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SEASONAL INCIDENCE OF RICE GALL MIDGE, *ORSEOLIA ORYZAE* (WOOD-MASON)AND ITS CORRELATION WITH WEATHER FACTORS

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ABSTRACT

The present investigation was carried out to evaluate the relation between light trap catches and seasonal incidence of rice gall midge, *Orseolia oryzae* (Wood-Mason) with weather factors *viz.*, temperature (maximum and minimum), relative humidity (morning and evening), rainfall and sunshine hours at Agricultural Research Station (ANGRAU, Guntur), Nellore. The peak light trap catches of gall midge adults during *kharif* season was reported at 38th (third week of September) and 37th (second week of September) standard weeks with 387 and 228 adults during 2022 and 2023, respectively and the second peak catches were reported during 3rd (third week of January) and 5th (first week of February) standard weeks with 296 and 24 adults during 2022 and 2023, respectively. During both the years of study, minimum temperature had significant correlation with gall midge adult catches but during 2022 it was negative correlation and during 2023 it was positive correlation. During both the years relative humidity had significant negative correlation with gall midge adult catches but during 2022 with evening relative humidity and during 2023 with morning relative humidity. Field incidence of gall midge was initiated form 41st standard week *i.e* second week of October on TN1 and NLR 34449 with peak incidence at 45th standard week (15.43 and 18.3 % SS on TN1 and NLR 34449 during 2022, respectively; 21.82 and 17.44 % SS TN1 and NLR 34449 during 2023, respectively) i.e during 2nd week of November during both the years.

***Key words*:** rice gall midge, field incidence, light trap catches, weather factors

Introduction

Rice, *Oryza sativa* (L.) is one of the important cereal crops, being the staple food for more than 65 per cent of the world population (Mathur *et al*., 1999). It is cultivated in almost all the tropical, sub-tropical and temperate countries of the world. India is the largest rice growing country, while China is the largest producer of the rice. One of the major constraints of rice production and low productivity in India is the occurrence of insect pests at various stages of the crop growth. The rice crop is subject to attack by more than 100 species of insects and 20 of them can cause economic damage (Pathak and Khan, 1994). Worldwide upto 37% rice crop is damaged by many insect species. And average loss of 25-30% in paddy production due to the damage of insect pests was recorded in India (Dhaliwal and Arora, 2010).

The rice crop is subjected to damage by many number of insect pests, among them the rice gall midge Asian rice gall midge, *Orseolia oryzae* is one of the important insects which as been prevalent in almost all the rice cultivated states in India except the western Uttar Pradesh, Uttaranchal, Punjab, Haryana and hill states of Himachal Pradesh and Jammu and Kashmir (Bentur *et al*,. 1992). This is a monsoon pest and causes damage wherever high humidity and moderate temperature prevail, even in dry seasons (Kalode and Viswanathan,

1976). It attacks rice from nursery to the end of tillering stage. The damage symptom of gall midge is the production of a silvery-white, onion leaf like appearance called a silver shoot or onion leaf. This is due to the feeding and salivary secretion by the maggot which turns the growing shoor meristem into a gall. Early infestation results in gall formation from the tillers which consequently do not hear panicles. In India, this pest contributes to an average annual yield loss of about 4.77 lakh tonnes, equivalent to 0.8% of total production and worth approximately US$80 million (Bentur *et al*., 2003). The Asian rice gall midge affects various South and Southeast Asian countries, including Bangladesh, China, India, Indonesia, Myanmar, Sri Lanka, and Vietnam, and is ranked as the third most significant pest in India, following the stem borer and plant hopper (Bentur *et al*., 1992).

Recently, emphasis is being given on ecological based pest management strategies. The main components of any pest management programme is to study the incidence period of the pest, population distribution on crop and regular monitoring or survey of field. The seasonal effects of weather and ongoing changes in climatic conditions will directly lead to modifications in dispersal and development of insect species. The changes in surrounding temperature regimes certainly cause alterations in developmental rates, voltinism and survival of insects and subsequently act upon size, density and genetic composition of populations (Kennedy and storer, 2000; Bale *et al*., 2002). The developmental success of insect pests also indirectly depends on climate, as environmental parameters impact on plant physiology. Weather factors like temperature, day length, rainfall and relative humidity are important components in forecasting and predicting the severity of insect-pests population. In this context seasonal incidence studies helps in planning need based application of insecticides as it clearly reveals the insect's peak activity as well as insect free periods during crop growth. In the current experiment an attempt was made to know the effect of abiotic factors on the gall midge population trend on rice crop during Kharif, 2022-23 and 2023-24.

