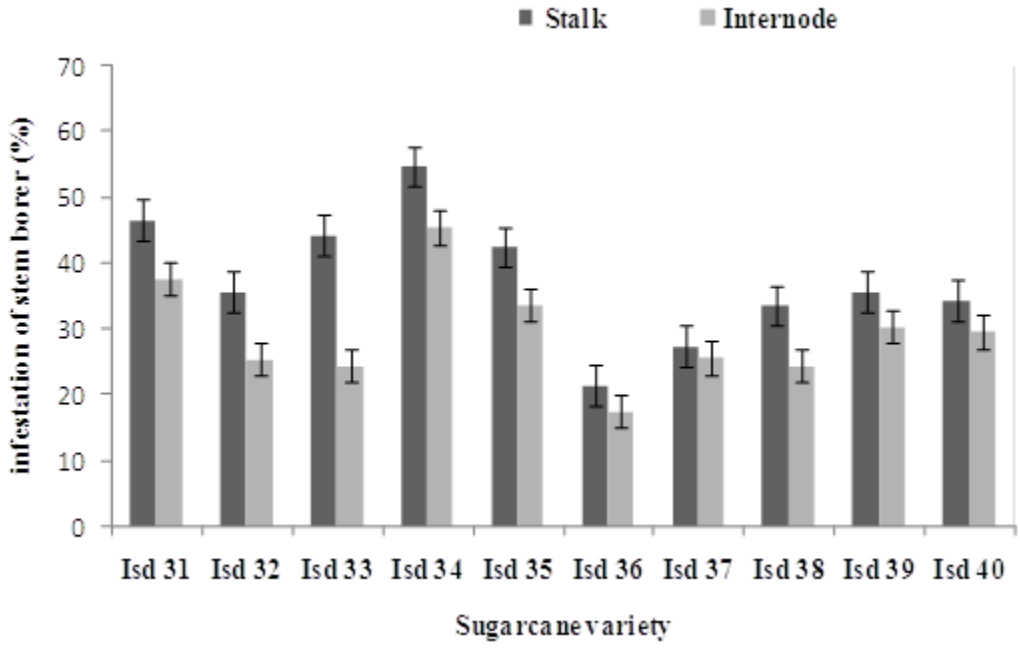

Fig. 2. Percent infestation of stem borer in stalk and internodes of the tested sugarcane varieties at BSRI farm, Ishwardi, Pabna during July-October, 2010 (Standard error, SE ± 1)

Comparison of infestation between tolerant and susceptible variety

Due to primary infestation, top leaves completely dried up and infested plant was visible from a distance (Plate 1a). At later infestation stage, the grown up larvae came out and migrated to the neighboring canes to cause secondary infestation (Plate 1b). Aerial roots came out profusely from the nodes adjacent to the damaged internodes after secondary infestation (Plate 1c). The secondary infested canes had entry holes from where excreta oozed out showing dust like damaged tissue (Plate 1d). The resistant variety Isd 36 was healthy whereas the susceptible variety Isd 34 was dried and broken by the attack of stem borer (Plate 1e). The tolerant and susceptible variety was determined based on healthy sugarcane plants (Plate 1f). Grading of sugarcane varieties for reaction to stem borer infestation were made based on following methods. The range of 0 to 30% infestation indicated less susceptible variety, 30.1 to 50% infestation indicated moderately susceptible and above 50% indicated highly susceptible variety. Here the infestation of the variety Isd 36 (17.63%) was observed on internode basis which describes the classification of less susceptible means for tolerance or susceptibility (Miah *et al.* 2010). The variety Isd 36 contains yellowish leaf colour, less number of leaf (13.33), leaf area 415.40 cm^2, long length of top internode (12.93 cm) and lowest leaf moisture of sugarcane play an important role as a physical barrier against stem borer. Highest number of leaf might create a micro-climate favorable for stem borer for mating and ovipositor and may positive enough supply of food for successful livelihood for next generation.

On the basis of both stalk and internode, the variety Isd 36 had minimal stem borer infestation. The variety Isd 36 could be recommended for less borer infestation as commercial cultivation in mill zone areas. The variety Isd 34

was found susceptible to attack of major insect pests such as stem borer, top shoot borer, rootstock borer and white grub.

a. Primary infestation of *C. tumidicostalis* showing dead heart symptom in Isd 34

b. Secondary infestation due to the severe attack by *C. tumidicostalis* showing borer and excreta in Isd 34

c. Aerial root formation in Isd 34 due to the severe attack by *C. tumidicostalis*

d. Secondary infestation in Isd 34 showing excreta with damaged tissue

e. Isd 36. Stem borer tolerant (left side) and Isd 34. Stem borer susceptible (right side)

f. Isd 36- Tolerant variety Isd 36 free from the attack by *C. tumidicostalis*

Plate 1 a-f. Symptoms of insect infestation in susceptible and tolerant sugarcane varieties

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References

Abdullah M, Biswas M M and Siddiquee M N A. 2006. Response of some promising sugarcane clones/variety to major insect pests of sugarcane. Indian Sugar. 56 (3): 23-28.

