



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(2): 1283-1288

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Received: 20-01-2018

Accepted: 23-02-2018

Kumbhar CR

Division of Entomology, Dr.
Rajendra Prasad Central
Agricultural University, Pusa,
Samastipur, Bihar, India

AK Rai

Division of Entomology, Dr.
Rajendra Prasad Central
Agricultural University, Pusa,
Samastipur, Bihar, India

Succession of borer complex and their relation to major biotic factors in Sugarcane (*Saccharum officinarum* L.) under North Bihar condition

Kumbhar CR and AK Rai

Abstract

Five borer pest species were recorded namely early shoot borer, *Chilo infuscatellus* (Snell.); root borer, *Emmalocera depressella* (Swinhoe); top borer, *Scirpophaga nivella* (Walk.); plassey borer, *Chilo tumidicostalis* (Hampson) and pink borer, *Sesamia inferens* (Walk.) found to infest sugarcane crop at their different growth stages in North Bihar during 2013-14. Top borer had been observed as major pest followed by early shoot borer and root borer, respectively while plassey and pink borer had been recorded as a minor pest based on injury symptom. In succession two groups of pests *i.e.* major and minor which were founded on the crops from seedling to maturity stage. Per cent dead heart infestation of these borer ranges from 02 to 25.0, 02 to 20.0, 02 to 9.0, 01 to 10.0 and 01 to 5.0 and their peak occurred on July 1st and September 1st (bunchy top), April 2nd, May 1st and Aug. 1st fortnight and no clear trend appearance for pink borer.

Keywords: Borer pests, Sugarcane (*Saccharum officinarum* L.), succession, weather factors, north Bihar

1. Introduction

Sugarcane (*Saccharum officinarum* L.) is one of the important cash crops grown in all tropical and subtropical countries of world and world's most efficient living collector of solar energy, storing this energy in a huge quantity of biomass in the form of fibre and fermentable sugars. It provides employment not only to agricultural labourers in the fields but also to industrial labourers in the sugar factories. It is also an important source of foreign exchange. Considered 32 insect pests as major pests of sugarcane crop [3]. Nine species of borers regularly damage sugarcane. Of these, the shoot borer *Chilo infuscatellus* is posing serious threat to sugarcane production all over India while stalk borer, *Chilo auricilius* and internode borer, *C. sacriphagous indicus* are major pests in north India and Peninsular India, respectively. It has been computed that the shoot borer destroys 26-65 per cent mother shoot and 6.4, 27.1 and 75 per cent primary, secondary and tertiary tillers, respectively [9]. The top borer, *Scirpophaga excerptalis* is a major pest in north India, especially in the states of Bihar, Uttar Pradesh, Haryana and Punjab. In young and grown up canes, the infestation resulted in "dead heart" formation which induces sprouting of the lateral buds giving a "bunchy top" appearance [19]. Root borer has been observe to be active at high temperatures and moderate humidity levels and appears to be tolerant to rain to an extent of 45 cm after which population declines [6]. The Plassey borer *Chilo tumidicostalis* was firstly recorded in Assam at Jorhat in 1919 [5]. Since then, this insect has been observed to infest sugarcane regularly in the different regions of Assam, Bihar, West Bengal and Utter Pradesh. In order to evolve, economically feasible, ecologically sound and socially acceptable pest management strategies, detailed information on the pest complex, their status and sequence of appearance during the cropping period, losses type of damage are of great importance [8].

Therefore, the present research work was undertaken to record the insect pests of sugarcane, their infestation and time of appearance with the crop stages.

2. Materials and Methods

The field experiment was conducted at Pusa Farm, Rajendra Agricultural University, Pusa, Samastipur (Bihar), India during 2013-14 crop seasons. The test crop was planted in 0.2 acre. The sets of sugarcane were planted in plots on the fourth week of February, 2013. Plots were selected Randomized Block Design with four replication. Each plot measure 10x5.4 m² having 8 rows of 90 cm apart with spacing of 1 m between and 0.5 m treatments.

