Assessment of Insect Pests of Sugarcane at Different Growth Stages at Tendaho, Ethiopia

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ABSTRACT

Tendaho sugar factory is one of the government owned company in Ethiopia which has about 25,000 ha of sugarcane plantations. Sugarcane (*Saccharum officinarum* L.) is one of the most important cash and industrial crop in Ethiopia. Lepidopteran borers are major constraints that limit production of sugarcane in the country. Information on the identification of the insect pest and understanding their significance in the sugarcane production system is in the primary step in pest management. Therefore, this study was undertaken to assess the major insect pests of sugarcane and generating information for future projects on pest complex and their relative abundance. Assessment was started from June 2016 to February 2017 at Dubti and Detbahari sugarcane plantation sites. Pest complex and their relative abundance were assessed regularly in ten days interval from 25 randomly selected sugarcane plants. Based on the data obtained from the two surveys location, the incidence of shoot borers in sugarcane plantation was observed during tillering growth stage of the crop at both of the study sites. At Dubti site, the highest and lowest incidence was recorded in B-52/298 (33%) and N-14(14.61%) varieties, respectively. Likewise, at Detbehari site, highest and lowest pest incidence was recorded in Co-678 (14.9%) and N-14(5%) respectively. At ground growth stage of the crop, stalk borers were dominant insect pests. In this regard the highest and lowest incidence of stalk borers was recorded at Dubti in B-52/298 (40%) and N-14(4.87%) varieties, respectively. At Detbehari the highest incidence of borer was scored in Co-678(19.7%) of variety. In general, among the varieties, B-52/298 exhibited high incidence of stalk borer as compared to the other varieties in the plantations. In view of above information, further studies may be planned and implemented to enhance high production of sugarcane consequently the sugar in the country.

Key words: Insects Pests, Sugarcane, Stalk borer and insect population

INTRODUCTION

Sugarcane, Saccharum spp. L. (Poaceae) is a perennial crop that is grown as a source of sugar primarily in the tropical and subtropical areas of the world, including several countries in Africa, the Mascarene Islands and Madagascar [1]. The taxonomic status and the origins of cultivated sugarcane varieties are not clear but the varieties of noble canes, Saccharum officinarum L., are thought to have originated in Melanesia and the ancestral form is thought to be the wild Saccharum robustum L. of New Guinea and adjacent islands [2] .Other cultivated sugarcanes, Saccharum barberi L. and Saccharum sinense L., are believed to have been derived through natural hybridisation of S. officinarum with the wild Saccharum spontaneum L. [3]. Sugarcane has been grown in gardens in New Guinea since time immemorial [2]and cultivation of the crop in Africa and neighbouring islands was first recorded in the Cape Verde Islands in the early 15th century [4].

According to FAO (2004), a total of 20,114,934 ha of land is allocated to sugarcane in 100 countries of the world. Sugarcane is not an indigenous crop to Ethiopia. However, it was grown in some parts of the country even before the commencement of large-scale commercial plantation and establishment of modern sugar factory at Wonji mainly for local consumption [5]. So far there is no well documented reference about how, when and who introduced sugarcane to Ethiopia except the clue provided by [6]regarding the probable time of introduction; which is estimated to be sometimes during the early 18th century [7].

Modern sugar production in Ethiopia commenced in 1954 at Wonji by the Dutch Company, Handles-Vereening Amsterdam (HVA) with sugarcane plantation of 5,000 ha. Later in 1962, the Company established the second sugar factory, Shoa, expanding the cane plantation by 2000 ha. Similarly, other sugarcane plantations were established at Metahara (over 10,000 ha) and Finchaa (over 8000 ha) in 1969 and 1998, respectively [8] The country's annual production of sugar from the three sugar estates is about 280,000 tons [9]. In addition to the above mentioned sugarcane factory the biggest sugar factor in Ethiopia is the Tendaho Sugar Project found in afar region.