Materials and Methods

Experimental layout

Assessment of rice gall midge, *Orseolia oryzae* (Wood-Mason) population was done by light trapping, 200-watt electric light source was used for the trapping of insects. Light trap was installed in ARS farm long ago, 6 m above the ground level with collection pan below the light source. The trap was operated from 18.00 to 6.00 hours. The light trap catches of gall midge adults have been recorded daily throughout the year. The daily observations of meteorological variables *viz*., temperature (maximum and minimum), rainfall and relative humidity were collected from Agro-meteorological observatory, Department of Agronomy at Agricultural Research Station, Nellore. These observations were compiled and averaged to weekly.

For recording field incidence of gall midge, the study was conducted at Agricultural Research Station, Nellore, Andhra Pradesh (ANGRAU, Guntur), India during kharif, 2022-23 and 2023-24. The total experimental plot size measured 30×30 m (900 m^2). The seedlings of 28 days old were transplanted in the experimental plot with spacing 20 cm between rows and 15 cm between plants. A susceptible rice variety Taichung Native 1 (TN1) and a popularly grown rice variety, NLR 34449 were used as test varieties for the experiment. All other cultural practices were followed as per the recommendations except plant protection measures against insect pest and diseases. No plant protection measures were taken throughout the crop period to get natural pest incidence on the crop.

Observations and analysis

Observations on the incidence of gall midge in terms of silver shoots were recorded at on 50 randomly selected hills by counting the total number of tillers and number of gall midge effected tillers at weekly intervals starting from 15 days after transplantation. The per cent gall midge incidence was calculated as follows.

$$\text{Percent gall midge incidence} = \frac{\text{Number of silver shoots}}{\text{Total number of tillers}} \times 100$$

The correlation co-efficient of light trap catches and field incidence was worked out in relation to weather parameters.

Results and Discussion

Light trap catches of gall midge adults during kharif, 2022-23 and 2023-24

The gall midge adult population build up through trap collections are presented in Table 1. Initially from 27th to 34th standard week gall midge catches were low to moderate i.e form 0 to 30 moths/week, then the adult moth catches were increased suddenly from 35th standard week with 74 adults/week during 2022-23. The peak catches of gall midge adults during kharif season was reported at 38th standard week (387 adults). Higher adult catches per week was continued till 43rd standard week. Thereafter the number of adult catches were declined gradually and lowest was noticed at 47th standard week

Table 1: Weekly light trap catches of rice gall midge and weather parameters during kharif, 2022-23 and 2023-24.

