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Research Article

Screening of sugarcane genotypes against Top Borer (*Scirpophaga exerptalis* Walker) infestation

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ABSTRACT
Fourty sugarcane genotypes with different period of maturity were evaluated against top borer (*Scirpophaga excerptalis* Walker) infestation under natural field condition during 2018 and 2019 at National Sugarcane Research Program, Jeetpur, Nepal. The experiment was conducted in alpha-lattice design under natural condition of infestation using Co 0238 as susceptible check. Based on the incidence, 26 genotypes were categorized as less susceptible, eleven genotypes were found moderately susceptible to *S. excerptalis*. However, among less susceptible genotypes lowest incidence of 3.11 percent was recorded in genotype CoS 8432. Whereas, highest incidence of 25.24 percent was recorded in highly susceptible genotype, CoSe 98255BD 24. Most of the cane genotypes were found low to moderately susceptible, having 5 to 20% incidence of the pest. Whereas, some of the varieties, namely CoH 160 (21.22%), CoSe 95255 BD 24 (25.24%) and BO 150 (22.02%) were found highly susceptible. The mechanism responsible for host plant resistance against top borer is not studied in this experimentation. The study in these aspects is to be conducted to explore the mechanisms of host plant resistance for using these resistant genotypes for breeding purpose.

Keywords: Top borer, Sugarcane genotypes, Infestation percentage, Resistance

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INTRODUCTION
Sugarcane (*Saccharum officinarum* L.) is one of the important cash crops grown in all tropical and subtropical areas around the globe. This crop is an important economic contributor to many of the tropical and sub-tropical developing countries including Nepal. About 1300 species of insect pests are known to cause damage to sugarcane crop globally (Box, 1953) and 220 species (David *et al*., 1986) of insects have been known to attack sugarcane in India. 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*

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sacchari Cockerell) and scale insect (*Melanaspis glomerata* Green) are the damaging pest of sugarcane (Rao & Rao, 1965). Top borer is an important pest of sugarcane in Nepal (Ansari *et al*., 2016; Paudel *et al*., 2019). It damages the crop of all stages from germination to harvest. Both yield and sugar recovery were reported to be negatively affected in sugarcane due to top borer infestation (Kuniata *et al*., 2012). The symptoms of infestation include the peculiar line on the leaf due to the feeding on midribs by young larvae which becomes prominent after it gets reddish brown. The growing larvae enters into the central core of the spindle through unopened leaves which later on appear as bullet holes when they unfold. The full-grown larvae cut the growing point preventing its apical dominance and form a pupal chamber underneath. In tillering phase, the infested young shoots die while in grand growth phase the axillary buds of the top nodes sprout due to the apical dominance which gives a bunchy top appearance. Sugarcane borers are hidden pests, therefore the approach of pesticides and limited use of biological agents were found less effective (Mohyuddin *et al*., 1997). The varietal response on the top borer was found. Borers' resistant varieties provide the additional control needed in the Integrated Pest Management program (Butani, 1961). So the varietal screening of sugarcane genotypes is needed to assess the level of damage in various sugarcane varieties.

MATERIALS AND METHODS

Fourty sugarcane genotypes were grown in α-lattice design. Co 0238 was used as susceptible check in the screening process. All standard agronomical practices were followed during the cropping seasons to raise the crop. No any plant protection measures were adopted in experimental plots. The observation and counting of injury were done on the basis of visual observation. The screening assessment was done by counting the injury symptom and its percentage. The present investigation was undertaken considering the importance of borer pests in sugarcane cultivation and their screening against different varieties in central terai condition of Nepal. The observation was recorded on the basis of bunchy and dead tops at maturity and finally percent incidence was worked out. Top borer infestation percentage was calculated by following formulae

$$\% \text{ incidence} = \frac{Total\ number\ of\ infected\ canes}{Total\ number\ of\ caneobserved} x100$$

The assessment of reaction of top borer based on % incidence was work out and grading level were categorized as follows:

Grade	% incidence of top borer
LS	Below 10
MS	10.1-20
HS	Above 20

RESULTS AND DISCUSSION

Among the fourty genotypes tested twenty-six genotypes were categorized as less susceptible, eleven genotypes were found moderately susceptible and three genotypes were highly susceptible to *S. excerptalis*. However, among less susceptible genotypes lowest incidence of 3.11 percent was recorded in genotype CoS 8432. Whereas, highest incidence of 25.24 percent was recorded in highly susceptible genotype, CoSe 98255 BD 24. Most of the cane varieties/genotypes were found low to moderately susceptible, having 5 to 20% incidence of *S. excerptalis*. Whereas, some of the varieties, namely CoH 160 (21.22%), CoSe 95255 BD 24 (25.24%), BO 150 (22.02%) were found highly susceptible.

