SEASONAL INCIDENCE AND ABUNDANCE OF EARLY SHOOT BORER, TOP SHOOT BORER AND INTERNODE BORER OF SUGARCANE

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Abstract: The present investigation was conducted to understand the incidence of three major borer pests on sugarcane at Zonal Agricultural Research Station, V.C., Farm, Mandya, Karnataka during 2014 – 16. The incidence of *C. infuscatellus* was observed from 30 DAP to 150 DAP in all the five commercial varieties. The peak incidence was observed at 60 DAP (2.22-4.71 per cent). Cumulative incidence of ESB varied from 3.1 to 7.5 per cent. Highest cumulative incidence was recorded in variety VCF 0517 (7.5 per cent) and Co 86032 (7.1 per cent). Activity of TSB was observed from 90 DAP to 210 DAP. The peak incidence was observed at 120 DAP (1.10 – 2.86 per cent) with a cumulative incidence of 3.7 to 6.0 per cent. Incidence of INB varied from 8.00-29.00 per cent with an intensity of 0.72 to 3.01 per cent and infestation index of 0.07 to 0.88. Highest incidence of INB was recorded on the variety VCF 0517 (36.00 per cent).

Introduction: Sugarcane (*Saccharum officinarum* L.) is an important commercial crop that is cultivated in more than seventy countries between 40°N and 32° 5′S. It is also an important cash crop of India. India ranks first in the world in area under sugarcane cultivation and ranks fifth in the world in terms of sugar production. In India, sugarcane occupies an area of 5.01 m ha and produces 338.96 m tones of cane with an average productivity of 66.99 tones ha^{-1} (Anon., 2015). In tropical zone, Karnataka is one of the major cane growing states. It occupies fourth place in the country, having an area of 4.04 lakh ha under sugarcane cultivation producing about 3.2 mt of cane with an average yield of 79.80 tones ha^{-1} during 2013-2014 (Anon., 2015).The production and productivity of sugarcane is not sufficient to meet out the requirement of ever increasing population due to factors like poor soil fertility, prevalence of pest and diseases and environmental stress. Pests are known to inflict considerable loss on cane yield as well as sugar output. Box (1953) reported 125 species of insect pests on sugarcane in India. Gupta (1957b) categorized 18 species of insects as major pests and 21 species as minor insect pests of sugarcane in India.

Based on feeding habit, the insect pests of sugarcane are broadly classified as borers, sucking pests, subterranean pests, defoliators and non-insect pests. The nine species of lepidopteran pests regularly damage sugarcane (David, 1977) in India. Among the major species of borers, the early shoot borer (ESB), *Chilo infuscatellus* Snellen, is a major problem in all sugarcane growing states of India. The internode borer (INB), *Chilo sacchariphagus indicus* (Kapur) is a major pest in peninsular India and the top shoot borer (TSB), *Scirpophagous excerptalis* Wlk., is a major pest in north India, specially in the states of Bihar, Uttar Pradesh, Haryana and Punjab. Borer pests are the major ones which are causing considerable damage to sugarcane. Among the borers, early shoot borer (ESB), *Chilo infuscatellus* Snellen is an important pest infesting the crop during early stages prior to internode formation. It also infests millable cane during the years of drought or scanty rainfall.

It has been computed that the shoot borer destroys 23-65 per cent mother shoots and 6.4, 27.1 and 75 per cent primary, secondary and tertiary tillers, respectively (Doss, 1956; Khan and Rao, 1956). As reported by Patil and Hapase (1981), the ESB can cause loss to the extent of 22-33 per cent in yield, 12 per cent in sugar recovery and two per cent in commercial cane sugar. In Northern Karnataka, the early shoot borer infestation was as high as 50-60 per cent in late planted canes (after January), death of mother shoots to an extent of 26-65 per cent and 6.4 to 75 per cent of side tillers (Patil *et al*., 1996d). Therefore ESB is considered to be the most destructive pest of sugarcane in this region.

