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Original Research Article

Management of Borers Complex through Pheromone Traps in Sugarcane Agro Ecosystem of Bihar

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A B S T R A C T

The experiment was conducted at Pusa Farm, Sugarcae Research institute, Dr. Rajendra Prasad Central Agricultural University, Pusa - 848125 Samastipur (Bihar) to study the efficacy of pheromone traps in mass trapping of adults of sugarcane borers viz., *Chilo infuscatellus* Snellen, *Scirpophaga excerptalis* Walker and *Chilo auricilius* Dudgeon for their effective management during three consecutive years, 2014-15 to 2016-17 with variety BO 154. The pheromone traps @ 21/ha were installed in 2nd fortnight of February till harvest of the crop. The activity (2014-15) of early shoot borer started from 1st fortnight of March to 1st fortnight of July, while the highest (4.99/traps) number of moths were trapped in 1st fortnight of May, when the maximum and minimum temperature (^{0}C) were 38.6 and 24.2, respectively with relative humidity (%) at 07 hrs. (67.0) and 14 hrs. (35.8) and rainfall was 1.30 mm. Whereas, the activity of top borer started in 2nd fortnight of April to 1st fortnight of October with maximum (4.33/trap) moth trapped in 2nd fortnight of May when the maximum and minimum temperature (^{0}C) were 36.6 and 24.0, respectively with relative humidity (%) at 07 hrs. and 14 hrs. were 77.2 and 40.5, respectively and rainfall was zero mm. The stalk borer activity started from 2nd fortnight of July to 1st fortnight of October with maximum (1.33/trap) moth trapped in 1st fortnight of September when the maximum (32.5^{0}C) and minimum (25.9^{0}C) with relative humidity at 07 hrs. (90.2%) and 14 hrs. (69.7%) with rainfall was 61.2 mm. During 2nd year and 3rd year of experimentation the population of borers (Early Shoot Borer, Top borer and Stalk borer) more or less same patter was observed. The correlation was worked out in between weather factors and population of borer complex indicated that the populations of early shoot borer showed positive correlation and statistically highly significant with maximum temperature, while top borer showed positive relation and highly significant against maximum and minimum temperature. The stalk borer had positive correlation and statistically significant with minimum temperature. The relative humidity at 14 hrs. had played a positive role with stalk borer, while early shoot borer and top borer showed negative relation. It was also clearly indicated from the data that the pheromone traps @ 21/ha reduced the incidence of early shoot borer, top borer and stalk borer to an extent of 55.33, 47.77 and 58.86 per cent, respectively, with 8.08 per cent increase in cane yield as compared to without pheromone traps. Based on the present findings, it may be concluded that the mass trapping with pheromone traps @ 21/ha can be included one of the IPM practices for the effective management of sugarcane borers in agro ecosystem of Bihar.

Keywords

Management, Borer complex, Pheromone traps, Sugarcane and Agro ecosystem

Introduction

Sugarcane is one of the important commercial crops of Bihar and it has occupied a very prominent position on the agricultural map of India covering a large area in tropics as well as sub tropics. It is the major agro-industrial crop in India next to textiles. Sugar is still the most preferred sweetener and most widely used calorific food, especially in the developing countries. Sugar is today regarded as a mass consumption item and it also accounts for a large share of the total calorie intake of an average household (Pruthi, 1995). Presently, the sugarcane crop provides the third highest quantity of human consumed plant calories (152 kcal/capita/day) following rice (533 kcal) and wheat (530 kcal) as reported by Moore *et al.,* (2014). During last decades, production, productivity and sugar recovery have also shown remarkable resilience in productivity growth rate. Today there is a growing concern about susceptibility of sugar production as the growth rate has stagnated and another declining trend is seen in most of the cane growing districts. One of the reasons for the low productivity and recovery is increasing incidence of insect pests.