Correspondence

Kumbhar CR

Division of Entomology, Dr.
Rajendra Prasad Central
Agricultural University, Pusa,
Samastipur, Bihar, India

All standard agronomic practices were followed to raise the crop except the application of pesticides. The observations of symptom were recorded at fortnightly intervals starting from the second week of April, 2013 to till maturity of the crop. Twenty numbers of plants were selected randomly from each spot, altogether 100 numbers of plant were examined for symptom appear on plants due to the injury done by borers in each observation of fortnightly interval.

The succession of sugarcane borer pests was done by

recording the data of infestation caused by the different borers on plants which appeared as symptom on the plant resulting phenological/ symptomatological change of the plant. It was observed that the phenology of this plant was correlated with the succession of the pest complexes. Their association with host plants were analysed in relation to temperature, humidity, and rainfall. The data of present studies were analysed by using NCSS2000 and OPStat programme.



Plate 1: Leaf initial injury



Plate 2: Leaf completes injury



Plate 3: Deadheart of early shoot borer



Plate 4: Pulled deadheart of early shoot borer



Plate 5: Damaged shoot by ESB



Plate 6: Damaged growing point



Plate 7: ESB moth



Plate 8: Deadheart of root borer



Plate 9: Root borer larva inside the plant



Plate 10: Damaged Plant by boot borer



Plate 11: Incomplete mid-rib mining



Plate 12: Complete midrib mining



Plate 13: Braked mid-rib mining

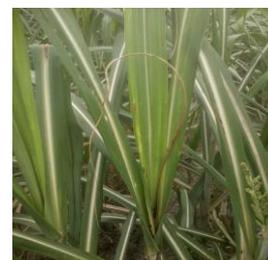


Plate 14: Deadheart of top borer



Plate 15: Pulled deadheart of top borer



Plate 16: Top borer larva



Plate 17: Top borer moth



Plate 18: Bunchy top of top borer



Plate 19: Damaging symptom of: plassey borer



Plate 20: Plassey borer larva



Plate 21: Plasley borer moth



Plate 22: Infestation symptom of pink borer

3. Results and Discussion

Succession on major borer complexes and their symptoms in different parts of sugarcane have been shown in the plate 1. It was observed that different borer pests, viz. early shoot borer, root borer, top borer, plasley borer and pink borer were present in the crop season during 2013-14. A few workers had reported succession study result on other crops such as ^[12] on chickpea, ^[18] on cowpea and ^[2] on soybean.

Early shoot borer attacking the crop during March 2nd fortnight to August 2nd fortnight with its peak in April 2nd fortnight and its leaf and dead hearts infestation ranges from 0.81 to 8.11 and 0.2 to 20.0 per cent, respectively. Sable *et al.* (2005) revealed that the early shoot borer populations build up started from 11th standard week and peaked in 17th standard week. Early shoot borer increasing and decreasing trend was found during March 2nd to May 1st fortnight and May 2nd fortnight to August 2nd fortnight, respectively ^[1] as his infestation result started in April and gradually increase up to September ^[11] also found that the early shoot borer infestation started in May 1st week with gradual increase up to end of May. They also found that the pest infestation became negligible during mid- July. The root borer existence and its peak were observed during the April 1st fortnight to June 2nd fortnight and May 1st fortnight and its dead hearts infestation ranges from 0.2 to 9.0 per cent, respectively ^[17] revealed that the root borer emergence and activities found during April to November with its population peak in 2nd fortnight April. Increasing and decreasing of these borer trend was found during the April 1st fortnight to May 1st fortnight and May 2nd fortnight to June 2nd fortnight ^[1] found that the pests increasing and decreasing trend was observed during the April to August and May to June. From Table 1, top borer existence and its peak were found during the April 2nd fortnight to November 2nd fortnight and July 1st fortnight for dead hearts and September 1st fortnight for bunchy top and its leaf and dead hearts infestation ranges from 1.40 to 9.27 and 0.2 to 25.0 per cent, respectively. ^[10] observed that the infestation was found during May to December (in Haryana) with its peak in October. ^[14] found the incidence of top borer was observed during crop season in Gujarat. ^[1] found the pest existence and its peak during March to July. The increasing and decreasing trends of the pest were found during April 2nd fortnight to July 1st fortnight and July 2nd fortnight to September 2nd fortnight. ^[7] revealed that the pests increasing trend from last week of June to 3rd of July. ^[16] also reported that the population top borer increased with the age of the sugarcane plant. Plasley and pink borer existence were found during July 1st fortnight to September 2nd fortnight and its plant infestation ranges from 0.1 to 10 per cent. Plasley borer existence reported by ^[15] as April to December 1st fortnight and its two peaks during August and October ^[4]. The pink borer existence was found between December to April