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Table 2: Infestation of borer in various genotypes

Genotypes	Cumulative % infestation of top borer	Reaction
BO 141	6.14	LS
CoJ 64	9.08	LS
CoJ 88	5.44	LS
Co 0118	7.49	LS
CoSe 98255 BD 58	6.55	LS
CoSe 1434	7.89	LS
Co 0238 (Standard check)	10.47	MS
CoS 88230	9.3	LS
CoSe 9275	5.72	LS
BO 120	11.82	MS
BO 150	21.22	HS
CoSe 95255 BD 24	25.24	HS
CoSe 98255 BD 38	16.22	MS
CoH 160	22.02	HS
CoSe 98255 BD 15	18.45	MS
CoSe 98255 BD 56	12.85	MS
CoH 152	8.36	LS
BO 146	7.45	LS
BO 147	10.73	MS
H 70	9.57	LS
UP 0098	8.75	LS
CoS 767	7.74	LS
CoSe 3234	4.68	LS
Co 0233	6.87	LS
CoJ 85	16.24	MS
UP 9530	7.2	LS
CoSe 95436	9.75	LS
Jeetpur 3	8.45	LS
CoSe 97232	4.85	LS
CoSe 96275	5.46	LS
UP 9742 BD 10	11.5	MS
CoLk 94184	8.88	LS
Jeetpur 4	16.21	MS
Co 0232	8.78	LS
Co 97263	8.28	LS
BO 139	5.43	LS
CoSe 07250	4.62	LS
CoP 9742 BD 2	11.59	MS
CoS 8432	3.11	LS
JS 35	18	MS

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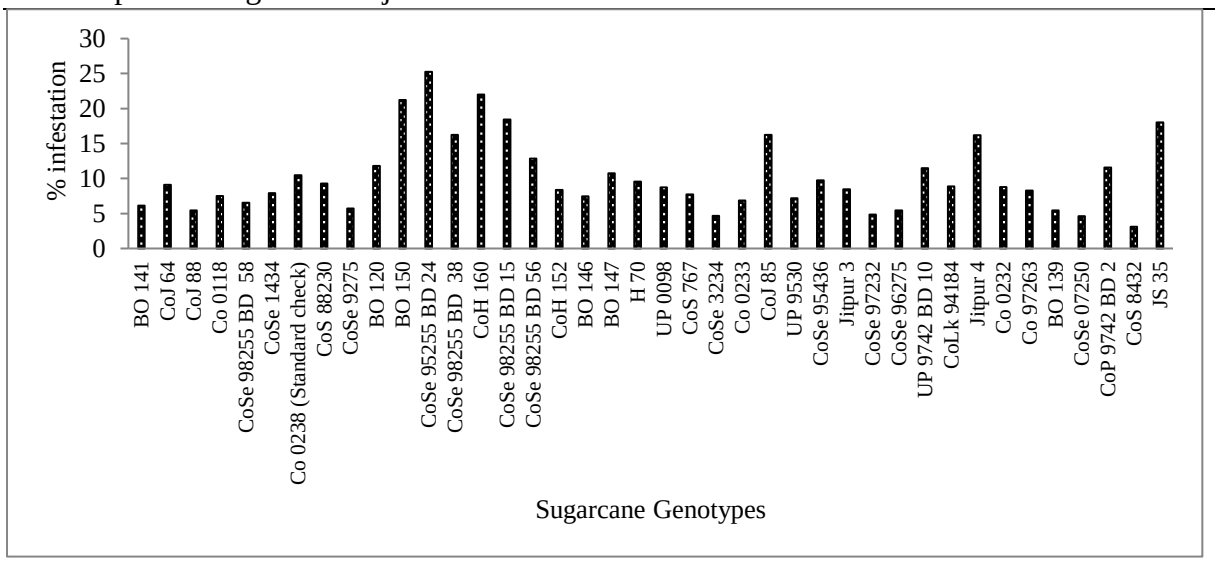

