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IMPACT OF ABIOTIC FACTORS ON POPULATION DYNAMICS OF RICE STEM BORER *SCIRPOPHAGA INCERTULAS* (WALKER) AND LEAF FOLDER *CNAPHALOCROCIS MEDINALIS* (GUENEE)

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Abstract

The present study was under taken to analysis the major pests of paddy collected in solar light trap and influence of meteorological parameters during kuruvai, samba and navarai seasons at Annamalai nagar during the year 2017-2019. Major pests of paddy were collected and observed on daily basis, in order to study the seasonal incidence, week division was based on Standard Meteorological Week (SMW), observation of weather data *viz*., maximum temperature, minimum temperature, relative humidity, sunshine and rainfall were recorded on daily basis from the Meteorological observatory, Department of Agronomy, Faculty of Agriculture, Annamalai University. The maximum population catches 72 moths of rice stem borer and leaf folder adults 64 moths during 47th and 3rd standard weeks respectively. The maximum, minimum temperature and sunshine showed a positive correlation, relative humidity and rainfall showed a negative correlation with stem borer population. In kuruvai season, mean collection of stem borer 22.91 were trapped. The peak population of stem borer moths in 27th standard week 25 moths. The minimum number of 15 moths was collected in 33rd standard week. The leaf folder population was positively correlated with relative humidity and negatively correlated with maximum and minimum temperature, sunshine and rainfall. In samba season, a mean population of yellow stem borer 42.31 was trapped. The peaks of stem borer moths in 47th standard week (72 moths) and another peak were recorded in 48th standard week. The minimum numbers of 20 moths were collected in 41st standard week. The leaf folder population was positively correlated with sunshine and negatively correlated with maximum and minimum temperature, relative humidity and rainfall.

Key words: Solar powered light trap, Rice pests, Seasonal incidence and Abiotic factors.

Introduction

Rice is an important cereal crop in the world serving as staple diet for millions of peoples. Rice stands second in the world after wheat in area and production. About 90 percent of world rice is produced and consumed in Asia (Anonymous, 2016). In India it is cultivated in an area of 44.00 million hectares with the production of 104.80 million tonnes with a productivity of 2177 kg per ha (Anonymous, 2018). Paddy crop in the field is attacked by numerous guilds of insect pests, but few cause significant losses. Evidence indicates that insect pests cause 25% of loss in rice, 30% in pulse, 35% in oilseeds and 50% in cotton (Dhaliwal and Arora, 1996). In India, average losses in paddy production due to insect pests were 25-30% (Dhaliwal and Arora, 2010) and in Tamil nadu about 42% losses were reported (Dhamdhere, 1990). The light trap as a monitoring tool to determine the economic status, pest abundance and kind of pests and natural enemies as first information suspected how can to reduce the pest population density. Many insects are positively phototrophic in nature and use of light trap for insect catches produces valuable faunistic data, this data can be seen as a parameter of health of biodiversity of concerned vicinity. Therefore the present study was undertaken with following objectives, identification of pest species of insects collected in solar powered light trap and to find out the influence of meteorological parameters on solar powered light trap catches of pest species of insect during Navarai, Kuruvai and Samba seasons at Annamalai nagar.

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Materials and methods

The present study was carried out in the Department of Entomology, Faculty of Agriculture, Annamalai

University during the year 2017-2019 (Navarai season - February to May, Kuruvai season - June to August and Samba season - October to January). The trap was setup in the garden land area of the Annamalai University Experimental Farm. The farm is situated at an elevation of 5.79 M above the Mean Sea Level. The trap was placed three feet above the crop level at each stage of crop. The trap was operated continuously from 2017 to 2019, covering navarai, kuruvai and samba seasons.

