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Population Dynamics of Rice Case Worm, *Nymphula Depunctalis* Guenee and Rice Grasshopper, *Hieroglyphus Banian* Fabricius in Relation to Weather Parameters: A Light Trap Study

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ABSTRACT: *Light trap study was conducted at research farm of Indira Gandhi Krishi Vishwa Vidyalaya, Raipur during* kharif *season 2013-14. The maximum adult catches of rice case worm (CW) and grasshopper were observed on 41th SMW of October with 416.0 adult/weeks and 73.0 adult/week respectively then adult population gradually decreased as the crop departing towards maturity stage. Case worm showed non-significant negative correlation with average rainfall (mm)* (r = – 0.342), *RH-I* (r = – 0.135), *RH-II* (r = – 0.024), *Average RH* (r = – 0.042) *while non significant positive correlation with maximum temperature* (r = + 0.166), *minimum temperature* (r = + 0.095), *average temperature* (r = + 0.118) *and sun shine (hours)* (r = + 0.109). *Grasshopper showed significant negative correlation with RH-I* (r = – 0.455*) *and non-significant negative correlation with average rainfall (mm)* (r = – 0.135), *sun shine (hours)* (r = – 0.174) *whereas non significant positive correlation with maximum temperature* (r = + 0.078), *minimum temperature* (r = + 0.157), *average temperature* (r = + 0.151), *RH-II* (r = + 0.152) *and average RH* (r = + 0.074) *at 1 and 5 per cent level of significance.*

Key words: *Grasshopper, Light trap, Rice case worm, Weather parameters.*

INTRODUCTION

Chhattisgarh has a tremendous agricultural potential with a diversity of soil and climate, mountains, plateau, rivers, natural vegetation and forest. It is unique in sense in many ways. In Chhattisgarh, rice, *Oryza sativa* Linnaeus occupies average of 3.6 million ha. with the productivity of the state ranging between 1.2 to 1.6 t/ha depending upon the rainfall. Technological innovations are also required for production of high quality seed for hybrids, development of appropriate varieties and agronomic practices for specific ecosystems, new management practices for control of diseases, insects and pests including weeds, [1]. Rice caseworm, *Nymphula depunctalis* Guenee (Lepidoptera: Pyralidae) is a serious pest of paddy that attacks young rice plants theirs moths are nocturnal in habit and are attracted to light. They are delicate, white with luscous markings and black specks on wings. Usually eggs are laid during night. Larvae are transparent green in color with light brownish orange heads. The damaging stage is the larvae that live in sections of leaves cut from young rice plants and rolled into tubes called cases. The leaf cases floats to carry the larvae from one plant to another during the day and at night the larvae climb plants to cut off leaves to make new cases, or feed on severed leaves on the water surface. Rice at seedling and tillering stages are the preferred host but does not occur after maximum tillering, [2]. The caseworm is widely distributed in rice growing counties of Asia, Australia, America and Africa [3]. The adult rice grasshopper, *Hieroglyphus banian* Fabricius (Orthoptera: Acrididae) is of medium size, the female measuring 30 - 55 mm and the male, 30 - 40 mm in length. It is dull green or yellow-brown. The lower body surface is brownish black. Eggs are laid in egg pods in soil containing about 35 eggs per pod. The nymphs are brownish yellow and later change to dull green and feed newly germinated rice seedlings and cause them to wilt. Adult grasshoppers feed on the leaves and shoots and sometimes cut the earheads. If the emerging inflorescence is attacked, the resulting grains become chaffy as reported by [2]. Many of the insect pests mostly nocturnal and few diurnal species are positively phototropic and are

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attracted towards light. Use of light trap is one of the oldest, traditional and Indigenous technologies of pest control for sustainable agriculture, which was very common in early decade of 20th century mostly for the control of insect pests. In recent year's use of light trap occupied an important place in entomological studies and IPM systems all over the world for survey, detection and control of insect pest population [4]. Detection, surveillance and forecasting of the field dynamics of caseworm and grasshopper population in relation to crop phenology and climatic conditions is considered as a prime requisite for the execution of the subsequent crop protection package in view of modern IPM practices. So the population dynamics of insect pest species must be monitored very effectively through trap catches. Meteorological factors play an important role in seasonal abundance; distribution and population build up of insect pests. It is difficult to find direct cause and effects relationship between any single factor and pest activity because the impact of meteorological factor on pests is usually compounded [5, 6]. The present study was undertaken to find out the influence of weather parameters namely temperature (maximum and minimum), rainfall, sun shine (hours) and relative humidity on light trap catches of aforesaid insect pests so that active period may be ascertained for controlling them in the field condition to avoid the loss to the rice crop caused by them.

