Seasonal Incidence of major insect pests of rice (*Oryza sativa* L.) and its correlation with weather parameters

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Abstract

The present investigation was carried out to study the seasonal incidence of major insect pests of rice (*Oryza sativa* L.) at Agricultural Research Station (ANGRAU, Guntur), Nellore. For recording seasonal incidence of yellow stem borer, leaf folder and whorl maggot the seedlings

of 27 days old were transplanted in the experimental plot (900 m^2) 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. No plant protection measures were taken throughout the crop period to get natural pest incidence on the crop. Observations on stem borer, leaf folder, gall midge and whorl maggot infestation was recorded on 50 randomly selected hills at weekly intervals starting from 15 days after transplantation. Dead heart incidence (Stem borer) was commenced during first week of October i.e 40th standard week. Dead heart incidence was reached to its peak level (32.56 %) during 42nd standard week on TN1 and 23.3 % on NLR 34449. The leaf folder incidence was commenced from 42nd standard week both on NLR 34449 and TN1 (1.8 and 0.4 %, respectively). Then the per cent leaf folder damage was gradually increased and reached its peak during 46th standard week n NLR 34449 (21.41 %) and during 45th standard week on TN1 (17.8 %). The gall midge incidence in terms of silver shoot was initiated during 41st standard week both on NLR 34449 and TN1 (2.10 and 0.5 %, respectively). Then the per cent silver shoot incidence was gradually increased and reached its peak during 45th standard week both on NLR 34449 (15.46 %) and TN1 (18.3 %). The whorl maggot incidence was first noticed during 40th standard week on both NLR 34449 and TN1 (1.12 and 0.98 %, respectively). Then the per cent damage was gradually increased and reached its peak during 44th standard week.

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 yellow stem borer, *Scirpophaga incertulas* (Walker) is the major insect pest causing dead hearts and white ears leading to major economic damage (Satpathi et al., 2012). The leaf folder, *Cnaphalocrocis medinalis* (Guenee), which was become major pest during recent years. The larvae fold the leaves and scrape the green tissues showing scorching and drying symptoms. The yield loss caused by leaf folder reported to the extent of 5-25 % (Kulgagod et al., 2011). The rice gall midge attacks rice from nursery to the end of tillering stage. The larvae of the gall midge fly cause heavy damage to the rice crop. Early infestation results in gall formation from the tillers which consequently do not hear panicles.

The rice whorl maggot *Hydrellia philippina* Ferino was first reported in India on rice crop and seven other graminaceous weeds growing in rice fields as host of *H. philippina* (Ferino, 1968). Whorl maggot damages rice plnat s primaril during the vegetative phase, althrough minor damage can be seen in later growth stages. Its damge not only reduceds phhotosymthetic area and also causes necrosis of leaf margins which is a unique damage symptom and reported up to a significant yield loss of 41 per cent from untreated plot (Ferino, 1968). In recent years due to conductive environment whorl maggot is cusing severe damage in all rice growing areas of Andhra Pradesh.

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). 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 pest population trend on rice crop during Kharif, 2022-23.

Materials and Methods

Experimental layout

For recording seasonal incidence of yellow stem borer, leaf folder, gall midge and whorl maggot the study was conducted at Agricultural Research Station (ANGRAU), Nellore, Andhra Pradesh, India during kharif, 2022-23. The total experimental plot size measured 30x30 m (900 m^2). The seedlings of 27 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.

The daily observations of meteorological variables viz., temperature (maximum and minimum), rainfall and relative humidity were collected from Agro-meterorological observatory, Department of agronomy at Agricultural Research Station, Nellore. The observations were compiled and averaged to weekly.

Observations and analysis

Observations on stem borer infestation was recorded in terms of dead heart counts on 50 random hills by counting the total number of tillers and number of dead hearts at weekly intervals starting from 15 days after transplantation. The per cent dead heart incidence was computed as follows.

Per cent stem borer incidence = $\dfrac{\text{Number of dead hearts/hill}}{\text{Total number of tillers/hill}} \times 100$

Observation on the leaf folder incidence in terms of number of damaged leaves by leaf folder was recorded on 50 randomly selected hills by counting the total number of leaves and number of leaf folder damaged leaves at weekly intervals starting from 15 days after transplantation. The per cent leaf folder incidence was calculated as follows.

Per cent leaf folder damage = $\dfrac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$

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.

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

Observation on the whorl maggot incidence in terms of number of damaged leaves by whorl maggot was recorded on 50 randomly selected hills by counting the total number of leaves and number of whorl maggot damaged leaves at weekly intervals starting from 15 days after transplantation. The per cent whorl maggot incidence was calculated as follows.