reported by ^[1] while its peaks were in April/ May and in August ^[13]. In the present investigation the pests plasley and pink borer trend, existence and its peak could not shown an appreciable level of infestation. So, it was difficult to find out pests infestation trends. This poor level of infestation could be due to the unfavorable weather parameters prevalence in the study area.

From Fig 2. It was observed that the early shoot borer appeared first among the all available sugarcane borers and remain during March 2nd fortnight in September. This could be due to shoot started to establish first among the sugarcane borer. It could be due to niche (host plant) was found vacant and associative evolutionary relationship with the plant stage. In the April first fortnight, root borer along with early shoot borer was found. This could be due to both population could coexist with different degree of infestation as the host stage suitability fit for both the population (shoot and root borer). During the April 2nd fortnight, there were early shoot borer, root borer and top borer coexistence. This coexistence would be due to difference in niche occupation. The niche differences of the different borers in the plant were found as an underground stem portion for root borer, stem portion just on the ground surface of shoot borer and the terminal part of the plant for top borer. In the May 2nd fortnight, top borer outcompete than the others borer. In this part of time, the interaction of root borer, shoot borer and top borer seem to be more influenced by physical parameters (Fig. 3). Root borer and shoot borer started to decrease due to also arrival on unsuitable stage of the plant. In the June 1st fortnight top borer overcome the root borer and shoot borer because of the fact that the physical parameters favoured top borer interaction with plant (Fig. 3). In the July 1st fortnight, plasley borer appearance occurred and in July 2nd fortnight pink borer appeared. In the month of June coexistence of shoot borer, top borer and plasley borer infestation occurred but top borer infestation decreased. In the August 1st fortnight plasley borer increased from the previous level and also decreased from previous level of borer infestation. In the August 1st fortnight, there was a coexistence of shoot borer, top borer, plasley and pink borer could be due to following facts as niche difference, time difference and increase of niche breadth (plant size increase). In the September, 1st and 2nd fortnight there was further decreased of infestation level of top borer and pink borer. In the latter part of crop maturity, the coexistence could be due to habitat for the borers; early shoot, root, top, plasley and pink borer reached the climax of saturation (equilibrium level).

The overall per cent infestation of different borers were 29 per cent, 13 per cent, 36 per cent, 15 per cent and 07 per cent caused by early shoot borer, root borer, top borer, plasley borer and pink borer during cropping season (Fig. 1)

Table 1: Succession of sugarcane borer pests in relation to crop stages during March to September, 2013-14

Name of pest	Plant growth stages	Duration of existence	Infestation range		Trend duration		
			Leaf Infestation (%)	Deadhearts/ bored plant infestation (%)	Increasing/ Initial/Fluctuating	Decreasing	Peak
Early shoot borer	Shoot formation and tillering	March 2 nd fortnight to Aug. 2 nd fortnight	0.81 to 8.11	02 to 20.0	March 2 nd fortnight to May 1 st fortnight (Increasing)	May 2 nd fortnight to Aug. 2 nd fortnight	April 2 nd fortnight
Root borer	Shoot formation and tillering	April 1 st fortnight to June 2 nd fortnight	--	2 to 9.0	April 1 st fortnight to May 1 st fortnight (Increasing)	May 2 nd fortnight to June 2 nd fortnight	May 1 st fortnight
Top borer	Grand growth stage and set formation	April 2 nd fortnight to November 1 st fortnight	1.40 to 9.27	02 to 25.0	April 2 nd fortnight to July 1 st fortnight (fluctuation)	July 2 nd fortnight to November 1 st fortnight	July 1 st fortnight and September 1 st fortnight (bunchy top)
Plassey borer	Set and Cane formation	July 1 st fortnight to Sep. 2 nd fortnight	--	01 to 10.0	July 1 st fortnight to Aug. 1 st fortnight (For brief period)	Aug. 2 nd fortnight to sep. 2 nd fortnight (For brief period)	Aug. 1 st fortnight
Pink borer	Set and cane formation	July 2 nd fortnight to September 1 st fortnight	--	01 to 5.0	No clear trend of appearance and its existence due to brief period.		

