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# Effect of abiotic factors on incidence of leaf folder, *Cnaphalocrocis medinalis* (Linnaeus) in rice ecosystem of Varanasi region

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**Abstract**
The present investigation was conducted on submergence rice variety Swarna sub-1 to study the effect of abiotic factors on the incidence of leaf folder, *Cnaphalocrocis medinalis* (Linnaeus) during *Kharif* season of 2016-17 and 2017-18 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The infestation of leaf folder was noticed in the field from 31st SMW to 41st SMW during both years of investigation. The maximum leaf damage was recorded in 41st standard meteorological week (SMW) (11.76 %) during *Kharif* 2016. And 11.10 per cent leaf damage was recorded in 39th standard meteorological week (SMW) during *Kharif* 2017. The relationship between the population of leaf folder and weather parameters showed a significant positive correlation with maximum temperature (r= 0.549*) i.e. with an increase in temperature the population of leaf folder also increased and highly significant negative correlation with rainfall (r= -0.620**). Other parameters showed a non-significant positive and negative relationship with the leaf folder population.

**Keywords:** Incidence, leaf folder, abiotic factors, rice ecosystem

## Introduction
Rice (*Oryza sativa* L.) is the world second leading cereal crop and known with different names in India as Dangar, Bhatt, Chawal, Voldu, Dhan, Chaul, Shali and Nellu. It is grown under diverse growing conditions such as irrigated, rainfed lowland, rainfed upland and flood prone ecosystems. Cultivation of rice is significant for the food security of Asia. India has a long history of rice cultivation. India stands first in an area (44.0 mha) and the world's second largest producer (111.0 MT) of rice after China with the productivity of 3.78 tons per hectare (Anonymous, 2016) [1]. In Uttar Pradesh, 4.55 million hectares was occupied by rice in India which produced 12.51 million tones with a productivity of 2.13 t/ha (Anonymous, 2016) [1]. In the world, more than 10,000 insect species are attacked on food plants. (Dhaliwal *et al.*, 2007) [5]. In India, average losses of paddy production due to insect pests are 25-30% (Dhaliwal and Arora, 2010) [4]. Around 52 per cent of the worldwide production of rice is lost yearly due to the damage caused by biotic stress factors, of which 21 per cent is attributed by the attack of major insect pests (Yarasi *et al*., 2008) [15].
An important lepidopteran pest in rice is leaf folder (*C. medinalis*) is considered as minor pests, has assumed major pest status during the last two decades (Nanda *et al.*, 2000) [11]. It is one of the most important insect pests in the Indian subcontinent. It has study assumed major pest status in some parts of India due to injudicious cultivation practices (Maragesan and Chellish, 1987) [9]. The second instar of leaf folder larvae glues the growing paddy leaves longitudinally for somewhere to stay and feeds voraciously on green foliage which results in papery dry leaves (Chatterjee, 1979), stunting, curling or yellowing of plant green foliage (Mishra *et al.*, 1998) [10]. The larvae scrap the chlorophyll content of leaves resulting in the photosynthesis and thus result in the reduction of yield. The yield loss caused by leaf folder reported from 5 to 25 per cent (Kulgagod *et al.*, 2011) [7] and 12-18.8 per cent yield loss in irrigated condition (Singh *et al.*, 2003) [14]. The yield loss ranges from 30 to 80 per cent due to leaf folder outbreak (Nanda and Bosoi, 1990) [12]. This insect pest is a key pest among the lepidopteron pests infesting rice. The present investigation is proposed to observe the incidence of leaf folder in the rice ecosystem.

## Materials and Methods
**Experimental Layout:** Field study was conducted during *Kharif* season of 2016 and 2017 in

an untreated field (100 $m^2$ bulk area) of paddy variety Swarna sub-1. Transplantation to main the field was done with 25-30 days old seedlings at 20 × 15 cm spacing on 28-30 standard meteorological weeks (SMW). The fertilizers were applied at the rate of 120:60:60 kg N, $P_2O_5$ and $K_2O$ in the form of urea, single superphosphate and murate of potash. A full dose of phosphorous and potash and half dose of nitrogen was applied as basal dose. Rest of the nitrogen was applied in two equal doses, first at 25 days after transplanting and second at 55 days after transplanting.

