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POPULATION DYNAMICS OF BORERS COMPLEX ON SUGARCANE THROUGH PHEROMONE TRAPS

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Abstract: The experiment was conducted with variety CoP 2061 at Pusa to study the population of borers complex of sugarcane (Early Shoot Borer, Top Borer and Stalk Borer) through lures. Three pheromone traps for each pest was installed in the second fortnight of February till harvest of crop in one acre. The data of crop season 2014-15 revealed that the activity of Early shoot borer (ESB) started from 1st fortnight of March to 1st fortnight of July, while the highest number of moths were trapped in 2nd fortnight of April (4.99/trap) when the maximum and minimum temperature (^{0}C) were 38.40 and 21.0, respectively with relative humidity 07 hrs.(65.6%) and 14 hrs (25%) and rainfall was 0 mm. Whereas, the activity of Top borer (TB) started from 1st fortnight of April to 1st fortnight of October with maximum moth trapped in 1st fortnight in June (4.83 moth/trap) when the maximum and minimum temperature (^{0}C) were 36.5 and 26.6, respectively with relative humidity (%) 07 hrs. and 14 hrs were 82.5% and 53.8%, respectively. the rainfall was 24.6 mm. The activity of Stalk borer (SB) started from 1st fortnight of July to 1st fortnight of October with maximum moth trapped in 2nd fortnight of September (1.33 moth/trap) when the maximum and minimum temperature (^{0}C) was 32.5 and 25.9, respectively with relative humidity (%) 07 hrs. and 14 hrs. were 91.2% and73.9 %, respectively and rainfall was 68.2mm. Similar results were recorded during cropping season 2015-16.

Keywords: Borers, population, dynamics, sugarcane, pheromone.

Introduction

Sugarcane (*Saccharum officinarum*) is an important cash crop of Bihar. It is growing an area of 0.3 M. ha with total production of cane 14.9 M. tonns and average productivity 50 t/ha. It is low as compare to national average 64.7 t/ha [1]. There are many factor to reduce cane yield like climatic barriers, improper cultural practices, lack of irrigation, cultivation of uncertified seeds, late sowing and harvesting, unbalance nutrition, bad ratooning, insect pests and diseases. Among these, insect pests are one of the most important factors. More than 120 species of insect pests have been associated with sugarcane including sap feeding, leaf feeding and stem borers [2]. Among these, sugarcane borers complex are considered to be the dominant insect pests both in damage level and distribution. These include top borer, *Scirpophaga excerptalis* early, early shoot borer *Chilo infuscatellus* and stalk borer, *chilo*

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auricilius. Borers may reduce yield upto 80%. The damage caused by borers not only reduces the crop yield but also affect the sucrose content of cane [3]. The larvae bore into either the shoots or stalks of sugarcane depending on the borer species, producing severe economic loss to both the quantity and quality of the sugarcane [4, 5, and 6]. Effective control measures of these insect pests are being sought. Nevertheless, most sugarcane farmers conventionally apply insecticides to control these insect pests. Although, adverse side effects usually exist and sustainable control of the insect pests cannot be achieved, the famers continuously and indiscriminately use this practice because of the convenience of application. Moreover, the target insect pests develop insecticide resistance to the chemicals. Chemical treatments, for long term use, are generally ineffective and expensive. Considering the longer term viewpoint with regard to environmental preservation and biodiversity conservation, biological control represents an acceptable preference [6]. Applications of parasitoids, insect predators and entomopathogenic microorganisms have been administered to control sugarcane insect pests in various countries. While, pheromone trap is one of the important tools in integrated pest management in view of the fact they are essentially non toxic and ecological safe. Beneficial insect population both parasite and predators usually destroyed by broad spectrum insecticidal application, are preserved and therefore assist in control of damaging secondary pests or minor pest. Moreover, application of pheromone trap provides relief from chemical stress on the plant and ecosystem. Although, not yet fully operation as direct control agent in pest management system it is really promise as safe, selective and effective control agent in plant protection. Pheromones have scope beyond over imagination but require understanding and support and it is certain that if at all there is any replacement to pesticides its is pheromone [7].

Materials and method

Sugarcane variety CoP 2061 was planted in 01 ha area to study population dynamics of sugarcane borers complex i.e. early shoot borer, top borer and stalk borer through pheromone traps during cropping season 2014-15 and 2015-2016 under AICRP on Sugarcane, Entomology at Pusa farm, Sugarcane Research Institute, DRPCAU, Pusa, Samastipur, Bihar-848 125. Three pheromone traps for each pest was installed in the second fortnight of February till harvest of crop in one acre. The pheromone lure was changed after 2 months. All the recommended practices were followed except application of insecticide. Observations on number of moths trapped were recorded at fortnightly interval. The correlations of mean moth captures were worked out with meteorological parameters.