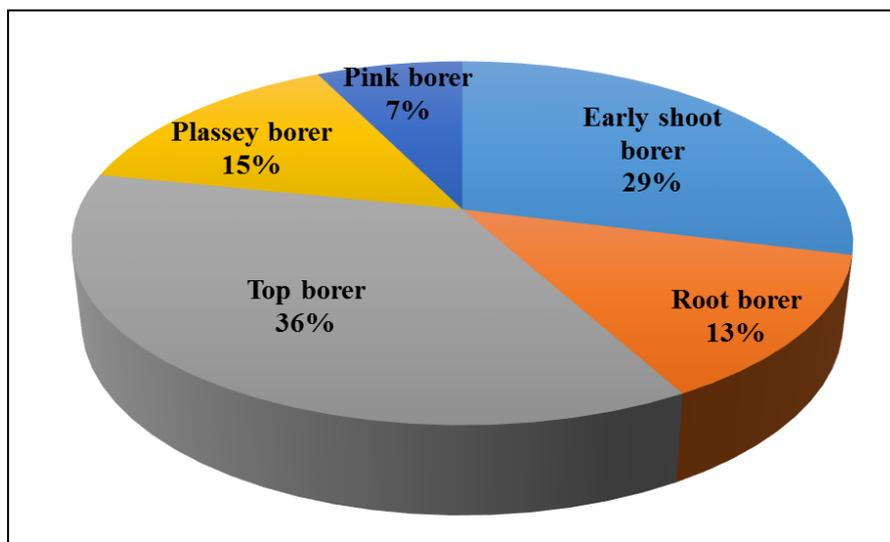
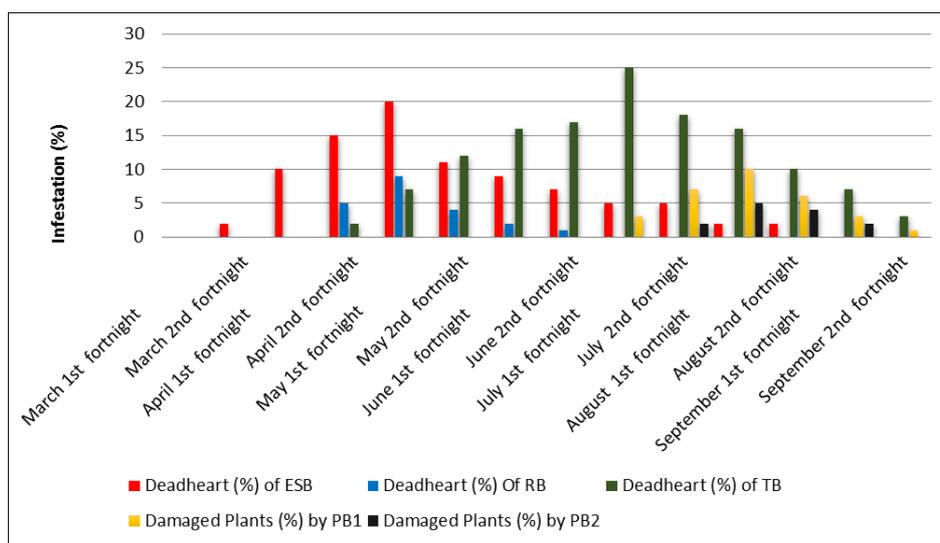


Fig 1: Total per cent infestation of sugarcane borer pests in during 2013-14



PB1- Plassey Borer, PB2- Pink Borer

Fig 2: Different borer pests infestation in relation to weather parameters during croppingseason, 2013-14