Sugarcane crop has been associated with more than 120 species of insect pests including sap feeding, leaf feeding and stem borer (Suasa-and Allsopp, 2000). Based on their damage, the insect pests are classified as borers, sucking pests, subterranean pests and defoliators. Among, the various borers, three borer species-early shoot borer (*Chilo infuscatellus* Snellen), top borer (*Scirpophaga excerptalis* Walker) and stalk borer, (*Chilo auricilius* Dudgeon) are known to often cause yield losses and sugar recovery. Borers may reduce yield up to 80 per cent. The damage caused by borers not only reduces the crop yield but also the sucrose content of cane (Kalra *et al.*, 1955). 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 (Goebel *et al.,* 2011).

Several management strategies including cultural, mechanical, biological and chemical methods have been evolved from time to time as a result of research and development work over the years. Pheromone trapping can be used as complement to field scouting to determine the distribution of borer complex optimizes control tactics. The mean moth catch increased from 2.95 to 3.80, when the distance between the traps was reduced from 25 to 16 meters. During 1984, 80600 moths were trapped in 247 traps. The incidence of the pest was reduced and consequently there was an increase in the cane yield and ccs/plot as observed by David *et al*. (1985). Moreover, application of pheromone trap provides relief from chemical stress on the plant and ecosystem. Keeping all these in view a field experiment was conducted to study the efficacy of pheromone traps in mass trapping of adults of sugarcane borers for their effective management although, not yet fully operation as direct control agent in pest management system, but it is really promise as safe, selective and effective control agents in plant protection.

Materials and Methods

The field experiment was conducted to study the efficacy of pheromone traps in mass trapping of adults of sugarcane borers for their effective management during three consecutive years, 2014-2016 with sugarcane variety BO 154 planted in one hectare area at Pusa Farm, Sugarcane Research institute, Dr. Rajendra Prasad Central Agricultural University, Pusa -

848125, Samastipur, Bihar, India. The pheromone traps @ 21/hectare were installed at 45 days after planting at a distance of about 10 metres. The pheromone lure was changed at 30 days interval. The observations were recorded at weekly interval and converted into fortnightly interval. The experimental location weather data maximum temperature, minimum temperature (^{0}C), relative humidity (%) and rainfall (mm) were collected from Meteorological department, DRPCAU, Pusa and subjected to correlation tests with pheromone traps. All recommended agronomic practices were followed except application of insecticides.

Results and Discussion

Population Dynamics

The data on moth trapped during 2014-15 cropping season presented in Table 1. 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 1st fortnight of May (4.99/trap) when the maximum and minimum temperature (^{0}C) were 38.6 and 24.2, respectively, with relative humidity (%) at 07 hrs. (67.0) and 14 hrs. (35.8) and rainfall was 1.30 mm. Whereas, the activity of Top borer (TB) started from 2nd fortnight of April to 1st fortnight of October with maximum (4.33/trap) moth trapped in 2nd fortnight of May when the maximum and minimum temperature (^{0}C) were 36.6 and 24.0, respectively with relative humidity (%) at 07 hrs. and 14 hrs. were 77.2 and 40.5, respectively and rainfall was zero mm. The activity of stalk borer (SB) started from 2nd fortnight of July to 1st fortnight of October with maximum (1.33/trap) moth trapped in 1st fortnight of September when the maximum and minimum temperature (^{0}C) was 32.5 and 25.9, respectively, with relative humidity (%) at 07 hrs. and 14 hrs. was 90.2 and 69.7, respectively with rainfall was 61.2 mm. Simple correlation was worked out between weather factors and population of early shoot borer, top borer and shoot borer (Table 1a). It was observed that maximum temperature showed highly significant (r = 0.644**) while minimum temperature showed positive relation but statistically was non-significant. The relative humidity 07 at hrs. and 14 hrs. along with rainfall showed negative correlation, with early shoot borer. In case of Top borer, maximum and minimum temperature (r = 0.667* and r = 0.622**) showed positive relation and highly significant and relative humidity had positive relation but non-significant. The rainfall showed non-significant negative correlation. While, stalk borer showed highly significant correlation with minimum (0.588**) temperature (^{0}C) and relative humidity (r = 0.605**) had positive relation and statistically highly significant at 14 hrs. The maximum temperature showed non-significant positive correlation and rainfall showed negative correlation.