2022-23								2023-24						
SMW	Gall midge (No.of adults)	Rain fall (mm)	Temp. (°C)		Relative humidity (%)		Sun shine hours	Gall midge (No.of adults)	Rain fall (mm)	Temp. (°C)		Relative humidity (%)		Sun shine hours
			Max.	Min.	Morn.	Even.				Max.	Min.	Morn.	Even.	
27	15	10.0	31.7	26.3	73.3	61.7	1.1	0	15.6	33.2	25.5	67.4	53.0	2.2
28	0	10.6	30.7	25.2	70.3	59.0	6.6	0	26.4	33.9	24.9	68.4	50.7	3.1
29	23	104.8	32.8	24.6	77.4	63.9	5.2	0	0.0	32.9	25.1	65.9	53.4	1.0
30	30	8.8	30.9	24.6	77.7	66.0	3.0	0	34.6	29.3	24.5	78.6	73.3	3.3
31	0	9.5	33.1	26.3	81.0	69.4	8.3	0	0.0	33.0	24.6	60.3	50.1	7.3
32	10	30.6	31.1	26.8	74.9	67.7	0.3	0	0.0	33.7	25.5	68.3	54.3	2.4
33	0	32.4	33.2	24.8	67.7	54.9	0.0	19	0.0	33.9	25.5	60.4	47.0	7.1
34	20	55.1	33.9	25.0	72.0	54.4	10.6	28	0.0	34.0	25.3	60.4	46.9	6.3
35	74	39.6	31.6	24.6	78.3	61.1	0.0	14	24.8	35.2	25.0	64.7	44.4	5.5
36	65	33.9	30.9	24.8	78.1	70.0	0.0	135	0.0	32.9	25.0	65.3	54.3	3.8
37	138	27.9	32.2	24.6	73.3	57.7	2.0	228	4.2	32.3	25.1	62.0	48.1	3.8
38	387	53.5	33.5	24.8	65.9	52.9	0.0	103	5.2	34.6	25.2	59.9	47.6	5.1
39	65	43.5	33.6	24.6	72.9	58.9	3.2	84	62.4	34.3	23.9	68.3	52.4	7.2
40	117	7.4	30.5	24.1	82.6	75.7	1.8	43	24.8	34.0	23.7	69.1	50.9	5.5
41	101	30.7	30.2	24.1	81.1	77.9	1.5	42	6.4	33.4	24.1	71.7	52.9	7.4
42	148	61.9	30.7	24.8	81.4	70.4	1.0	33	0.0	32.2	24.4	64.7	52.0	7.2
43	51	58.9	31.2	23.1	61.1	52.3	1.2	3	0.0	32.5	22.5	61.7	52.1	6.2
44	19	20.5	27.5	22.1	83.7	79.4	27.2	0	27.4	30.1	21.8	84.0	74.3	2.8
45	13	43.5	28.7	22.4	80.4	71.6	3.4	1	83.8	28.9	23.1	88.6	79.7	3.7
46	15	18.6	28.1	22.3	90.6	74.0	27.8	0	0.0	29.1	22.9	80.6	69.4	4.1
47	1	28.9	26.9	21.1	79.6	75.6	4.3	0	158.0	27.4	23.3	94.7	81.7	2.1
48	2	37.4	28.0	21.0	86.9	76.0	0.0	5	47.6	26.9	24.3	87.4	81.3	9.7
49	2	25.8	28.4	21.7	83.0	70.7	0.0	2	16.4	22.1	27.6	91.4	85.4	75.5
50	28	50.1	27.1	24.0	82.4	83.7	35.1	2	16.3	22.0	27.4	86.9	73.1	0.0
51	19	34.2	27.3	20.0	93.1	85.0	0.0	0	3.7	21.3	27.6	83.9	68.3	0.0
52	63	43.2	27.6	20.4	90.9	83.0	0.0	0	23.0	21.9	26.9	77.7	65.4	0.0
1	0	0.0	28.0	20.5	84.4	79.0	6.4	0	0.0	25.1	71.4	27.0	69.6	0.0
2	21	0.0	26.7	18.1	83.1	69.0	7.7	0	0.0	23.0	85.1	27.1	76.4	0.0
3	296	0.0	27.2	17.3	84.6	63.6	8.3	7	0.0	24.3	83.9	27.3	77.7	0.0
4	180	0.0	27.7	17.5	81.3	62.9	7.5	19	0.0	24.7	82.0	27.4	81.1	0.0
5	93	16.9	27.8	17.9	86.9	72.6	2.0	24	0.0	23.9	53.9	55.3	74.6	4.6
6	44	60.1	28.7	18.3	84.3	69.4	0.0	18	0.0	21.0	30.7	80.4	67.7	5.3
7	184	68.3	29.3	18.9	77.3	59.1	0.0	14	0.0	21.1	29.3	81.1	60.6	5.0
8	153	67.8	30.6	19.0	71.0	54.7	0.0	2	0.0	21.2	30.6	82.4	63.4	4.1

(1adult). Again, the gall midge second brood was started form 51st standard week (28 adults) and reached to its second peak during 3rd standard week i.e third week of January (296 adults) and declined gradually and lowest was recorded at 10th standard week (5 adults).

During 2023-24, gall midge catches were first noticed during 33rd standard week and catches were moderate till 35th standard week (19, 28 and 14 gall midge adults/ week during 33, 34 and 35th standard weeks, respectively). Higher gall midge catches were noticed from 36th standard week and reached to its peak during 37th standard week (228 adults). Higher adult catches per week was continued till 42nd standard week. Thereafter the number of adult catches were declined gradually. Again, second brood was started from 3rd standard week (7adults) and reached to its second peak during 5th standard week (24 adults) i.e during first week of February and declined gradually and lowest was recorded during 8th standard week (2 adults).

Correlation between weather parameters and gall midge light trap catches.