Description of solar powered light trap

The Solar panel contained 32 small squares of solar powered cells, in these cells are generates electricity about 3 watts or (3W / 6 Volts). with a diameters of 30cm. The insect trapping system consisting battery about 6 volts/ 5A. and also contains two initiating light points of which one green in colour that indicated battery charging status, another red light was indicated the unit operation status, when the switch is ON. The trapping system battery gain charges from solar panel through connectivity cable wire. The capacity of the collection pan is 2 lit. This possessed one adjustable screw. It was used to drain the water and clean the pan every day. The stand is made up of highly compactable plastic material the funnel type stand which posses adjustable keys, this key was inserted into required height of the hole and turn to clockwise to lock the key (pushing the key in to the stand having hole then turn clockwise to lock) to installing the trap with in the field 2 to 3 feet above the crop level. Inserting the fisher in to the hole of foot rest gave stability to the trap unit.

Operation procedure

Switch ON the button to start the operation and keep the device under the direct sunlight location, never turn OFF switch while the device is in use, because light turns ON automatically when the sun set happen. When the device is not used for longer duration, switch OFF the device and keep it under safe. To keep minimum of 8 hrs on solar light charging every week long time switch OFF. To drain the water in the tub unscrew the bottom knob of the tub ,when water is fully drained and close the knob , and refill the tub with 2 lit of water mix with soap solution. (Soap solution is the preservative agent).

Identification of insect fauna

For the taxonomic documentation the light trap was operated every night (6.00 PM to 6.00 AM) and collection was observed on the next day morning, Observation were recorded everyday throughout the cropping season on the three seasons of experimentation. Insects were sorted out on the basis of specimens available in the Department of Entomology, Faculty of Agriculture, Annamalai University.

Study on seasonal incidence of major pests of paddy

Seasonal incidence study of major insect pests of paddy was done by operating the light trap in navarai, kuruvai, samba seasons. Major insect pests of paddy were collected and observed, in order to study the seasonal incidence, daily collection was converted in to weekly total (weekly mean per day), week division was based on standard meteorological week (SMW), observation of weather data (maximum temperature, minimum temperature, relative humidity, sunshine and rainfall) were recorded on daily basis from the Meteorological observatory of Department of Agronomy, Faculty of Agriculture, Annamalai University.

Statistical method

The method given by Panse and Sukhatme, (1957) was followed for statistical analysis to study the effects of meteorological parameters and seasons on insect incidence. Following statistical analysis was worked out, the correlation coefficient between various insect trap catches and meteorological parameters were calculated using the following formula

$$Fxy = \text{"}xy - (\sum x)(\sum y) / n\text{"} / (\sqrt{(\text{"}\sum x^2 - (\sum x)^2 / n) \text{ "} (\text{"}\sum y^2 - (\sum y)^2 / n)\text{"}})$$

Where,

F (xy) - Correlation coefficient between insect and a particular meteorological parameter

x - Particular meteorological parameter (Standard week)

y - Insect Catches.

Results and Discussion

Stem borer *Scirpophaga incertulas* (Walker)

The population of stem borer was recorded from installation of the solar powered light trap and throughout the cropping period during navarai, kuruvai and samba seasons and the mean collection of rice stem borer was 29.81, 22.91 and 42.31 respectively (Tables 1, 2 and 3). Different meteorological parameters and number of stem borer moths collected were correlated, the maximum temperature showed that positive correlation with stem bore moths trapped in navarai seasons and negative correlation in kuruvai and samba seasons, minimum temperature was positively correlated in navarai and kuruvai season however it showed that negative correlation in samba season, relative humidity has positive correlation in samba season and negatively correlated in navarai and kuruvai season, sunshine showed positive correlation in navari season and negatively correlation in kuruvai and samba season and the rainfall showed positive correlation in navarai and samba season however it

Table 1: Yellow stem borer and leaf folder moth collected from solar powered light trap and meteorological parameters during navarai season (Feb-May, 2018).