The data on 2nd year experimentation (Table 2) revealed that the activity of early shoot borer started from 1st fortnight of March to 2nd fortnight of July and its maximum (6.33/trap) moths were catched in 2nd fortnight of May when the maximum and minimum temperature (^{0}C) were 36.4 and 24.1, respectively, with relative humidity (%) at 07 hrs. (81) and 14 hrs. (48) along with rainfall was 28.6 mm. The activity of top borer started from 1st fortnight of April to 1st fortnight September with maximum (8.33) moth/trap catched in 1st fortnight of June when the maximum and minimum temperature (^{0}C) were 38.2 and 25.5, respectively, coupled with relative humidity (%) at 07 hrs. and 14 hrs were 83 and 44 per cent, respectively, and rainfall was 19.8 mm.

The activity of stalk borer started from 1st fortnight of July to 2nd fortnight of October with maximum (2.66 /trap) catch in 1st fortnight of August when the maximum and minimum temperature (^{0}C) was 34.1 and 24.4, respectively, with relative humidity (%) at 07 hrs. and 14 hrs. being 89 and 60 per cent, respectively and rainfall was 56.4 mm. Simple correlation of early shoot borer, top borer and stalk borer presented in Table 2a. It was observed that maximum temperature showed highly significant (r = 0.518**), while minimum temperature and rainfall showed positive relation but non-significant. The relative humidity at 07 hrs. and 14 hrs. showed negative correlation, but 14hrs showed significant relation against early shoot borer. In case of top borer, the maximum (r = 0.623**) and minimum (r = 0.558**) (^{0}C) temperature showed highly positive significant correlation and relative humidity at 07 hrs. and 14 hrs. showed negative correlation, but relative humidity at 7.00 hrs. (r = 0.575**) showed significant relation. The rainfall also showed negative relation. While correlation with stalk borer the minimum (r = 0.491*) temperature (^{0}C) showed significant relation, whereas maximum temperature non-significant. The relative humidity at 07 hrs. (r = 0.514*) showed statistically significant and positive relation and 14 hrs. (r = 0.557**) along with and rainfall (r = 0.558**) showed highly significant with positive correlation.

During 3rd year of experimentation (2016-17), the data (Table 3) revealed that the activity of early shoot borer started from 1st fortnight of March and stopped in 2nd fortnight of July. The maximum moth (2.99/trap) was trapped during 1st fortnight of June thereafter activity was observed in declined trend when the maximum and minimum temperature being 36.2^{0}C and 26.2^{0}C, respectively, coupled with relative humidity at 07 hrs. and 14 hrs. being 80 and 55 per cent, respectively, along with rainfall was 28.4 mm. In case of top borer, activity was started from 1st fortnight of April and activity stopped during 2nd fortnight of September the maximum number of moth (4.99/trap) was catched in 1st fortnight of June when prevailing maximum and minimum temperature (^{0}C)being 36.2 and 26.2, respectively, coupled with relative humidity at 07 hrs. and 14 hrs. were 80 and 55 per cent respectively, along with rainfall was 28.4 mm. The activity of stalk borer started from 1st fortnight of July and activity stopped during 2nd fortnight of October. Its maximum (1.33/trap) moth was recorded during 1st fortnight of September when maximum and minimum temperature (^{0}C) being 31.9 and 25.8, respectively, along with relative humidity was 93 and 79 per cent, respectively and rainfall was 170.4 mm. Simple correlation was worked out between weather factors and population of early shoot borer, top borer and stalk borer presented in Table 3a. It was observed that maximum (r = 0.600**) temperature showed highly significant, while minimum temperature showed positive relation but statistically was non-significant and rainfall showed negative relation. The relative humidity at 07 hrs. and 14 hrs. showed (r = -0.843* and - 0.615**) highly significant but negatively correlation, with early shoot borer. In case of Top borer, maximum and minimum temperature showed (r = 0.492* and 0.644**) significant and highly significant, respectively.