Figure 1: Borer infestation in various genotypes

A lot of research works had been conducted on screening of sugarcane genotypes against top borer in Nepal and neighboring countries. Bhatti *et al*. (2008), Sharma *et al*. (2009) and Kazi *et al*. (2010) revealed different levels of infestation of top borer in the screening trials and categorized as moderately resistant to moderately susceptible or resistant to less resistant. Findings of Kumar *et al*. (2010) revealed the same result in their investigation. They reported that 8 genotypes were less susceptible, 34 as moderately susceptible and only two genotypes showed highly susceptible against top borer. Singh and Madan (2002) reported that 12 genotypes were graded as tolerant, 39 as moderately tolerant, 34 as susceptible and 8 as highly susceptible with top borer based on graded percent incidence. Recent works of Kumar *et al*. (2002), Singh *et al*. (2002), Bhoopathi and Karnatak (2003), and Choudhary and Jaipal (2008) had rated their varieties as resistant, moderately resistant, susceptible and highly susceptible and also as tolerant, moderately tolerant and susceptible against early shoot borer which is also relatable with top borer infestation.

The different level of infestation of top borer is due to various morphological anatomical and physiological characteristics of genotypes. A lot of studies have been made in these aspects of resistance to top borer. In an experiment conducted by Chaudhary and Yadhav (1998a), quick growing sugarcane genotypes were found less susceptible to damage of top borer than slow growing. Chaudhary and Yadav (1995a) also observed negative correlation between growth rate of cane and the incidence of top borer. Other than this, field resistance to top borer was observed more in the varieties with leaves having strong and hard mid rib (Issac, 1939). It is found that the resistance in these type of varieties is due to inability of the newly hatched larvae to penetrate and feed on the hard mid rib. The tunnels in the resistant varieties were also found lesser in distance as reported by Chaudhary and Yadhav (1995). The amount of lignification in the mid rib is also found closely associated with top borer resistance (Rao & Venkataraman, 1941; Rao, 1947). Khanna and Ramanathan (1946) reported that longer spindle length and longer leaves shows greater resistance to top borer infestation. In Nigeria, Chaudhary and Yadhav, (1995) also observed a negative relationship between incidence of top borer and length of the leaf and spindle. Varieties with high number of denticules on the midrib were found to have less attack of top borer (Verma & Mathur, 1950). It is found that moisture content in the growing point, mid rib and leaf blades were positively correlated to the infestation of top borer

whereas dry matter content is negatively correlated with infestation of top borer (Chaudhary & Yadav, 1998b).

In other studies, it is also found that certain biochemical attributes are also responsible for resistance to the various insect pests. The varieties with higher sucrose content were found to be susceptible to top borer in a study conducted by Nuss *et al.*(1986). In our study, Co 0238 is high sucrose containing variety which is moderately susceptible to top borer infestation. Study in Nigeria indicated that reducing sugars in the growing points were positively correlated to the susceptibility to top borer. Relatively higher quantity of chlorophyll in leaves and lignin in mid rib causes tolerance to top borer infestation (Chaudhary & Yadhav 1996; 1998a).

The morpho-physiological characters of plants such as higher lignin in the mid rib, P and K content in growing point, midrib and leaf blade, higher cane growth rate, longer leaf blade and mid rib, higher total chlorophyll content and relatively lower moisture and N content in growing point confer tolerance to top borer (*Scirpophaga excerptalis* Walker), infestation. So further study on the bio-chemical composition, morphological traits, physiological and anatomical characteristics of the above experimented sugarcane genotypes need to be conducted to elucidate the cause for the resistance.

CONCLUSION

Among the 40 genotypes tested, 26 genotypes were categorized as less susceptible, 11 genotypes were found moderately susceptible. These genotypes will be useful for developing the top borer resistant genotypes through breeding approaches. The top borer resistant genotypes identified in this study could be processed for the yield and stability study for the varietal release also.

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Authors' contributions

K. Paudel was the lead investigator and responsible for the conceptualization, methodology development, data curation and drafting the manuscript of this study. N. Dangi was responsible for review and editing of the manuscript. A.R. Ansari and R. Regmi were responsible for the literature search, data generation and drafting of this manuscript.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

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