Standard week	Period	Temperature (°C)		Relative humidity (%)	Sunshine /day (hour)	Cumulative rainfall (mm)	Cumulative no. of Yellow stem borer moth trapped/week	Cumulative no. of Leaf folder adult trapped/week
		Maximum	Minimum					
6	Feb 5-11	29.4	21	77	7.4	0	18	9
7	18-DEC	30.1	21.4	78.4	7.8	0	20	13
8	19-25	29.5	20.2	74.4	9.5	0	31	7
9	26 MAR 4	30.8	21	74.4	8.4	0	34	19
10	11-MAY	30.9	20.5	70.8	6.5	0	34	21
11	18-DEC	31.8	24.3	77.7	4.4	23.5	18	15
12	19-25	28.6	22.3	72.7	6.8	0	31	15
13	26 APRIL 1	34.3	24	67.1	6	0	29	18
14	8-FEB	34.3	24.4	73.8	6.4	0	28	24
15	15-SEP	33.8	25.4	73.2	6	1.4	12	26
16	16-22	35.2	25.3	72.2	7.5	0	29	26
17	23-29	36	25.5	71.7	7.7	0	38	32
18	30 MAY 6	37.1	26.6	66.8	7.6	0	30	41
19	13-JUL	36.3	26.4	68.2	6.5	0	34	32
20	14-20	36.2	22.6	62.4	7.1	0	29	25
21	21-27	35.8	26.1	70	3.4	0	30	31
MEAN		**33.1**	**23.5**	**71.9**	**6.8**	**1.5**	**29.81**	**22.12**

Table 2: Yellow stem borer and Leaf folder adults collected from solar powered light trap and meteorological parameters during kuruvai season (Jun-Aug, 2018).

Standard week	Period	Temperature (°C)		Relative humidity (%)	Sunshine /day (hour)	Cumulative rainfall (mm)	Cumulative no. of Yellow stem borer moth trapped/week	Cumulative no. of Leaf folder adult trapped/week
		Maximum	Minimum					
23	June 4-10	37	26	65.2	6.2	5.8	15	19
24	17-Nov	36.9	26.1	66.7	6.3	4.6	20	15
25	18-24	35	25.9	55.5	7	0	26	19
26	25-Jul-01	36.6	25.6	66.2	5.7	1.3	17	23
27	8-Feb	35.4	24.8	69.5	6.9	0	28	25
28	15-Sep	35.8	26.4	67.4	4.7	0	32	22
29	16-22	36.1	26.2	63.7	3	0.5	26	21
30	23-29	36.7	25.9	65.8	6.6	2.2	28	18
31	30-Aug-05	36.3	25.1	67.1	4.6	2.9	19	22
32	12-Jun	35.2	25.1	67.4	5.3	1.4	20	17
33	13-19	35.4	25.6	67.5	5.3	1.4	23	15
34	20-26	35.1	25.3	69	5.5	1.7	21	23
Mean		**35.9**	**25.6**	**65.9**	**5.5**	**1.8**	**22.91**	**19.9**

showed negative correlation in kuruvai season (Tables 4, 5 and 6). The activity of yellow stem borer in the present study was similar to the findings of Kakde and Patel, 2004 who reported that the maximum population catches (72) of rice stem borer during 47th standard week. The result conform to the finding of Mishra *et al*., (2005) who reported that the incidence of rice stem borer had positive significant correlation with maximum and minimum temperature and negative correlation with relative humidity.

Leaf folder *Cnaphalocrocis medinalis* (Guenee)

Collection of leaf folder moths commenced from standard weeks of 6th to 21st (Navarai season), 23rd to 34th (Kuruvai season), 40th to 3rd (Samba season). The mean collection of rice leaf folder moth was 22.12, 19.90 and 29.62 during navarai, kuruvai and samba seasons

Table 3: Yellow stem borer and Leaf folder adults collected from solar powered light trap and meteorological parameters during samba season (Oct, 2018 - Jan, 2019) .