The relative humidity showed non-significant correlation. The rainfall showed highly significant positive relation. 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 highly (r = 0.664*) significant with positive relation.

Table.1 Moth borers trapped in sugarcane through pheromone traps during 2014-15

Months/year	Fortnightly Interval	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	No of moth trapped		
		Maximum	Minimum	07 00 hrs.	14 00 hrs.		ESB	TB	SB
March, 2015	I	26.9	13.2	88.8	46.6	10.6	0.66	0.00	0.00
	II	32.7	17.2	77.8	35.1	0.0	1.66	0.00	0.00
April, 2015	I	35.7	18.0	71.6	31.6	0.0	3.66	1.00	0.00
	II	38.4	21.0	65.6	25.0	0.0	4.33	1.99	0.00
May, 2015	I	38.6	24.2	67.0	35.8	1.3	4.99	2.33	0.00
	II	36.6	24.0	77.2	40.5	62.7	3.99	4.33	0.00
June, 2015	I	36.5	26.6	82.5	53.8	24.6	2.33	2.99	0.00
	II	35.9	26.1	83.4	63.7	68.6	1.66	3.99	0.00
July, 2015	I	32.8	26.6	89.6	74.3	212.6	0.66	2.53	0.33
	II	32.3	26.4	88.1	71.9	127.2	0.33	1.66	0.66
August, 2015	I	32.9	26.5	90.5	78.2	270.2	0.00	0.66	0.99
	II	32.5	25.9	91.2	73.9	81.7	0.00	0.33	1.00
September, 2015	I	32.4	25.6	90.2	69.7	61.2	0.00	0.66	1.33
	II	32.5	25.9	91.2	73.9	68.2	0.00	0.33	1.00
October, 2015	I	32.7	23.6	91.4	63.9	81.6	0.00	0.33	0.33
	II	30.2	19.2	90.4	52.6	0.0	0.00	0.33	0.33
November, 2015	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, 2015	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, 2016	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, 2016	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.1 (a) Correlation analysis between moth catches and weather parameters 2014-15

Borer Complex	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	Maximum	Minimum	7.00 hrs.	14.00 hrs.	
Early Shoot Borer	0.644**	0.244	-0.141	-0.403	-0.239
Top Borer	0.667**	0.622**	0.047	0.045	-0.159
Stalk Borer	0.226	0.583**	0.313	0.605**	-0.039

Table.2 Moth borers trapped in sugarcane through pheromone traps during 2015-16

Months/year	Fortnightly Interval	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	No of moth trapped		
		Maximum	Minimum	07.00 hrs.	14.00 hrs.		ESB	TB	SB
March, 2015	I	27.5	13.3	83	48	10.8	1.33	0.00	0.00
	II	31.7	17.6	84	47	21.8	1.99	0.00	0.00
April, 2015	I	33.3	19.1	80	35	0.6	2.66	1.33	0.00
	II	32.9	20.7	84	50	32.6	3.00	2.33	0.00
May, 2015	I	34.6	23.0	82	43	15.2	4.33	5.66	0.00
	II	36.4	24.1	81	48	28.6	6.33	5.66	0.00
June, 2015	I	38.2	25.5	83	44	19.8	3.33	8.33	0.00
	II	35.1	25.5	85	55	35.6	1.66	3.83	0.00
July, 2015	I	33.7	25.2	87	77	97.6	1.33	2.66	0.33
	II	33.8	24.9	88	64	52.0	0.33	1.66	1.33
August, 2015	I	34.1	24.4	89	60	56.4	0.00	1.00	2.66
	II	33.1	24.3	92	75	400.4	0.00	0.66	1.66
September, 2015	I	34.3	24.5	89	65	112.2	0.00	0.33	1.33
	II	33.0	23.4	89	63	43.6	0.00	0.00	1.00
October, 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
November, 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
December, 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
January, 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
February, 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.2 (a) Correlation analysis between moth catches and weather parameters 2015-16