A great variety of insect pests feed on sugarcane, including insects from a broad spectrum of orders such as Lepidoptera, Coleoptera, Hemiptera, Orthoptera and Isoptera [2], [10], [11]. Wade (1951)[12] ,listed 277 species of insects associated with sugarcane worldwide. However, only a limited number are of economic importance [13]

The group of insect that are known as major pest of sugarcane globally include moth borer, white grubs and their adults (Scarabaeidae beetles), termites and froghoppers (Anonymous no date). However, these insect are not found in every area of sugarcane production. These group of insect are represented by different species in different area. For example, Sesamia spp. Are the common borer in the tropics while *Diatreae* spp. common in template region. The species of black beetle found in the tropics and temperate region also vary. Beetles of the Scarabaeidae Family, especially *Hertonychus* spp. are the most common abundant in Africa and other tropics . [14];[15]

In Ethiopia, insect damage on sugarcane has been recognized since the establishment of the first sugarcane plantation at Wonji[16]. Presence of the group of the world major insect pest of sugarcane (black beetle, borer and termite) has been recognise in the three plantation of the country. However, no detail survey regarding sugarcane insect in Ethiopia sugarcane plantation has been conducted.

Identifying the insect pest and understanding their significance in the sugarcane production system is the primary step in pest management program. In this regard, except few attempts that indicate the presence of complex stem borer [13] no extensive works have been undertaken in the Ethiopian sugarcane plantations. Identification of the insect pest complex according to their significance to the stake holder has a paramount importance in their management. [13]reported that *S.calamistis* is relatively the most significant stem borer species in the three sugarcane plantations. However, in Tendaho sugar project, except few attempts that indicate the presence of complex stem borer no extensive works have been undertaken. Hence, assessment of insect pest complex is a continuous process and should be made periodically. Furthermore, such approaches lead to a better understanding of the population structure of important insect pests, which in turn allows more sound and scientific insect management systems to be planned and implemented.

Therefore, this work was done with the objective of assessing the insect pest of sugarcane at Tendaho sugarcane plantation sites at different growth stages.

MATERIALS AND METHODS

Assessment of pest complex

Assessment was started from June 2016 to February 2017. Pest species complex and their relative abundance were assessed by plant sampling. In this survey, sugarcane plots were identified and evaluate randomly from production data sheets from each site. The assessment was from Plant cane crop with due consideration of plant growth stages (germination and establishment phase, tillering phase and ground growth phase) and varieties (N-14, Co-678, Nco-334, Mix-54/245 and B-52/298).

Plant sampling procedure

Pest complex and their relative abundance were assessed regularly in ten day intervals from twenty- four plots with 87 m^2 [six furrow of 1.45 m width 10 m] [17] that were demarcated in the selected field of the plantation in w-shape design [17] . The survey was conducted on plant cane both at Dubti and Detbahir plantation sites on varieties (N-14, Co-678, Nco-334, Mix-54/245 and B-52/298), (N-14, Co-678, Nco-334) respectively. The fields were inspected for signs of insect infestation, and insects found feeding on sugarcane were recorded and counted from 25 randomly selected plants per sampling occasion. Ten of the 25 plants samples were randomly inspected by walking from the top left corner diagonally to bottom right corner of the field, and the other 10 samples were from the right diagonally to the bottom left corner. The remaining five samples were inspected by walking through the center of the field from top to bottom by inverted v- shape walk. Relative abundance of each insect pests were determined as the total number of insect pests found, expressed as the percentage of the total population of all insect pests plantation sites. Small and flying insects were collected by yellow water trap. Field identification of the insects that produced distinguished symptom was made by personal experience from plantation records and other references.[18]

Insect pest incidence

Incidence of shoot borer was estimated as Assefa [19] using the following formula:

$$\text{Incidence \%} = \frac{Total\ number\ of\ dead\ shoot/plot}{Total\ number\ of\ tillers/plot} * 100$$

Incidence of stalk borers was determine based on the number of the number of bored stalks over the total stalk population as

$$\text{Incidence \%} = \frac{Total\ number\ of\ bored\ stalks/plot}{Total\ number\ of\ stalks\ population} * 100$$

Data analysis

Data were analysed using descriptive statistics to show the relative abundance of insect composition at both sugarcane plantation sites. Data on the relative abundance of insect pest were pooled for graphic presentation based on crop growth stages (germination and establishment phase, tillering phase and ground growth period) and varieties N-14, Co-678, Nco-334, Mix-54/245 and B-52/298.

RESULTS AND DISCUSSION

Insect Pests Composition

Generally, the assessment results have indicated that five different insects have been recorded from sugarcane plantation at Dubti and Detbehari sites (Table 1). Except mealy bugs that found only at Dubti site, the plantations have relatively similar in types of insect pests. This may be due to similarity of crop production system and agro-ecological condition.