MATERIALS AND METHODS

Light trap work on the principle of phototrophic behaviour of insects. A SM-84 model light trap was stationed permanently at the research farm of IGKV with a 200 watt candy bulb. It was operated for 12 hours from 6 p.m. to 6 a.m. daily during the crop season to observe the appearance and disappearance of rice caseworm and grasshopper. The trapped insects were collected and sorted out in laboratory every day in the morning. The collection was kept in a galvanized tray measuring 30×45 cm and sorted by brush, needles and lens. Weekly total of daily collection were calculated for determining the population dynamics of rice caseworm and grasshopper [7 - 9]. Correlation analysis was carried out between weather parameters and light trap collection populations during *kharif* season 2013-14 and regression analysis was worked out as per method given by [10].

RESULT AND DISCUSSION

Case worm, *Nymphula depunctalis* Guenee

The data (Table 1 and Fig. 1) revealed that the initial population of case worm (CW) adult was very low on 27 SMW of July with 4.0/weeks then it gradually increases and reached up to 52nd SMW of December with 7.0/weeks in light trap catches. The maximum adult catches of CW were observed on 41th SMW of October with 416.0/weeks and then adult population gradually decreased as the crop departing towards maturity stage. The correlation studies made between case worm (CW) and meteorological parameters (Table 2) revealed that, the CW showed non-significant negative correlation with average rainfall (mm) (r = – 0.342), morning relative humidity (RH-I) (r = – 0.135), evening relative humidity (RH-II) (r = – 0.024), average relative humidity (Avg. RH) (r = – 0.042) while non significant positive correlation with maximum temperature (r = + 0.166), minimum temperature (r = + 0.095), average temperature (r = + 0.118) and sun shine hours(r = + 0.109) at 1 and 5 per cent level of significance. The correlation and regression analysis between CW and weather parameters revealed that average rainfall (mm) showed maximum effect on trap catches of CW 11.72 per cent and their regression equation value is [$y = -4.917x + 72.56$ $R^2 = 0.154$] as compare to another factors.

The present investigations on the monitor of pests through light trap are in close agreement with [11] who reported that, the peak activity of caseworm was observed during September and October month. Similarly, [7] also reported that the highest peak population of CW was observed during 40th SMW of October and the second peak was observed during 39th SMW of September. Maximum temperature, minimum temperature and relative humidity-I did not show any significant effect on the buildup of CW population. Similarly, [12] reported that the maximum population (80 per cent) of the phototropic insects like gall midge, stem borer, case worm, leaf folder, leaf and plant hoppers were observed during 19:00-22:00 hours. There was a positive correlation in most cases between light trap catches and field incidence. As par [13] the case worm maintained a low level during the first 3 month of cropping season. Relatively higher numbers of moths were trapped during October. Caseworm catches of light trap showed significant negative correlation with minimum temperature, evening relative humidity and rainfall however, positive significant correlation with maximum temperature and sunshine hours. Path analysis revealed that minimum temperature played an important role in population build up. According to [14] the population of case worms remained active from August to November and peak periods of 39th, 44th and 47th SMW were recorded as light trapped catches of

Table 1
Weekly observations of rice case worm and grasshopper through light trap collection at Raipur during *kharif* 2013-14.