Borer Complex	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	Maximum	Minimum	7.00 hrs.	14.00 hrs.	
Early Shoot Borer	0.518**	0.399	-0.82**	-0.434*	-0.106
Top Borer	0.623**	0.558**	-0.575**	-0.215	0.006
Stalk Borer	0.342	0.491*	0.514*	0.557**	0.558**

Table.3 Moth borers trapped in sugarcane through pheromone traps during 2016-17

Months/year	Fortnightly Interval	Temperature (^{0}C)		Relative humidity (%)		Rainfall (mm)	No of moth trapped		
		Maximum	Minimum	07.00 hrs.	14.00 hrs.		ESB	TB	SB
March, 2015	I	29.1	16.9	85	47	2.0	1.33	0.00	0.00
	II	33.7	17.1	80	34	3.6	1.99	0.00	0.00
April, 2015	I	37.2	21.2	69	30	3.2	3.66	0.99	0.00
	II	39.3	22.2	73	28	0.0	4.33	1.99	0.00
May, 2015	I	35.2	23.4	83	50	65.2	3.33	2.33	0.00
	II	33.8	22.7	83	56	67.6	2.66	3.66	0.00
June, 2015	I	36.2	26.2	80	55	28.4	2.99	4.99	0.00
	II	34.2	26.2	87	67	76.7	1.33	3.99	0.00
July, 2015	I	32.9	26.4	89	73	100.6	0.66	2.99	0.33
	II	30.9	23.9	92	84	203.5	0.33	2.83	0.66
August, 2015	I	33.4	26.3	87	68	107.4	0.00	1.99	0.99
	II	34.0	24.2	85	65	3.4	0.00	0.66	1.00
September, 2015	I	31.9	25.8	93	79	170.4	0.00	0.33	1.33
	II	30.8	23.2	92	78	148.8	0.00	0.33	0.66
October, 2015	I	33.1	23.9	90	67	34.6	0.00	0.00	0.33
	II	39.1	21.8	86	48	0.0	0.00	0.00	0.33
November, 2015	I	30.9	18.2	85	39	0.0	0.00	0.00	0.00
	II	27.2	13.6	87	49	0.0	0.00	0.00	0.00
December, 2015	I	23.2	11.3	88	63	0.0	0.00	0.00	0.00
	II	21.3	11.2	92	67	0.0	0.00	0.00	0.00
January, 2016	I	20.8	8.2	93	60	0.0	0.00	0.00	0.00
	II	24.1	9.1	93	65	0.0	0.00	0.00	0.00
February, 2016	I	23.8	10.2	92	61	0.0	0.00	0.00	0.00
	II	27.9	11.5	87	55	0.0	0.00	0.00	0.00

Table.3 (a) Correlation analysis between moth catches and weather parameters 2016-17

Borer Complex	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)
	Maximum	Minimum	7.00 hrs.	14.00 hrs.	
Early Shoot Borer	0.600**	0.338	-0.843**	-0.615**	-0.108
Top Borer	0.492*	0.644**	-0.286	0.127	0.408*
Stalk Borer	0.213	0.530**	0.318	0.586**	0.664**

Significant at 5% level (r ± = 0.4227)
Significant at 1% level (r ± = 0.5368)

Table.4 Incidence (%) of borers in sugarcane

Pests	Treatment	2014-15	2015-16	2016-17	Mean	% reduction
Early Shoot Borer	Pheromone traps @ 21 traps/ha	7.90	10.66	8.63	9.06	55.33
	Untreated	20.60	13.09	17.36	20.35	-
Top borer	Pheromone traps @ 21 traps/ha	10.73	15.05	18.60	14.79	47.77
	Untreated	18.35	30.87	35.75	28.32	-
Stalk Borer	Pheromone traps @ 21 traps/ha	8.55	11.65	7.75	9.32	56.87
	Untreated	18.33	20.50	26.00	21.61	-