Per cent whorl maggot damage = $\dfrac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$

Results and discussion
Stem borer

In the present study stem borer incidence was initiated on rice crop during 39th standard week i.e last week of September on TN1 (0.82 %) and on NLR 34449 dead heart incidence was commenced during first week of October i.e 40th standard week. Dead heart incidence was reached to its peak level (32.56 %) during 42nd standard week (15th – 21st October) on TN1 and 23.3 % on NLR 34449. Dead heart incidence was starts decline from 43rd standard week to 46th standard week on NLR 34449 and TN1 from 14.59 to 1.75 and from 15.7 to 5.1 % dead hearts, respectively.

Present study also matches to the findings of Kumar and Sudhakar, 2001 reported that peak incidence of YSB at 2nd fortnight of October during kharif season. Rai *et al*., 2002 also revealed that peak occurrence of YSB during first fortnight of October, which may be due to the difference in climatic conditions. On the other hand present observation was contradicted by Justin and preetha, 2013, who reported *S. Incertulas* incidence in two spells during August-September and December-February at Thirupathsaram (Kanyakumari) whereas Gole (2012) stated that the incidence of YSB initiated from second week of August (32nd SMW) and continued up to the harvest of the crop.

Correlation co-efficient analysis between weather parameters and field incidence of dead hearts revealed, significant positive correlation was recorded with correlation co-efficient r= 0.6863 (p≤ 0.01) between dead heart incidence and maximum temperature and minimum temperature (r=0.8145). Whereas morning and evening relative humidity had a non-significant negative correlation (r= 0.3327 and 0.3263), while rainfall had significant positive correlation with dead heart incidence. Similar observations were recorded by Israel and Rao (1961) and Singh, et al. (2013). Ayyanna and Hamidali (1970) also reported *S. incertulas* emergence started from second week of September, with a peak activity during the first week of October between temperatures of 30.60 ℃ and 21.60 ℃. The damage was negatively correlated with minimum temperature.

Leaf folder

The first observation of leaf folder damage was recorded during 42nd standard week both on NLR 34449 and TN1 (1.8 and 0.4 %, respectively). Then the per cent leaf folder damage was gradually increased and reached its peak during 46th standard week on NLR 34449 (21.41 %) and during 45th standard week on TN1 (17.8 %). Afterwards from 47th standard week on wards leaf folder damage starts decline from 14.4 % to 2.54 % leaf folder damage on NLR 34449. On TN 1 also leaf folder incidence starts decline from 46th standard week from 12.4 % to 1.85 %. Kumar et al. (1996) recorded the infestation of rice leaf folder, *C. medinalis* varied from 1.4 to 33.2 per cent in rice from July to October. Kumar et al. (2003) found that the peak activity leaf folder in the October during the kharif, season. Alvi et al. (2003) found that the activity of *C. medinalis* lasted from the second week of august to the second week of October during 2000, while it lasted from the last week of august to the second week of October during kharif, 2001. The leaf folder infestation on leaves was noticed that peak leaf infestation was maximum (61.9 %) at second week of October (Chavi et al., 2015). Kumar et al. (2013) and Khan and Ramamurthy (2004) revealed in his study leaf folder population were higher in the month of October, exhibiting peak activity in the first week, followed by September.

Correlation studies revealed that per cent leaf damage by leaf folder showed non-significant negative correlation with maximum and minimum temperatures (r= 0.4795 and 0.3714) and non-significant positive correlation was recorded with morning and evening relative humidity (0.1223 and 0.0930). Rainfall showed non-significant negative correlation with leaf folder damage (r= 0.2840). Khan et al., 2004 also reported that leaf folder infestation had negative correlation with minimum temperature, evening relative humidity and rain fall (r=0.1665, 0.0067 & 0.0888) and had positive correlation with maximum temperature (r=0.0442) and morning relative humidity (r=0.2062).

Gall midge

The gall midge incidence in terms of silver shoots was initiated during 41st standard week both on NLR 34449 and TN1 (2.10 and 0.5 %, respectively). Then the per cent silver shoot incidence was gradually increased and reached its peak during 45th standard week both on NLR 34449 (15.46 %) and TN1 (18.3 %). Afterwards from 46th standard week on wards silver shoot incidence starts decline from 10.25 % to 0.89 % on NLR 34449. On TN 1 also silver shoot incidence starts decline from 46th standard week from 5.9 % to 1.4 %.

Correlation studies revealed that per cent silver shoot incidence showed non-significant negative correlation with maximum and minimum temperatures (r= 3042 and 0.1934) and non-significant positive correlation was recorded with morning and evening relative humidity (0.0343 and 0.1320). Rainfall showed non-significant negative correlation with silver shoot incidence (r= 0.1690).