Material and Methods: Five ruling sugarcane varieties (Co 62175, Co 86032, Co 8371, Co VC 99463 and VCF 0517) of Cauvery command area were selected; these varieties had been planted in Randomized Complete Block Design with four replications. Each genotype planted in thirty rows of six meter length with four feet of row to row spacing. Sugarcane setts with three eye buds were used for planting. The recommended cultural practices (irrigation, fertilizers) are performed equally in all the replications. The insecticidal treatment is avoided in and around these fields. The observation on the incidence of borer pests of sugarcane were recorded by using 30 rows of six meter length per replication in each variety at different intervals as mentioned below

- At 30^{th}, 60^{th}, 90^{th}, 120^{th} and 150^{th} day for early seedling borer
- At 90^{th}, $120^{th,}$ 150^{th} and 210^{th} day for top shoot borer and
- At the time of harvest for Internode borer

Number of dead hearts caused by early shoot borer out of the total number of tillers observed in all the entries at 30, 60, 90 and 120 days after planting (DAP) was recorded. After each count, the dead hearts were pulled out to avoid counting them later on.The per cent incidence of ESB, *Chilo infuscatellus* was calculated by using the formula

$$\text{Per cent incidence} = \frac{\text{Number of dead hearts}}{\text{Total number of tillers}} \times 100$$

Cumulative per cent incidence of ESB, *Chilo infuscatellus*

The cumulative per cent incidence was worked out by relating the progressive total of infested tillers (deadhearts) in proportion to the total number of tillers (Sithanantham, 1973) at 120 DAP. Based on the cumulative per cent incidence, the sugarcane varieties were grouped in to three categories (Rao and Krinshamoorthy, 1973).

Results and Discussion: The incidence of early shoot borer was observed from 30DAP to 150 DAP in all the varieties. The peak incidence of ESB was recorded at sixty days after planting in all the varieties (2.22 – 4.71 per cent incidence). The per cent incidence steadily increased from 30^{th} to 90^{th} day and thereafter it declined. This is in confirmatory with the findings of Sithanatham *et al*. (1975), where they have reported young crop of 30 to 60 days age is susceptible to this pest. Rao (1962) has also reported *Chilo infuscatellus* avoiding older crop and preferring 45 days old crop for oviposition. During the present investigation, activity of ESB was also observed at one fifty days after planting in all the varieties (0.13 – 1.06 per cent incidence) but it was on tertiary shoots. This has no impact on the yield but it helps in the multiplication of the pest progeny. This is in agreement with the observations of Gupta (1953) that the borer activity is solely dependent on the availability of right aged shoots.The cumulative incidence of ESB across varieties varied from 3.1 to 7.5 per cent. The highest was in VCF 0517 (7.5%) followed by Co 86032 (7.1%). This is in confirmity with the findings reported by Anon., (2015).

Irrespective of the varieties, incidence of top shoot borer commenced from 90 days after planting and continued till 210 days after planting. Incidence of TSB across the varieties at 90 DAP ranged from 0.06-1.91 per cent, with the highest incidence in Co 62175 (1.91%). At 120 DAP incidence ranged from 1.10-2.86 per cent, with highest incidence in Co 62175 (2.86%). At 150 DAP incidence ranged 0.64-2.09 per cent, with highest incidence in Co 86032 (2.09%) and at 210 DAP it ranged from 0.41-1.91 per cent with the highest incidence in Co 86032 (1.91%). The peak incidence of TSB was recorded at 120 days after planting (1.10 – 2.86 per cent) followed by 150 days after planting (0.64 – 2.09 per cent) (Table 1).Cumulative incidence of TSB varied significantly in different varieties. Lower incidence was observed in Co 8371 (3.3%) followed by VCF 0517 (3.7%). Significantly higher incidence was recorded in Co 86032 (6.0%) followed by Co 62175 (5.8%) (Table 2). This is more or less in confirmity with the findings reported earlier (*Anon*., 2015).