Table.4 (a) Sugarcane yield (t/ha)

Treatment	2014-15	2015-16	2016-17	Mean	% increase
Pheromone traps @ 21 traps/ha	75.6	71.90	78.50	75.33	8.08
Untreated	68.90	67.60	72.60	69.7	-

Incidence of borers

The data on mean incidence of early shoot borer, top borer and stalk borer presented in table 4 revealed that incidence of early shoot borer was 20.35 per cent without pheromone traps while 9.06 per cent was recorded with pheromone traps. It is cleanly indicated from the data that 55.33 per cent reduction in early shoot borer incidence when through pheromone traps were installed. In case of top borer mean incidence without pheromone traps and with pheromone traps being 28.32 and 14.79 percent, respectively and 47.77 per cent reduction in top borer incidence was observed where pheromone traps were installed.

The reduction was found to be 56.86 per cent in incidence of stalk borer through pheromone traps.

The results show that pheromone traps are effective tool in management of borer complex, it may be utilized against early shoot borer, top borer and stalk borer in sugarcane crop.

Cane yield

The data on yield (t/ha) presented in table 4 (a) revealed that pheromone traps @ 21/ha reduced the incidence of early shoot borer, top borer and stalk borer up to desirable extent. The mean yield 75.33 (t/ha) of sugarcane was observed with increased yield of 8.08 per cent when pheromone traps @ 21/ha were installed while 69.7 (t/ha) was recorded in without pheromone traps. Based on the presented findings, it was concluded that the mass trapping with pheromone traps @ 21/ha can be included as one of the IPM practices for the effective management of sugarcane borers in sugarcane agro-ecosystem of Bihar.

At Faisalabad, Pakistan, populations of *C. infuscatellus* reaches a peak in late May, when maximum temperature (34-37°C), minimum temperature (20-27°C) and RH (52-70%) being conducive to the building up of the pest population as reported by Rana *et al.,* (1997). 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 in 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 as observed by Shenhmar and Singh (1997). According to Tanwar and Bajpai (1993) that *C. infuscatellus* incidence was positively correlated with maximum temperature in Sardarnagar, Gorakhpur, Uttar Pradesh, India Kumar *et al.,* (2016) reported that the maximum and minimum temperature showed highly significant and relative humidity showed non-significant correlation with positive relation with top borer. In case of stalk borer showed highly significant correlation with minimum temperature and relative humidity at 14 hrs. The maximum temperature showed highly significant while minimum temperature and rainfall showed positive relation but non-significant. Bhavani *et al.,* (2017), reported that 25 pheromone traps/ha were the optimum for reducing the incidence of ESB and INB to an extent of 65.00 and 62.37 per cent, respectively with 5.11 per cent increase in yield when pheromone trap were installed. The present study supports the above reports.

The present results indicated that the population of shoot borer showed highly significant with positive correlation with maximum temperature while, top borer showed statistically highly significant positive correlation with maximum and minimum temperature. The stalk borer had positive correlation and statistically significant with minimum temperature. The relative humidity at 14 hrs. had played a positive role with stalk borer while early shoot borer and top borer showed negative relation. The rainfall showed positive relation except stalk borer. It has also reflected from the data that the pheromone traps @ 21/ha reduced the incidence of early shoot borer, top borer and stalk borer to an extent of 55.33, 47.77 and 56.86 per cent, respectively with 8.08 per cent increase in cane yield as compared to without pheromone traps. Based on the present findings, it was conducted that the mass trapping with pheromone lures @ 21/ha can be included one of the IPM practices for the effective management of sugarcane borers in agro ecosystem of Bihar.

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