The insects were categorized by their common name depending on their feeding habits, type of damage and symptoms they cause. Based on their feeding habits they are categorized in to three groups as sugarcane borers, foliage feeders and sap feeders. Importance of the pest depends on plant part they attack and their feeding habits. The major insects attack shoots and stalks. Most of the minor insects recorded in this survey defoliators and sap suckers feeding on saps from stem or leaves of sugarcane.

Table 1. List of insect pests recorded at Tendaho sugarcane plantation sites (2016/17)

Common name	Pest status	Plant part attacked
Shoot borers	Major	Growing buds (Young shoot)
Stalk borers	Major	Sugarcane stalk
Grasshoppers	Minor	Leaf
Aphids	Minor	Leaf
White fly	Minor	Leaf
Mealy bugs	Minor	Cane stalk

Crop Growth Phase

At Germination Stage

To determine insect compositions recorded have been taken from twenty-five randomly selected plants at Dubti and Detbehari sugarcane fields (Figs 1 and 2). However, at germination stage of sugarcane less level of insect infestation was observed as compared to the remaining growth stage of the crop at both locations.

At Tillering Stage

According to Long and [20], the most important borers in sugarcane are shoot borers and stalk borers. Based on the data obtained from the two surveys location, the incidence of shoot borers in sugarcane plantation was observed during this growth stage of the crop regardless of the study sites. Infestation of shoot borer is assumed to be sever when shoot loss exceeds 30 [15] or 33%. At Dubti, the highest damage was (33%) was noted in variety B-52/298, followed by Co-678 (27%) variety (Figure1). These varieties seemed to be highly susceptible to borer attack. Least susceptible varieties (N-14, Nco-334 and Mix-54/245) received early shoot borer infestation ranging from 14.61%, 18.88% to 20%, respectively. Likewise, at Detbehari, highest and lowest pest incidence was recorded from Co-678 (14.9%) and N-14 (5%), respectively.

These results generally revealed that all the sugarcane varieties were indiscriminately affected by the borers at both locations except N-14 variety appeared as light infestation. The present study is supported by Arvind *et al* (1996) tested 36 promising genotypes of sugarcane together with standard co.7717 during 1995 at karnal under sodic normal soil condition shoot borer incidence

was recorded 90 days after planting shows that across genotypes mean shoot borer incidence was significantly higher (43.7 and 20%), respectively.

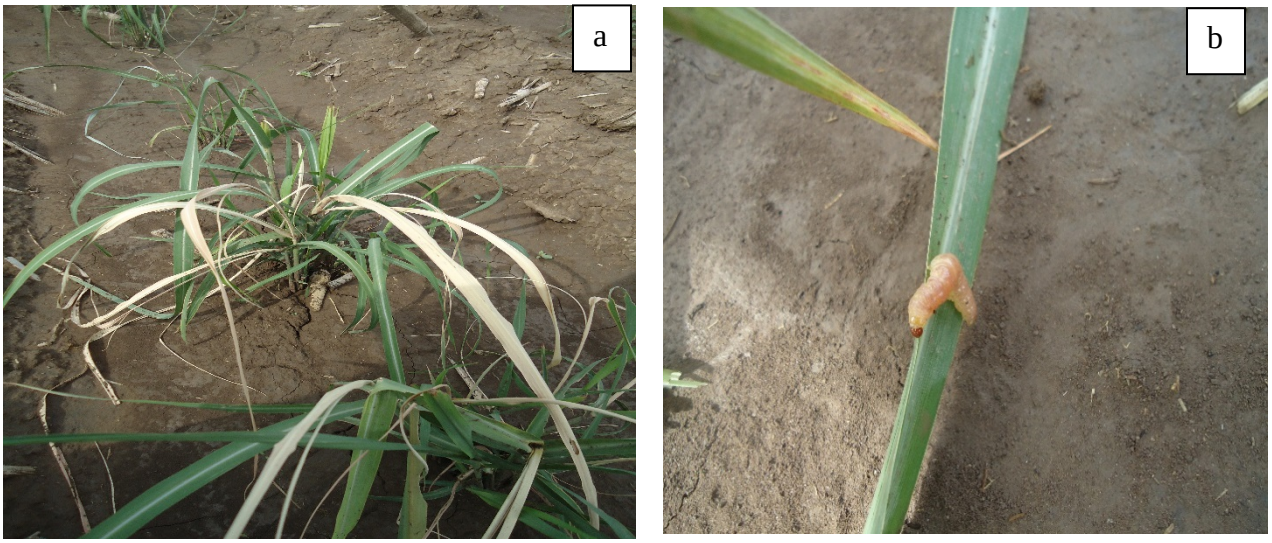

Fig. 1. Shoot borer at early stage symptom and its larvae at Dubti sugarcane plantation (2016/17) a) Symptoms of dead heart caused by shoot borer, b) Active stage of feeding larvae