Standard week	Period	Temperature (°C)		Relative humidity (%)	Sunshine /day (hour)	Cumulative rainfall (mm)	Cumulative no. of Yellow stem borer moth trapped/week	Cumulative no. of Leaf folder adult trapped/week
		Maximum	Minimum					
40	Oct 1-7	30.5	24.5	91.4	4.4	22.5	23	19
41	14-Aug	32.7	25.2	73.4	5.2	0.6	20	16
42	15-21	31.4	25.6	83.4	4	7.7	31	9
43	22-28	29.8	24	79	4.1	12.3	36	12
44	29-Nov-04	29.3	24.8	82.4	6.1	12.5	41	8
45	11-May	29.6	24.3	82.4	6.1	5.5	22	19
46	18-Dec	30.8	23.9	75.4	5.1	8.8	53	14
47	19-25	29	23.9	87.8	4	16.7	72	23
48	26-Dec-02	29.4	22.2	77.5	6.3	9.9	64	35
49	9-Mar	29.6	23.4	81.7	5.8	6.4	48	46
50	16-Oct	29.5	22.3	77.7	4	0	56	51
51	17-23	28.8	21.8	78.8	3.8	4.4	62	37
52	24-30	28.8	21.9	77.8	4.8	1.1	39	29
1	31-Jan-06	27.9	19.8	72	8.2	0	41	34
2	13-Jul	28.3	19.3	74.5	8.8	0	36	58
3	14-20	28.5	19.5	72.2	7.6	0	33	64
Mean		**29.6**	**21.6**	**79.1**	**5**	**6.7**	**42.31**	**29.62**

Table 4: Correlation of meteorological parameters with the trap catches of rice yellow stem borers and Leaf folders collected during navarai season.

Pest	Maximum temp. °C	Minimum temp. °C	Relative humidity %	Sun shine (hours)	Rain fall (mm)
Yellow stem borer	0.256	0.030*	-0.469	0.262	-0.404
Leaf folder	0.886**	0.821**	-0.613	-0.253	-0.199
Level of significance (at 5 %)					

Table 5: Correlation of meteorological parameters with the trap catches of rice yellow stem borers and Leaf folders collected during kuruvai season.

Pest	Maximum temp. °C	Minimum temp. °C	Relative humidity %	Sun shine (hours)	Rain fall (mm)
Yellow stem borer	-0.371	0.243	-0.102	-0.040	-0.705*
Leaf folder	-0.157	-0.329	0.201	-0.122	-0.413
Level of significance (at 5 %)					

Table 6: Correlation of meteorological parameters with the trap catches of rice yellow stem borers and Leaf folders collected during samba season.

Pest	Maximum temp. °C	Minimum temp. °C	Relative humidity %	Sun shine (hours)	Rain fall (mm)
Yellow stem borer	-0.384	-0.191	0.039	-0.227	0.115
Leaf folder	-0.585*	-0.836**	-0.443	0.500	-0.561*
Level of significance (at 5 %)					

respectively. The maximum numbers of adult moth were collected during 3rd standard week (64) (Tables 1, 2 and 3). Different meteorological parameters and number of rice leaf folder collected are correlated, the meteorological parameters like maximum and minimum temperature had significant positive correlation in navarai season and negatively correlation in kuruvai and samba seasons, relative humidity has positive correlation in kuruvai season and negative correlation in navarai and samba seasons. In sunshine showed positive correlation in samba season and negative correlation in navarai and kuruvai season and the rainfall has negative correlation in navarai, kuruvai and samba seasons (Tables 4, 5 and 6).

As the leaf is ideal for folding and feeding, dense foliage along with micro climate conditions favored for population build up of leaf folder. The Higher incidence was due to optimum combination of temperature and relative humidity, there result are in accordance with the reports of Kalode, (1974). who reported that the coastal rice ecosystem where relative humidity exceeding 90% in showed negative influence in the population multiplication of leaf folder. However, Chakraborty and Chandra

Deb, (2011) reported the incidence of leaf folder population in paddy was influenced by abiotic condition such as maximum and minimum temperature, relative humidity. Relative humidity showed significant positive influence on *C. medinalis* population in rice. Moreover Garg, (2012), Harinkhere *et al*., (1998) reported that the peak population was observed during September and October. Sharma *et al*., (2002) observed that the maximum appearance of leaf folder in the light during October of kharif season. The maximum population of *C. medinalis* was recorded in 3rd standard week (64 moths) due to the decreased temperature and relative humidity. In contrast with the present findings, Pathak, (1988) reported the population of pest densities, decreased with increase in the minimum and maximum temperature and relative humidity.

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