**Methods of observation**

To know the incidence of leaf folder, *C. medinalis* on rice, the observations were recorded as per standard meteorological week from 25 days after transplanting and continue to harvest. The observations were taken by counting the number of damaged leaves and the total number of healthy leaves from randomly selected ten hills. The per cent incidence of leaf folder was calculated as follows:

$$\text{Per cent Incidence} = \frac{\text{Number of damaged leaves}}{\text{Total number of leaves}} \times 100$$

**Result and Discussion**

***Kharif* 2016**

The data recorded on the incidence of *Cnaphalocrocis medinalis* (Linnaeus) was taken as the number of larvae per ten hills and initial incidence was observed on 31st standard meteorological week *i.e.*, 4th week of July as 2.25 per cent per 10 hills (Table 1 & Fig. 1). The incidence of *Cnaphalocrocis medinalis* ranged from 2.25 to 11.76 per cent during the course of study. The maximum leaf damage (11.76 %) per 10 hills was recorded in 41st standard meteorological week *i.e.*, in the 1st week of October followed by 10.52 and 9.44 per cent recorded in the 40th and 39th standard meteorological week *i.e.*, 5th and 4th week of September, respectively. Minimum incidence was recorded in 31st standard meteorological week *i.e.*, 4th week of July, respectively. It clearly indicates that the leaf folder incidence gradually increased from 31st to 41st standard meteorological week (SMW). Thereafter declined trend was recorded during the course of the investigation. The correlation was worked out to find out the relationship between the per cent leaf folder incidence and weather parameters like maximum, minimum and average temperature, morning and evening relative humidity and rainfall. The results showed a significant positive correlation with maximum temperature (r= 0.549*) and highly significant negative correlation with rainfall (r= -0.620**) (table 2), respectively. Others parameters showed a non significant positive and negative correlation with the population of leaf folder. From the above experimental findings, it was obvious that the per cent leaf damage by leaf folder was maximum during 1st week of October and minimum during 4th week of July, respectively.

***Kharif* 2017**

The data recorded on the incidence of *C. medinalis* (Linnaeus) was taken as per cent leaf damage per ten hills and initial incidence was observed on 32nd standard meteorological week *i.e.*, 1st week of July as 2.38 per cent per 10 hills (Table 1 & Fig. 1). The incidence of *Cnaphalocrocis medinalis* ranged from 2.38 to 13.20 per cent during the course of study. The maximum leaf damage (13.20 %) per 10 hills was recorded in 38th standard meteorological week *i.e.*, in the 3rd week of September followed by 11.10 and 9.35 per cent recorded in the 39th and 37th standard meteorological week *i.e.*, in the 4th and 2nd week of September, respectively. Minimum incidence of *C. medinalis* recorded in 32nd standard meteorological week *i.e.*, in the 1st week of August, respectively. It clearly indicates that the leaf folder incidence gradually increased from 32nd to 38th standard meteorological week (SMW) *i.e.*, 1st week of August to 3rd week of September, respectively. Thereafter declined trend was recorded during the course of the investigation.

The correlation was worked out to find out the relationship between the per cent leaf folder incidence and weather parameters like maximum, minimum and average temperature, morning and evening relative humidity and rainfall. The results showed a significant positive correlation with maximum temperature (r= 0.534*) and highly significant negative correlation with rainfall (r= -0.580**) and positive non-significant correlation with minimum and average temperature with r= 0.208 and r= 0.344 and negative non-significant correlation with morning, evening and average relative humidity with r= -0.435, -0.134 and -0.198 (Table 2), respectively. From the above experimental findings, it was obvious that the per cent leaf damage by leaf folder was maximum during 3rd week of September and minimum during 1st week of August, respectively.

**Pooled**

The pooled data on seasonal incidence of *C. medinalis* (Lin.) presented in table 1 and graphically depicted in fig. 1 revealed that 1.13 per cent damaged leaves of rice leaf folder was initiated from 4th week of July (31st SMW), which increased further and reached to its peak damage of 10.86 per cent during 3rd week of September (38th SMW). Then after, the percentage of damaged leaves (0.58%) was gradually declined and reached to zero levels at the maturity of the crop (46th SMW).

The present finding is in close conformity with the report of Kumar *et al.* (1996) [8] who recorded the minimum level of infestation in the month of July and in the 3rd and 4th weeks of October and reached a maximum during September followed by August. Further Balasubramani *et al.* (2000) [2] and Patnaik, H. P. (2001) [13] recorded outbreak of the rice leaf folder, *Cnaphalocrocis medinalis*, was observed during August and September, respectively. Kakde and Patel (2015) [6] also reported the peak level of rice leaf folder, *Cnaphalocrocis medinalis* Guenee reached during 4th week of September (39th SMW) was 2.30% under conventional method and 2.66% under SRI method.