At Ground Growth Stage

Stalk borers are the most destructive borers worldwide [21] As they indicated in report, stalk borers are responsible for 95% of insect problems in sugarcane production in USA causing about 20 % yield loss. At Dubti, the highest incidence of stalk borer was recorded on the variety B52/298 (40%) and followed by Co-678 (27%) than on the remaining varieties (Figure 1). Study conducted at Metahara by [22] agree with results of the present assessment that higher incidence of stalk borer was recorded on the variety B52/298 followed by NCO334 varieties. At Detbahri, the variety Co-678 (19.7%) followed by Mix-54/245 (16%) showed higher incidence of stalk borer as compared to the other variety grown on the plantation site.

At Dubti, the infestation of stem borer was lowest as 4.8% on variety N-14. These results generally revealed that N-14 variety showed better performance to borer infestation. The present finding is supported by [23] conducted insect pest assessment at three Ethiopian sugar Estate. The results at Metahara indicated that minimum infestation of stalk borer was recorded on N-14 variety. The minimum infestations of borers were may be due to the hard ride spiny leaves and other morphological characters of variety. On the other hand, B52/298 and Co-678 varieties showed comparatively more infestation of borers than the other varieties. The maximum

infestation in the standard variety may be to their soft rind, thick cane and spineless leaves. The other reason may also be due the mature sugarcane stay even for three years on the field without harvesting at Dubti plantation site. This over aged sugarcane is important harbor to the pupae left in old stems and stubble and to make possible carry-over populations and make easy for initial establishment of the pest on the following seasons. It is hoped that the promising varieties which have shown some tolerance to borers infestation will replace the old and not recommended varieties in the near future.

Figure 2: Stalk borer damage at Dubti sugarcane plantation (2016/17)