The incidence of INB across the varieties varied from 8.00-29.00 per cent, with an intensity ranging from 0.72 to 3.01 per cent and with an infestation index of 0.07 to 0.88 (Table 1). Significantly higher incidence of INB was recorded in VCF 0517 (36.00 per cent) followed by CoVC 99463 (24.00 per cent) and significantly lower incidence was recorded in Co 8371 (9.00 per cent) which is on par with Co 86032 (10.5 per cent) (Table 4). Significantly higher intensity of INB was recorded in VCF 0517 (3.01%) which was on par with CoVC 99463 (2.71%). Significantly less intensity of INB was recorded in genotype, Co 8371 (0.72%) which was on par with Co 86032 (0.97%). Significantly higher infestation index was recorded in VCF 0517 (0.88) which was on par with Co 99463 (0.64) and lower infestation index was recorded in Co 8371 (0.07) followed by Co 86032 (0.11) (Table 2). This is in confirmity with the findings reported by Anon., (2015).

Conclusion: The present study revealed the three different borer species of insects belonging to order Lepidoptera were found damaging different varieties of sugarcane. The incidence of *C. infuscatellus* was observed from 30 DAP to 150 DAP in all the five commercial varieties. The peak incidence was observed at 60 DAP (2.22-4.71 per cent). Cumulative incidence of ESB varied from 3.1 to 7.5 per cent. Highest cumulative incidence was recorded in variety VCF 0517 (7.5 per cent) and Co 86032 (7.1 per cent). Activity of TSB was observed from 90 DAP to 210 DAP. The peak incidence was observed at 120 DAP (1.10 – 2.86 per cent) with a cumulative incidence of 3.7 to 6.0 per cent. Incidence of INB varied from 8.00-29.00 per cent with an intensity of 0.72 to 3.01 per cent and infestation index of 0.07 to 0.88. Highest incidence of INB was recorded on the variety VCF 0517 (36.00 per cent).

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Table 1: Incidence of Borers in Five Different Popular Varieties of Sugarcane from January – December 2015

Varieties	Per cent incidence of ESB					Per cent incidence of TSB				Per cent incidence of INB
	30 DAP	60 DAP	90 DAP	120 DAP	150 DAP	90 DAP	120 DAP	150 DAP	210 DAP	At harvest
CoVC 99463	0.00	3.18	1.99	0.65	0.22	0.62	1.55	1.23	0.76	23
Co 86032	0.47	4.71	2.35	0.76	0.58	0.31	1.71	2.09	1.91	11
Co 8371	0.07	2.22	0.87	0.64	0.13	0.06	1.68	1.00	0.59	8
Co 62175	0.06	2.44	1.49	1.64	0.97	1.91	2.86	0.64	0.41	18
VCF 0517	0.71	3.74	2.57	1.28	1.06	0.27	1.10	1.31	1.06	29

* DAP: Days after planting; ESB: Early shoot borer; TSB: Top shoot borer; INB: Inter node borer

Table 2: Cumulative Incidence of Borers in Five Different Popular Varieties of Sugarcane from January – December 2015

Varieties	ESB	TSB	INB		
	Cumulative incidence	Cumulative incidence	% incidence	% intensity	Infestation index
CoVC 99463	$4.8(25.0)^{b}$	$4.2(23.3)^{c}$	$24(29.3)^{d}$	$2.71(9.4)^{cd}$	$0.64(4.5)^{cd}$
Co 86032	$7.1(30.5)^{d}$	$6.0(28.1)^{e}$	$10.5(18.9)^{ab}$	$0.97(5.6)^{ab}$	$0.11(1.9)^{b}$
Co 8371	$3.1(20.3)^{a}$	$3.3(20.5)^{a}$	$9(17.4)^{a}$	$0.72(4.8)^{a}$	$0.07(1.5)^{a}$
Co 62175	$5.3(26.3)^{c}$	$5.8(27.7)^{d}$	$18(25.1)^{c}$	$2.01(8.1)^{c}$	$0.38(3.4)^{c}$
VCF 0517	$7.5(31.4)^{de}$	$3.7(22.1)^{b}$	$36(36.9)^{e}$	$3.01(10)^{de}$	$0.88(5.4)^{de}$
SEM ±	0.30	0.30	0.70	0.50	0.40
CD@ P=0.05	1.00	0.80	2.10	1.60	1.20

*DAP: Days after planting; ESB: Early shoot borer; TSB: Top shoot borer; INB: Inter node borer

Values in the column followed by common letters are non-significant at p = 0.05 as per Tuckey's HSD (Tukey, 1965). Figures in the parentheses are arcsine √x transformed values.

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