The correlation co-efficient analysis between weather

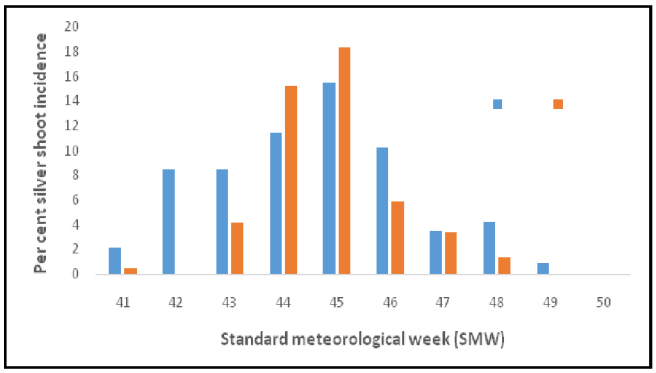

Fig. 1: Seasonal incidence of rice gall midge (% silver shoots) during kharif, 2022-23.

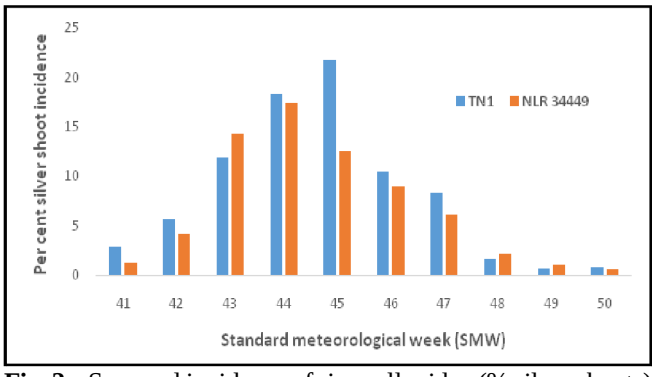

Fig. 2: Seasonal incidence of rice gall midge (% silver shoots) during kharif, 2023-24.

parameters and light trap catches of gall midge adults revealed that during 2022, significant negative correlation was recorded with correlation co-efficient r= 0.370 ($p \leq 0.05$) between gall midge adult catches and minimum temperature whereas maximum temperature (r= 0.030) had non-significant positive correlation with gall midge adult catches. Evening relative humidity had significant negative correlation with correlation co-efficient r=0.367 ($p \leq 0.05$) while morning relative humidity had non-significant negative correlation with gall midge adult catches. Sunshine hours and rain fall had non-significant negative correlation (r=0.193) and positive correlation (r=0.145) with gall midge adult catches, respectively.

During 2023 significant positive correlation was recorded with correlation co-efficient r= 0.577 ($p \leq 0.01$) between gall midge adult catches and minimum temperature whereas maximum temperature (r= 0.367, $p \leq 0.05$) had significant negative correlation with gall midge adult catches. Morning relative humidity had significant negative correlation with gall midge adult catches (r=0.435 $p \leq 0.01$) while evening relative humidity had non-significant positive correlation with correlation co-efficient r=0.199. Sunshine hours and rain fall had non-significant negative correlation (r=0.149) and positive correlation (r=0.226) with gall midge adult catches, respectively.

During both the years of study, minimum temperature had significant correlation with gall midge adult catches but during 2022 it was negative correlation and during 2023 it was positive correlation. During both the years relative humidity had significant negative correlation with gall midge adult catches but during 2022 with evening relative humidity and during 2023 with morning relative humidity.

Field incidence of rice gall midge during kharif, 2022-23 and 2023-24

The field incidence of rice gall midge in terms of per cent silver shoots (%SS) were recorded at weekly intervals according to the standard weeks during kharif season *i.e.* from September to December, 2022 and 2023. The data presented in Fig. 1, revealed that during both the years the gall midge incidence was initiated form 41st meteorological standard week (SMW) i.e second week of October on TN1 and NLR 34449 (2.10 and 0.5% silver shoots on TN1 and NLR 34449 during 2022, respectively and 2.83 and 1.24% silver shoots on TN1 and NLR 34449 during 2023, respectively) with peak incidence at 45th standard week (15.43 and 18.3% SS on TN1 and NLR 34449 during 2022, respectively; 21.82 and 17.44 % SS TN1 and NLR 34449 during 2023, respectively) during 2nd week of November during both the years. The gall midge incidence started to decline from 46th standard week to 50th standard week on TN1 and NLR 34449 from 10.25 to 0.00% SS, respectively during 2022; from 10.47 to 0.86% SS and 8.97 to 0.53% SS, respectively during 2023.

These finding of the present studies were found in corroboration with the reports of Yeshwant *et al.*, 2024 reported that peak incidence of gall midge (6.59%) was observed during 1st fortnight of October. Mardi *et al.*,

Table 2: Correlation co-efficient (r) studies on weather parameters in relation to light trap catches and field incidence of rice gall midge.