SMW	Case worm	Rice grasshopper	Temperature (^{0}C) Maxi. Temp.	Mini. Temp.	Average Temp.	Rainfall (mm)	Relative humidity (%) Morning	Evening	Average	Sun Shine (hours)
27	4.0	0.0	31.3	24.5	27.9	73.5	90.3	70.4	80.4	4.4
28	5.0	0.0	31.2	24.3	27.8	144.4	93.0	78.1	85.6	3.9
29	10.0	0.0	30.5	25.3	27.9	44.6	94.6	74.4	84.5	2.3
30	6.0	0.0	28.4	24.7	26.6	88.2	92.4	84.9	88.7	0.7
31	19.0	0.0	28.3	23.9	26.1	255.8	95.1	83.9	89.5	1.3
32	5.0	0.0	31.1	24.7	27.9	87.4	93.1	76.0	84.6	3.3
33	18.0	0.0	31.3	24.4	27.9	177.0	94.7	79.6	87.2	3.3
34	0.0	0.0	27.8	23.8	25.8	60.5	92.0	83.6	87.8	1.5
35	74.0	2.0	29.3	24.5	26.9	120.8	94.9	78.1	86.5	3.1
36	124.0	4.0	31.1	24.8	28.0	54.8	92.6	75.7	84.2	4.2
37	89.0	7.0	31.9	25.2	28.6	11.6	91.7	73.3	82.5	6.2
38	43.0	6.0	29.9	24.1	27.0	92.6	93.4	76.9	85.2	2.5
39	139.0	0.0	32.0	24.9	28.5	28.6	93.0	68.0	80.5	6.3
40	133.0	0.0	30.1	24.2	27.2	45.2	95.0	75.3	85.2	4.2
41	416.0	73.0	30.2	23.3	26.8	8.6	83.7	71.1	77.4	3.5
42	270.0	0.0	30.7	21.4	26.1	0.0	91.4	56.3	73.9	8.6
43	404.0	11.0	28.8	22.6	25.7	32.6	95.9	73.1	84.5	2.1
44	304.0	0.0	30.5	17.3	23.9	0.0	92.3	38.4	65.4	8.9
45	166.0	0.0	30.0	16.7	23.4	0.0	90.9	37.3	64.1	8.2
46	78.0	0.0	27.5	13.2	20.4	0.0	90.6	36.0	63.3	7.6
47	59.0	0.0	30.3	16.7	23.5	0.0	87.0	40.3	63.7	7.3
48	49.0	0.0	30.0	15.5	22.8	0.0	83.0	34.9	59.0	8.5
49	38.0	0.0	28.1	11.8	20.0	0.0	90.6	31.4	61.0	8.5
50	13.0	0.0	27.7	9.8	18.8	0.0	90.0	27.3	58.7	9.0
51	6.0	0.0	28.2	11.7	20.0	0.0	90.1	33.7	61.9	8.0
52	7.0	0.0	28.3	12.7	20.5	0.0	92.8	40.3	66.6	6.5

*SMW= Standard meteorological week

Table 2
Correlation co-efficient (r) and regression equation between case worm and weather parameters at Raipur during *kharif* season 2013-14

Riceinsect	Weather parameter		Correlation Coefficient(r)	Coefficient of determination(r)^2	Coefficient of variation(%)	Regression equation value
Case worm population in light trap catches per week	Temperature (^{0}C)	Maximum	0.166	0.027	2.748	y = 0.001x + 29.60 R² = 0.027
		Minimum	0.095	0.009	0.897	y = 0.004x + 20.22 R² = 0.009
		Average	0.118	0.014	1.392	y = 0.003x + 24.91 R² = 0.013
		Rainfall (mm)	-0.342	0.117	11.720	y = -0.182x + 68.42 R² = 0.117
	Relative humidity (%)	Morning	-0.135	0.018	1.814	y = -0.003x + 92.02 R² = 0.018
		Evening	-0.024	0.001	0.058	y = -0.004x + 61.85 R² = 0.000
		Average	-0.042	0.002	0.173	y = -0.003x + 76.94 R² = 0.001
	Sun shine (hours)		0.109	0.012	1.186	y = 0.002x + 4.919 R² = 0.011

*Significant at 5 % level (2.064), **Significant at 1 % level (2.797)

Table 3
Correlation co-efficient (r) and regression equation between grasshopper and weather parameters at Raipur during *kharif* season 2013-14

Riceinsect	Weather parameter		Correlation Coefficient(r)	Coefficient of determination(r)^2	Coefficient of variation(%)	Regression equation value
Grasshopper population in light trap catches per week	Temperature (^{0}C)	Maximum	0.078	0.006	0.608	y = 0.007x + 29.75 R² = 0.006
		Minimum	0.157	0.025	2.464	y = 0.057x + 20.38 R² = 0.024
		Average	0.151	0.023	2.285	y = 0.032x + 25.07 R² = 0.022
	Rainfall (mm)		-0.135	0.018	1.829	y = -0.615x + 53.44 R² = 0.018
	Relative humidity (%)	Morning	-0.455*	0.207	20.684	y = -0.100x + 92.09 R² = 0.206
		Evening	0.152	0.023	2.298	y = 0.213x + 60.62 R² = 0.023
		Average	0.074	0.005	0.541	y = 0.056x + 76.36 R² = 0.005
	Sun shine (hours)		-0.174	0.030	3.041	y = -0.033x + 5.281 R² = 0.030