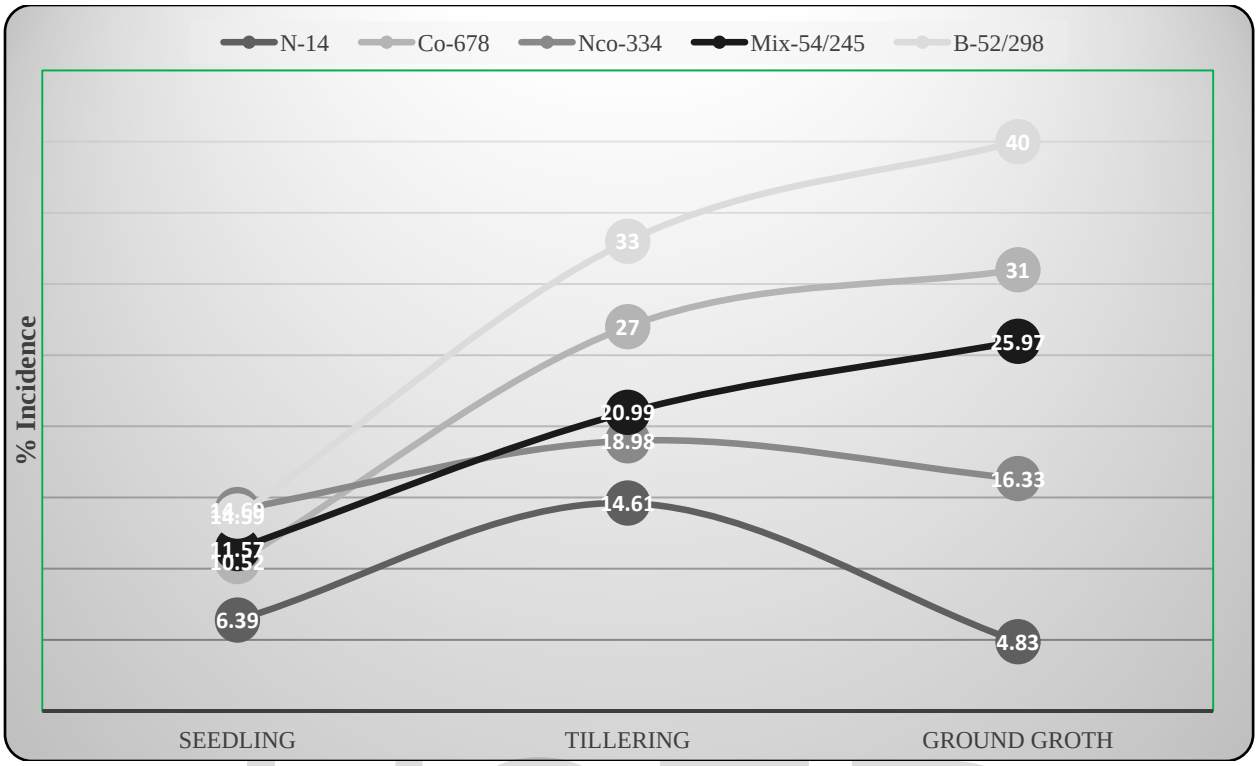

Fig. 3. Incidence of shoot borer and stalk borer at Dubti sugarcane plantation (2016/17)

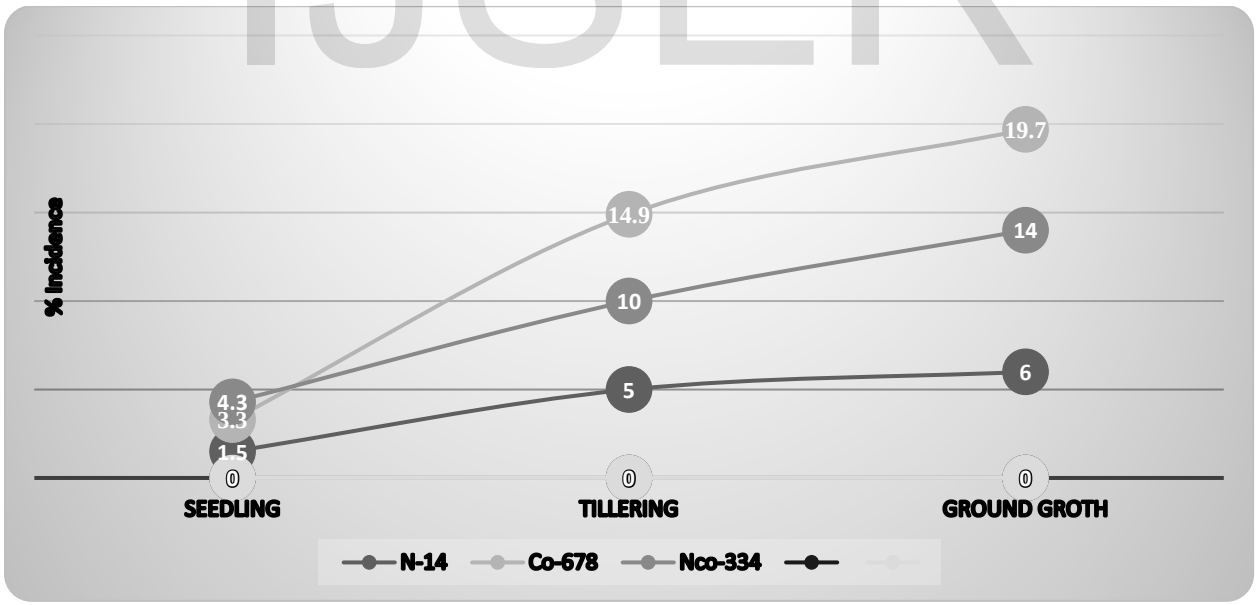

Fig. 4. Incidence of shoot borer and stalk borer at Detbehari sugarcane plantation (2016/17)

Miscellaneous Pests

The miscellaneous pests in this survey include the occasionally important ones, minor pests and those insects for which damage recorded was not available. These include different groups of insects that have different feeding habit.

Economic importance of pests is measured only in terms of frequency of their occurrence. Grasshopper was observed at both plantation sites. These are foliage feeders occurring usually at early stage of the crop.

Aphids and mealy bugs are the common sap feeders in sugarcane. Usually importance of aphids is associated more to their indirect damage through transmitting a devastating viral disease, the mosaic virus (SCMV) than their direct effect of sap feeding [2] cited in [15]. The aphids were recorded at both plantation sites, while mealy bugs were recorded only at Dubti site.

Regarding the general pattern of insect composition as plant growth stage progresses, population densities of grasshopper, white fly and aphids were almost showed decreasing trend following plant growth stage except the level of infestation by mealy bugs increased as plant growth progress and reached its highest level at ground growth stage(Figure 3 and 4).