Whorl maggot

The whorl maggot incidence on the rice crop was first noticed during 40th standard week (1st to 7th October) on both NLR 34449 and TN1 (1.12 and 0.98 %, respectively). Then the per cent damage was gradually increased and reached its peak during 44th standard week (29th October to 4th November) on TN1 and on NLR 34449 reached to its peak during 43rd standard week (8.29 %), from 45th standard week the whorl maggot incidence was followed decreasing trend. Correlation co-efficient analysis between weather parameters and field incidence of whorl maggot revealed, non-significant negative correlation was recorded with correlation co-efficient r= 0.3224 between Whorl maggot incidence and maximum temperature and minimum temperature (r=0.4856). Whereas morning and evening relative humidity had a non-significant positive correlation (r= 0.2879 and 0.3896). Rainfall had significant positive correlation with whorl maggot incidence (r=0.0985).

Conclusion

The present study concludes that during kharif season the major insect pest activity viz., stem borer, leaf folder, gall midge and whorl maggot on rice crop was initiated from 40th standard week (1st to 7th Oct) to 42nd standard week (15th to 21st Oct) i.e during first fortnight of October. And reached to their peak levels during 45th (5th to 11th Nov) to 46th (12th to 18th Nov) standard weeks i.e during first fortnight of November. From 47th standard week onwards pest activity showed a declining trend. With regard to correlation co-efficient analysis between weather parameters and field incidence of major pest of rice, stem borer incidence (dead hearts) showed significant positive correlation with maximum temperature with correlation co-efficient r= 0.6863 (p≤ 0.01) and minimum temperature (r=0.8145).

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Table 2: Correlation coefficient (r) of insect pest incidence on rice with prevailing weather parameters during kharif, 2022-23.

Factor	Correlation (r)					
	Maximum temperature	Minimum temperature	Relative humidity (Morng.)	Relative humidity (Even.)	Sunshine hours	Rainfall (mm)
Dead heart	0.6863*	0.8145**	-0.3327	-0.3263	-0.1408	0.7298*
Leaf folder	-0.4795	-0.3714	0.1223	0.0930	0.4655	-0.2840
Gall midge	-0.3042	-0.1934	0.0343	0.1320	0.4824	-0.1690
Whorl maggot	-0.3224	-0.4856	0.2879	0.3896	-0.1582	0.09855

*Significant at 5% level   ** significant at 1% level

Table 1: Influence of abiotic factors on seasonal incidence of various insect pest on rice during kharif, 2022-23.

SMW	Period	Stem borer (% heart)		% Leaf folder		Gall midge (% Silver shoots		% Whorl maggot		Temperature (°C)		Relative humidity (%)		Rainfall (mm)
		NLR 34449	TN 1	NLR 34449	TN 1	NLR 34449	TN 1	NLR 34449	TN 1	Max.	Min.	Morng.	Even.	
39	24th-30th Sep	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00	33.6	24.6	72.9	58.9	43.5
40	1st – 7th Oct	0.00	2.12	0.00	0.00	0.00	0.00	0.00	0.00	30.5	24.1	82.6	75.7	7.4
41	8th -14th Oct	4.5	9.4	0.00	0.00	2.10	0.5	5.89	2.25	30.2	24.1	81.1	77.9	30.7
42	15th -21st Oct	23.3	32.56	1.8	0.00	8.5	0.00	7.81	4.26	30.7	24.8	81.4	70.4	61.9
43	22nd -28th Oct	14.59	15.7	8.4	4.4	8.5	0.00	8.29	10.21	31.2	23.1	61.1	52.3	58.9
44	29th 4th Nov	4.5	11.3	14.6	8.9	11.4	15.25	7.90	11.35	27.5	22.1	83.7	79.4	20.5
45	5th – 11th Nov	4.0	9.8	17.25	17.8	15.46	18.3	1.34	8.46	28.7	22.4	80.4	71.6	43.5
46	12th - 18th Nov	1.75	5.1	21.41	12.4	10.25	5.9	1.56	1.76	28.1	22.3	90.6	74.0	18.6
47	19th -25th Nov	006	5.1	14.4	10.8	3.54	3.4	0.00	1.1	26.9	21.1	79.6	75.6	28.9
48	26th -2nd Dec	0.00	0.9	12.1	1.3	4.23	1.4	0.00	0.00	28.0	21.0	86.9	76.0	37.4
49	3rd -9th Dec	0.00	3.9	8.7	2.5	0.89	0.00	0.00	0.00	28.4	21.7	83.0	70.7	25.8
50	10th – 16th Dec	0.12	1.25	2.54	1.85	0.00	0.00	0.00	0.00	27.1	24.0	82.4	83.7	50.1
51	17th – 23rd Dec	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.3	20.0	93.1	85.0	34.2