Result and discussion

The data of crop season 2014-15 presented in Table 1 revealed that the activity of Early shoot borer (ESB) started from 1st fortnight of March to 1st fortnight of July, while the highest nos. of moths were trapped in 2nd fortnight of April (4.99/trap) when the maximum and minimum temperature (^{0}C) were 38.4 and 21, respectively with relative humidity (%) 07 hrs. (65.6) and 14 hrs (25) and rainfall zero mm. Whereas, the activity of Top borer (TB) started from 1st fortnight of April to 1st fortnight of October with maximum moth trapped in 1st fortnight in June (4.83 moth/trap) when the maximum and minimum temperature (^{0}C) were 36.5 and 26.6, respectively with relative humidity (%) 07 hrs. and 14 hrs were 82.5 and 53.8, respectively with rainfall 24.6 mm. The activity of Stalk borer (SB) started from 1st fortnight of July to 1st fortnight of October with maximum moth trapped in 2nd fortnight of September (1.33 moth/trap) when the maximum and minimum temperature (^{0}C) was 32.5 and 25.9, respectively with relative humidity (%) 07 hrs. and 14 hrs. was 91.2 and73.9, respectively with rainfall 68.2mm. Simple correlation was worked out between weather factors and % incidence of ESB, TB and SB presented in Table 1a. It was observed that maximum temperature showed highly significant, while minimum temperature and rainfall showed positive relation but non significant. The relative humidity 07 hrs and 14 hrs showed negative correlation, but 14hrs showed significant relation against Early shoot borer. In case of Top borer, maximum and minimum temperature showed highly significant and relative humidity showed non significant correlation with positive relation. The rainfall showed non significant negative correlation. While, Stalk borer showed highly significant correlation with minimum temperature and relative humidity at 14 hrs. The maximum temperature showed non significant positive correlation and rainfall showed negative correlation.

The data of crop season 2015-16 presented in table 2 revealed that the activity of ESB started from 1st fortnight of March to 1st fortnight of July and its maximum 5.66/trap of moths were catch in 2nd fortnight of May when the maximum and minimum temperature (^{0}C) were 36.4 and 24.1, respectively with relative humidity (%) 07 hrs. (81) and 14 hrs (48) and rainfall was 28.6 mm. At Faisalabad, Pakistan, populations of *C. infuscatellus* reaches a peak in late May, with maximum temperature (34-37°C), minimum temperature (20-27°C) and RH (52-70%) being conducive to the building up of the pest population [8]. The activity of TB started from 1st fortnight of April to 1st fortnight September with maximum 7.33 moth/trap catch in 1st fortnight of June when the maximum and minimum temperature (^{0}C) were 38.2 and 25.5, respectively with relative humidity (%) 07 hrs. and 14 hrs were 83 and 44,

respectively with rainfall 19.8 mm. The activity of stalk borer started from 1st fortnight of July to 1st fortnight of October with maximum 2.33 moth/trap catch in 2nd fortnight of August when the maximum and minimum temperature (^{0}C) was 33.1 and 24.3, respectively with relative humidity (%) 07 hrs. and 14 hrs. was 92 and75, respectively with rainfall 400.4 mm. In Nayagarh, Orissa, India, the pest is active from late June to November when the maximum temperature is 32.5°C to 36.1°C and relative humidity is between 71.3 and 79.5%. High temperature, high relative humidity and rainfall favours multiplication, with high relative humidity being very conducive to borer survival. Four distinct generations were recorded from mid June to late January [9, 10, and 11]. Simple correlation of ESB, TB and SB presented in Table 2a. It was observed that maximum temperature showed highly significant, while minimum temperature and rainfall showed positive relation but non significant. The relative humidity 07 hrs and 14 hrs showed negative correlation, but 14hrs showed significant relation against Early shoot borer showed that *C. infuscatellus* incidence was positively correlated with maximum temperature in Sardarnagar, Gorakhpur, Uttar Pradesh, India [12].

In case of top borer, the maximum and minimum temperature showed highly positive significant correlation and relative humidity at 7 and 14 hrs showed negative correlation, but relative humidity at 7hrs Showed significant relation. The rainfall showed highly significant with negative relation. While correlation against stalk borer the minimum temperature showed s significant relation whereas maximum temperature non significant and other parameter i.e. relative humidity at 7hrs and 14 hrs and rainfall showed highly positive significant except rainfall.

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Table 1: Moth Catch of borer complex of sugarcane through pheromone traps (2014-15)