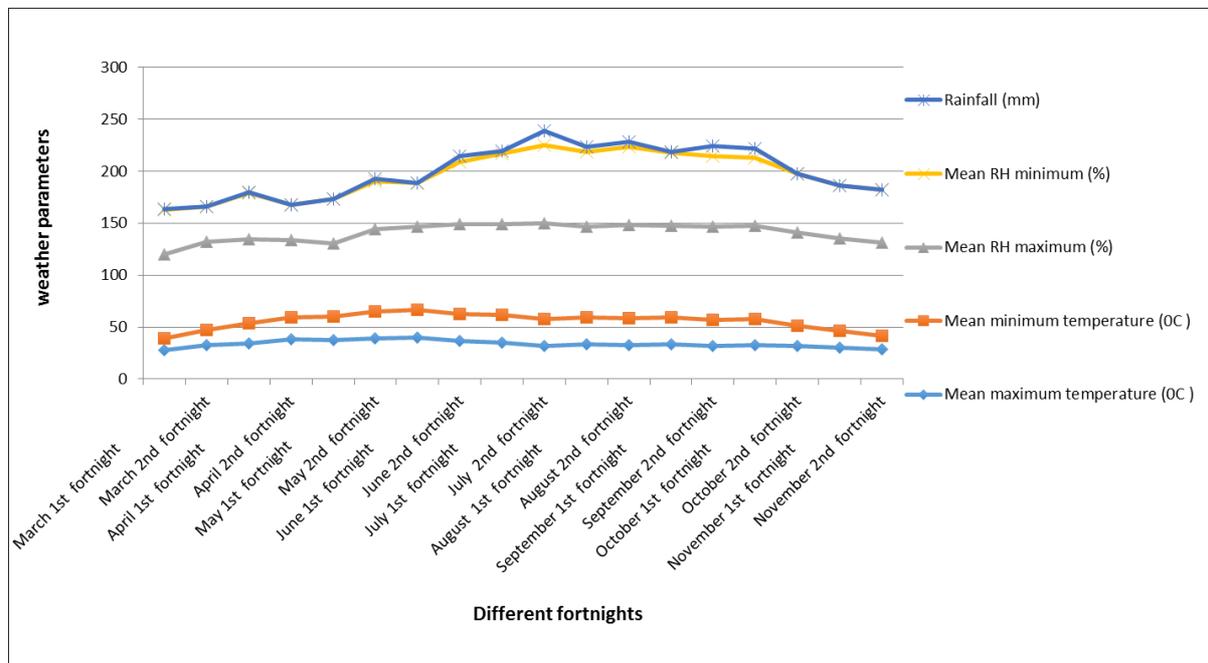


Fig 3: Meteorological parameters of crop season 2013-14

4. Conclusion

In the succession of borers, early shoot borer appeared first followed by root borer, top borer, plassey borer and pink borer in the same crop during the season 2013-14 and it appeared during 2nd fortnight of March and continued up to September. During April 2nd fortnight coexistence of three borers, i.e. early shoot borer, root borer and top borer was observed. However, dominance of shoot borer was observed which followed root and top borer. In the 1st fortnight of June, top borer overcome the root borer and shoot borer and in the month of July appearance of plassey borer and pink borer was recorded. The population of increased in 1st fortnight of August plassey borer but decreased from the previous level during 2nd fortnight of August. During September there was a further decrease in infestation of top borer and pink borer.

Early shoot, root, top, plassey and pink borer were observed infesting sugarcane in the experimental area. These utilization associations of borers form a community structure in sugarcane which caused a continued infestation of the different borers and sugarcane plant feeding relationship also produced distinct symptoms. The coexistence and interaction of root borer, shoot borer, and top borer seemed to be more influenced by physical parameters along with unsuitable stage of plant. Plassey borer and pink borer infestations were found as a sporadic status of these pests, which caused very less degree of infestation, then it's ETL. In the latter part of crop maturity, the coexistence could be due to habitat for different borers; early shoot, root, top, plassey and pink borer and reached the climax of saturation (equilibrium level). Statistical analyses of data also showed that weather parameters did not influenced the borers' infestation in a definite direction, i.e. the positive and negative effect on infestation.

5. Acknowledgement

The authors are grateful to the Head, Department of Entomology and also to breeders, Department of Genetics and Plant Breeding (SRI, Pusa), Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur (Bihar), (formerly Rajendra Agricultura University) India for providing necessary facilities to conduct the experiment.

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