*Significant at 5 % level (2.064), **Significant at 1 % level (2.797)

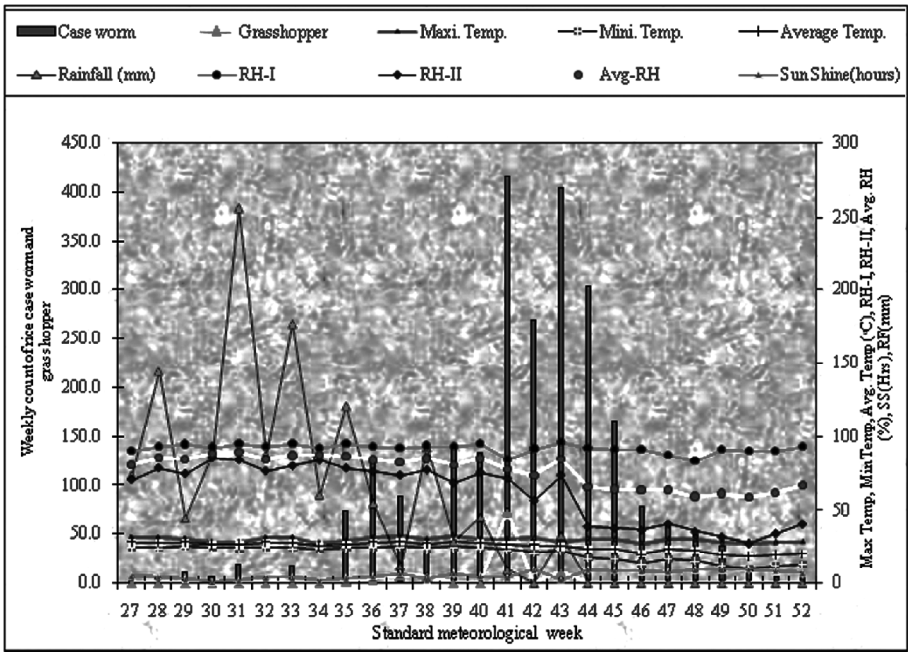

Figure 1: Population fluctuations of rice case worm and grasshopper with weather factors during *kharif* season

case worms viz. 100, 102 and 92, respectively. Case worm showed non-significantly positive correlation with maximum temperature and significant positive with sunshine hours while significant negatively correlated with minimum temperature, minimum relative humidity (RH-II), rainfall and non significant negative with maximum relative humidity (RH-I).

Rice grasshopper, *Hieroglyphus banian* Fabricius

From the data presented in (Table 1 and Fig. 1) revealed that the rice grass hopper adult catches in light trap was started from 35th SMW of August with a population 2.0/week and remained continue up to 43rd SMW of October with a population 11.0/week. The maximum light trap catch population of grass hopper was recorded on 41st SMW of October with a population 73.0/week. The correlation studies made between grasshopper and meteorological parameters (Table 3) revealed that, the grasshopper showed significant negative correlation with morning relative humidity (RH-I) (r = – 0.455*) and non-significant negative correlation with average rainfall (mm) (r = –0.135), sun shine hours(r = –0.174) whereas non significant positive correlation with maximum temperature (r = + 0.078), minimum temperature (r = + 0.157), average temperature (r = + 0.151) and evening relative humidity (RH-II) (r = + 0.152), average relative humidity (Avg. RH) (r = + 0.074) at 1 and 5 per cent level of significance. Trap catches of grasshopper maximum effect by morning relative humidity (RH-I) 20.68 per cent and their regression equation value is [$y = -0.100x + 92.09$ $R^2 = 0.206$] as compare to another factors. Similar finding [2] reported that the rice grass hopper is a pest in northeastern UP and the insects were collected by adopting the methods of light trapping, netting, sweeping or hand picking. *Hieroglyphus banian* Fabricius has been reported as a pest of paddy from central UP by [15, 16].

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