Abdullah M. 2012. Symptoms of attack, nature of damage and management of sugarcane borer insect pests In: Training Manual on the Developed Technology in Bangladesh Sugarcane Research Institute (BSRI), Ishwardi, Pabna [Eds. S K Pal and M M Hossain] (in Bengali). pp 31-35.

Alam M A, Biswas M M, Begum M, Rahman M A and Abdullah M. 2005. Effectiveness of different cartap insecticides in controlling stem borer and their effect on the yield of sugarcane. Bangladesh J. Sugarcane. 24:11-15.

Alam M Z. 1967. Insect pests of sugarcane and their control. In: Proceedings of East Pakistan Seminar on Sugarcane Research and Development. pp.79-85.

Anomymous 2000. Bangladesh Sugarcane Research Institute, Ishurdi, Pabna, Annual Report. 2000. pp.105-107.

Avasthy P N. 1983. Insect Pest Management for Sugarcane in India. In: Sugarcane Pest Management in India (Eds. M. Balasubramanian and A.R. Solayappan). Tamil Nadu Co-operative Sugar Federation, Madras. pp.71-77.

Begum M, Islam K S, Abdullah M and Biswas M M. 2005. Evaluation of some promising sugarcane clones for possible resistance against some major pests. Bangladesh J. Sugarcane. 24:63-69.

Begum M, Abdullah M,. Rahman M A, Siddiquee M N A and Ahmed T. 2011. Field infestation of some promising sugarcane clones by some major pests. Bangladesh J. Sugarcane. 32:73-81.

Bessin R T, Moser E B and Reagan T E. 1990. Integration of control tactics for management of the sugarcane borer (Lepidoptera: Pyralidae) in Louisiana sugarcane. J. Econ. Entomol. 83:1563-1569.

Biswas M M, Abdullah M, Alam M A, Begum M, Rahman M A and Siddiquee M N A. 2007. A hand book of introduction of sugarcane insect pest and their management in Bangladesh. Published by, Bangladesh Sugarcane Research Institute. Publication number,136:80p.

FRG (Fertilizer Recommendation Guide). 2005. Fertilizer Recommendation Guide. Published by Bangladesh Agricultural Research Council, New Airport Road, Farmgate, Dhaka-l215. pp.97-136.

Karim M A and Islam M N. 1977. Sugarcane insect pests and their natural enemies recorded in Bangladesh. Proc. 3rd Ann. conf. Bang. Soc. Sug. Technologist, 1974-1976. pp.32-68.

Khanna K L, Nigam L N and Puri V D. 1957. Stem borer, *Chilo tumidicostalis* Hampson, a serious pest of sugarcane in Bihar. Proc. Indian. Acad. Sci., (B) 46:75-95.

Khatun S. 2012. The importance of sugarcane cultivation in respect of socio-economic conditions of Bangladesh and contribution of sugarcane in national economy (*In:* Training Manual on the Developed Technology in Bangladesh Sugarcane Research Institute (BSRI), Ishwardi, Pabna [Eds. S K Pal and M M Hossain] (in Bengali). p.5

Mathes R and Charpentier L J. 1969. Varietal resistance in sugarcane to stalk moth borers, pp. 175-188. In: J. R. Williams, J. R. Metcalfe, R. W. Mungomery & R. *Mathes [eds.]*, Pests of Sugar Cane. Elsevier, New York.

Miah M A H, Biswas M M and Mannan M A. 1986. Effect of some Insecticides on white grub control and yield of sugarcane. Trop. Pest Manag. 32:338-340.

Miah M, Alamgir, Poddar B, Nurunnahar S M, Mannan S A, Rahman M M. 2010. A hand book of high yielding sugarcane varieties. Published by, Bangladesh Sugarcane Research Institute. Publication Number,153: 16p.

Panda N and Khush G S. 1995. Host plant resistance to insects. CAB international in association with the international rice research institute. 431p.

Rao M K R and Rao D V S. 1965. Insect pest of sugarcane in Andhra Pradesh. Golden Jubilee Souvenir. State Res, Stn., Anakapalle. pp.95-105.

Talukder M I, Kamal M M, Iqbal M and Rahman M S. 2005. A hand book of Sugarcane diseases and their management in Bangladesh. Published by Bangladesh Sugarcane Research Institute, Publication Number 111: 63p.