Light trap catch	Max Temp(°C)	Min Temp(°C)	RH morn (%)	RH eve (%)	SSH (hours)	Rainfall (mm)
2022	0.030	**-0.370***	-0.160	**-0.367***	-0.193	0.145
2023	-0.367*	0.577**	-0.435**	0.199	-0.149	-0.226
Field incidence	**Max Temp**	**Min Temp**	**RH morn**	**RH eve**	**SSH**	**RF**
2022	-0.3042	-0.1934	0.0343	0.1320	0.4824	-0.1690
2023	-0.251	-0.322	-0.431*	-0.181	0.157	0.142

2009 also reported that peak incidence of gall midge occurred in the rice fields in the fourth week of September (39th SMW) at Ranchi, Jharkhand. Shrivastava *et al*., (1987) reported that major active period of rice gall midge in the field was 36th to 43rd standard weeks at Raipur, India. Sain *et al*., (1992) also reported that the gall midge appeared in late August, its incidence reached a peak in October and declined by December. Hegdekatti (1927) reported that incidence of gall midge in the rice nurseries is seen in July, whereas in main field the pest appears in August. He also stated that when rainfall was more than 6" even in May the infestation was more serious, if the rice crop is available in the field in any case. Yen *et al*., (1941) found that adults were first observed in flight in late March and were most numerous in early August. In India, Khan and Murthy (1955) reported that *Orseolia oryzae* usually appeared on the monsoon crop in the first or second week of July. They noted two peaks of appearance of galls one in mid- August and the other some 14-20 days later. Injury caused by the past is occurring mainly in the monsoon season with maximum incidence between the 3rd week in August and the 2nd week in September. Descamps (1956) observed that infestation begins towards the end of July and increases until October, when rice fields begins to dry up. Murthy (1957) reported that infestation increases with lateness of sowing and transplanting of rice.

Correlation between weather parameters and field incidence of rice gall midge

The correlation co-efficient have been worked out between climate factors and gall midge field incidence in terms of % silver shoots and presented in Table 2. It was observed that silver shoot incidence had negative correlation with maximum and minimum temperatures during both the years (r=0.304 & 0.193, respectively during 2022; 0.251 & 0.322m respectively during 2023). Morning and evening relative humidity had positive correlation with % silver shoot incidence during 2022 (0.132 and 0.482, respectively). In contrast during 2023 morning and evening relative humidity had negative correlation with % silver shoot incidence (0.431, $p \leq 0.05$ & 0.181, respectively). Sunshine hours possessed positive correlation with % silver shoot incidence during both the years (0.482 and 0.157 during 2022 & 2023, respectively). Rainfall had negative correlation with % silver shoot incidence (r= 0.169) during 2022, in contrast possess positive correlation (r=0.142) during 2023.

Seni *et al*., 2023 reported that maximum infestation of gall midge was observed from 35th to 43rd (August - October) standard meteorological week (SMW) and highest infestation of gall midge producing silver shoots was observed in 38th SMW whereas peak catches by light trap were obtained in 40th SMW. Infestation of gall midge in field was positively correlated with maximum and minimum temperatures whereas it was negatively correlated with morning and evening relative humidity. Seni and naik, 2018 found that infestation of gall midge had positive correlation with both maximum and minimum temperature in Odisha, India

Conclusion

The present study concludes that during kharif season the peak light trap catches of gall midge adults during was reported at 38th (third week of September) and 37th (second week of September) standard weeks with 387 and 228 adults during 2022 and 2023, respectively and the second peak catches were reported during 3rd (third week of January) and 5th (first week of February) standard weeks with 296 and 24 adults during 2022 and 2023, respectively. During both the years of study, minimum temperature had significant correlation with gall midge adult catches but during 2022 it was negative correlation and during 2023 it was positive correlation. During both the years relative humidity had significant negative correlation with gall midge adult catches but during 2022 with evening relative humidity and during 2023 with morning relative humidity. With regard to the field incidence of gall midge was initiated form 41st standard week i.e second week of October on TN1 and NLR 34449 with peak incidence at 45th standard week (15.43 and 18.3% SS on TN1 and NLR 34449 during 2022, respectively; 21.82 and 17.44% SS TN1 and NLR 34449 during 2023, respectively) i.e during 2nd week of November during both the years. With regard to correlation co-efficient analysis between weather parameters and field incidence of gall midge showed significant negative correlation with morning relative humidity with correlation co-efficient r= 0.431 ($p \leq 0.05$).

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