Fig. 5. Insect populations on sugarcane plantation at Dubti (2016/17)

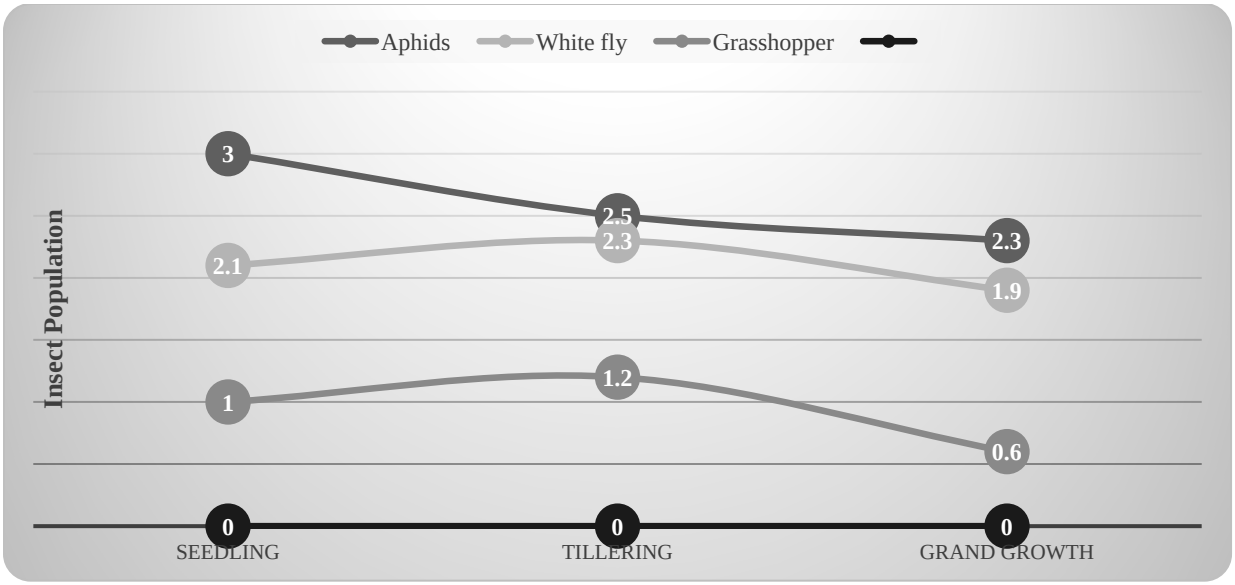

Fig. 6. Insect populations on sugarcane plantation at Detbehari (2016/17)

SUMMARY AND CONCLUSION

Sugarcane is one of the major cash crops providing immense income for many countries around the world. In Ethiopia, sugar industry plays a great role in the country's economy. However, its production is constrained by several biotic and abiotic factors among which insect pests are the major ones. In Ethiopia Lepidoptera borers are reported as major insect pest in the plantations in most sugarcane growing areas that limit production of this crop in the country. Moreover, there are gaps of information on the identifying the insect pest and understanding their significance in the sugarcane production system is the primary step in pest management. Hence, assessment of insect pest complex is a continuous process and should be made periodically and, such approaches lead to a better understanding of the population structure of important insect pests, which in turn allows more sound and scientific insect pest management systems to be planned and implemented. Therefore, this study was undertaken to assess the major insect pests of sugarcane and generating information for future projects on pest complex and their relative abundance at Tendaho Sugarcane plantation.

At Dubti, the highest and lowest incidence was recorded from B-52/298 (33%) and N-14(14.61%) varieties, respectively. Likewise, at Detbehari, highest and lowest pest incidence was recorded from Co-678 (14.9%) and N-14(5%) respectively.

At ground growth stage of the crop stalk borers was dominant insect pests. In this regard the highest and lowest incidence of stalk borers was recorded at Dubt from 52/298 (40%) and N-14(4.87%) varieties, respectively. At Detbehari the highest incidence of borer was scored from Co-678(19.7%) of variety.

Generally, from the current study the following conclusion has been given. These varieties seemed to be highly susceptible to borer attack. These results generally revealed that N-14 variety showed better performance to borer infestation. Proper attention should be also given for minor insects like mealy bug. Insect density alone does not indicate the relative importance of insect species for management program. Hence, crop damage and yield loss assessments are required to confirm the importance of insects found in high number at different crop growth stages of sugarcane.

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