Months/ year	Fortnightly Interval	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	Nos. of moth trapped		
		Max.	Min.	7 hrs.	14hrs.		ESB	TB	SB
March, 2014	I	26.9	13.2	88.8	46.6	10.6	1.00	0.00	0.00
	II	32.7	17.2	77.8	35.1	0.0	1.99	0.00	0.00
April, 2014	I	35.7	18.0	71.6	31.6	0.0	3.33	0.99	0.00
	II	38.4	21.0	65.6	25.0	0.0	4.99	1.66	0.00
May, 2014	I	38.6	24.2	67.0	35.8	1.3	3.99	1.99	0.00
	II	36.6	24.0	77.2	40.5	62.7	3.66	2.33	0.00
June, 2014	I	36.5	26.6	82.5	53.8	24.6	1.33	4.83	0.00
	II	35.9	26.1	83.4	63.7	68.6	0.33	2.49	0.00
July, 2014	I	32.8	26.6	89.6	74.3	212.6	0.33	3.99	0.16
	II	32.3	26.4	88.1	71.9	127.2	0.00	2.83	0.89
August, 2014	I	32.9	26.5	90.5	78.2	270.2	0.00	1.99	0.99
	II	32.5	25.9	91.2	73.9	81.7	0.00	0.83	0.83
September, 2014	I	32.4	25.6	90.2	69.7	61.2	0.00	0.33	1.00
	II	32.5	25.9	91.2	73.9	68.2	0.00	0.33	1.33
October, 2014	I	32.7	23.6	91.4	63.9	81.6	0.00	0.16	0.50
	II	30.2	19.2	90.4	52.6	0.0	0.00	0.00	0.00
November, 2014	I	30.0	16.2	88.8	43.8	0.0	0.00	0.00	0.00
	II	27.2	11.6	85.4	37.9	0.0	0.00	0.00	0.00
December, 2014	I	21.3	12.6	92.9	71.7	0.0	0.00	0.00	0.00
	II	18.4	8.5	91.3	70.0	0.0	0.00	0.00	0.00
January, 2015	I	19.4	10.1	9.8	11.3	1074	0.00	0.00	0.00
	II	19.3	11.9	8.9	10.1	1028	0.00	0.00	0.00
February, 2015	I	23.1	9.3	88.6	50.5	0.0	0.00	0.00	0.00
	II	26.2	15.3	91.3	61.5	1.2	0.00	0.00	0.00

Table 1a: Correlation analysis between moth catches and weather parameters

Borer complex	Temperature ^{0}C		Relative humidity %		Rainfall (mm)
	Max.	Min.	7hrs.	14hrs.	
ESB	0.5974**	0.1871	-0.1577	-0.4675*	0.2335
TB	0.6050**	0.6856**	0.115	0.2186	-0.0998
SB	0.224	0.577**	0.2939	0.5967**	-0.0276
Significant at 5% level (r± =0.4227) Significant at 1% level (r± = 0.5368)					

Table 2: Moth Catch of borer complex of sugarcane through pheromone lures

Months/year	Fortnightly Interval	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	Nos. of moth trapped		
		Max.	Min.	7 hrs.	14hrs		ESB	TB	SB
Mar, 2015	I	27.5	13.3	83	48	10.8	0.66	0.00	0.00
	II	31.7	17.6	84	47	21.8	1.00	0.00	0.00
Apr, 2015	I	33.3	19.1	80	35	0.6	2.66	0.33	0.00
	II	32.9	20.7	84	50	32.6	3.00	1.66	0.00
May, 2015	I	34.6	23.0	82	43	15.2	4.33	2.33	0.00
	II	36.4	24.1	81	48	28.6	5.66	4.66	0.00
Jun, 2015	I	38.2	25.5	83	44	19.8	2.33	7.33	0.00
	II	35.1	25.5	85	55	35.6	1.33	4.00	0.00
Jul, 2015	I	33.7	25.2	87	77	97.6	0.66	2.66	0.00
	II	33.8	24.9	88	64	52.0	0.00	1.66	1.00
Aug, 2015	I	34.1	24.4	89	60	56.4	0.00	0.66	1.66
	II	33.1	24.3	92	75	400.4	0.00	0.33	2.33
Sep,2015	I	34.3	24.5	89	65	112.2	0.00	0.33	1.66
	II	33.0	23.4	89	63	43.6	0.00	0.00	1.00
Oct, 2015	I	34.1	21.6	89	51	4.2	0.00	0.00	0.66
	II	32.0	18.8	89	48	0	0.00	0.00	0.33
Nov,2015	I	30.4	15.4	90	51	0	0.00	0.00	0.00
	II	28.3	13.7	88	52	0	0.00	0.00	0.00
Dec,2015	I	24.4	12.2	85	62	0	0.00	0.00	0.00
	II	22.3	5.1	87	44	0	0.00	0.00	0.00
Jan,2016	I	23.6	7.4	88	54	0	0.00	0.00	0.00
	II	20.4	8.5	89	60	0	0.00	0.00	0.00
Feb, 2016	I	24.7	10.0	89	52	2.6	0.00	0.00	0.00
	II	28.4	14.1	86	51	0.2	0.00	0.00	0.00

Table 2a: Correlation analysis between moth catches and weather parameters

Borer complex	Temperature ^{0}C		Relative humidity %		Rainfall (mm)
	Max.	Min.	7hrs.	14hrs.	
ESB	**0.4854***	**0.3696**	**-0.7937****	**-0.4570***	**-0.1098**
TB	**0.6070****	**0.5581****	**-0.4819***	**-0.1076**	**0.0146**
SB	**0.3249**	**0.4710***	**0.5673****	**0.5900****	**-0.7609****
Significant at 5% level (r± =0.4227) **Significant at 1% level (r± = 0.5368)**					