**Table 1:** Influence of abiotic factors on seasonal incidence of leaf folder of rice during *Kharif* 2016 & *Kharif* 2017)

| Months and dates | Standard meteorological weeks | Leaf folder (% leaf damage/10 hills) | | |
|---|---|---|---|---|
| | | ***Kharif* 2016** | ***Kharif* 2017** | **Pooled** |
| July 08-14 | 28 | 0.00 | 0.00 | 0.00 |
| 15-21 | 29 | 0.00 | 0.00 | 0.00 |
| 22-28 | 30 | 0.00 | 0.00 | 0.00 |
| 29-04 | 31 | 2.25 | 0.00 | 1.13 |

| | | | | |
|---|---|---|---|---|
| Aug 05-11 | 32 | 3.80 | 2.38 | 3.09 |
| 12-18 | 33 | 5.25 | 4.10 | 4.68 |
| 19-25 | 34 | 6.71 | 5.60 | 6.16 |
| 26-01 | 35 | 7.21 | 7.25 | 7.23 |
| Sep 02-08 | 36 | 6.67 | 8.61 | 7.64 |
| 09-15 | 37 | 7.10 | 9.35 | 8.23 |
| 16-22 | 38 | 8.52 | 13.20 | 10.86 |
| 23-29 | 39 | 9.44 | 11.10 | 10.27 |
| 30-06 | 40 | 10.52 | 8.51 | 9.52 |
| Oct 07-13 | 41 | 11.76 | 7.31 | 9.54 |
| 14-20 | 42 | 5.20 | 6.26 | 5.73 |
| 21-27 | 43 | 3.12 | 5.24 | 4.18 |
| 28-03 | 44 | 0.00 | 4.58 | 2.29 |
| Nov 04-10 | 45 | 0.00 | 3.10 | 1.55 |
| 11-17 | 46 | 0.00 | 1.15 | 0.58 |

**Table 2:** Correlation coefficient of leaf folder population on rice with prevailing weather parameters during *Kharif*- 2016 & 2017.

| Insect pests | years | Weather parameters | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Rainfall (mm) | Temperature ($^0$C) | | | Relative Humidity (%) | | |
| | | | Max. | Min. | Average | Morning | Evening | Average |
| Leaf folder | *Kharif*- 2016 | - 0.620** | 0.549* | 0.427 | 0.430 | 0.186 | 0.362 | 0.313 |
| | *Kharif*- 2017 | -0.580** | 0.534* | 0.208 | 0.344 | -0.435 | -0.134 | -0.198 |

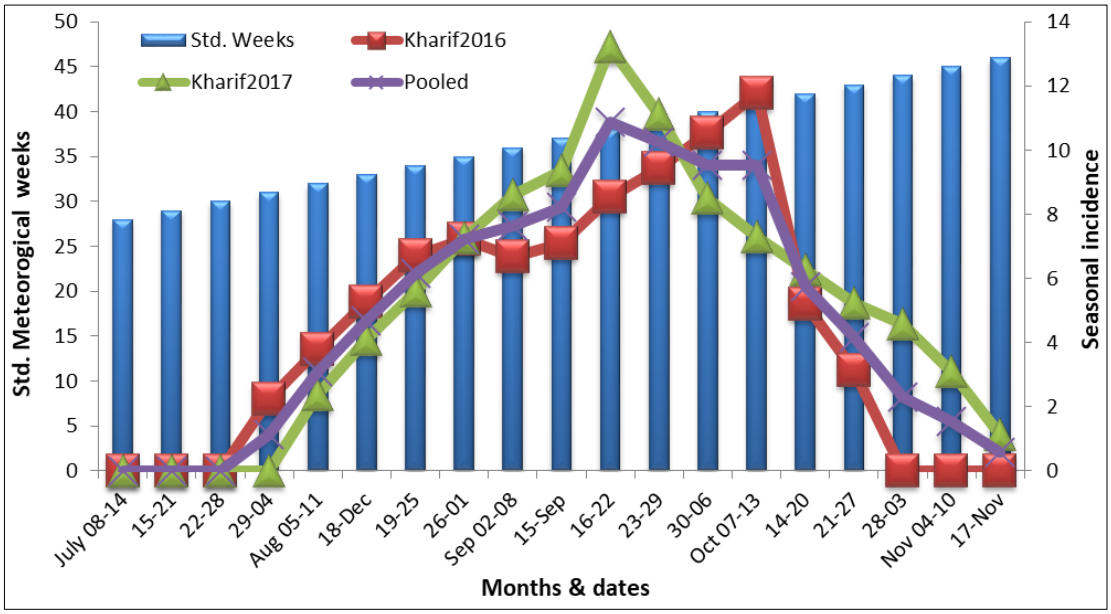


**Fig 1:** Influence of abiotic factors on seasonal incidence of leaf folder of rice during *Kharif* 2016 & *Kharif* 2017

## Conclusion

The incidence of leaf folder infestation initially during 31$^{st}$ standard meteorological week (SMW) with a pooled mean of 1.13 per cent and attained peak during 38$^{th}$ standard meteorological week with 10.86 per cent per 10 hills. Later, the infestation of leaf folder got declined and there was no infestation after 46$^{th}$ SMW till the end of crop season. The correlation between the leaf folder population and abiotic factors was tested. Significant positive correlation with maximum temperature while highly significant negative correlation with rainfall. Others parameters showed a non-significant positive and negative relationship with the population of leaf folder.

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