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# Impact of weather parameters on abundance of major defoliators of soybean

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ABSTRACT

Studies were under taken on seasonal incidence and relationship of weather parameters on major defoliators of soybean during *Kharif* 2014-15 at the College of Agriculture, Nagpur. Incidence of *Spodoptera litura* began during 35th standard week (0.20 ± 0.12) gradually attained maximum (1.80±0.11) during 41st standard week. Multiple regression analysis revealed that decrease in 1per cent of morning relative and evening relative humidity would lead to increase of 0.019 and 0.014 mean number of *Spodoptera* larvae per meter row length. Incidence of *Thysanoplusia orechalsia* began during 35th standard week (0.20 ± 0.15) gradually attained maximum (1.00 ± 0.12) during 42nd standard week. Population was decreased from 43rd standard week onwards, Regression analysis revealed that decrease in 1per cent of morning relative humidity would lead to increase of 0.010 mean number of larvae per meter row length, decrease in $1^0$ C of morning relative humidity would lead to increase of 2.264 per cent foliage damage.

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## INTRODUCTION

Soybean [*Glycine max* (L.) Merrill] is a fascinating crop with innumerable possibilities of not only improving agriculture, but also supporting industries. Soybean is a major source of edible oil (20%) and high quality protein (40%). It is a rich source of amino acids, vitamins and minerals. Soybean is a major oilseed crop of world grown in an area of 113.10 million hectares with production of 283.79 million tones in USA, China, Brazil, Argentina and India. It is an excellent source of protein and oil. The protein quality of soybean is equivalent to that of meat, milk products and eggs. Hence, it is well established fact that soybean is cheap source of protein and edible oil.

Soybean agro ecosystem is being adopted rapidly by farmers of Vidarbha and it becomes second major *Kharif* crop. As a result, many oil industries are established to provide employment in the region. During 2013, national acreage under soybean cultivation was 120.327 lakh ha with an estimated yield of 1079 kg/ha and production of soybean during 2013 was 129.832 lakh MT in India. In Maharashtra area sown under soybean was 38.704 lakh ha and total production was 48.565 lakh ton, with total productivity of 12.55 q/ha during *Kharif*

2013. In Vidarbha during *Kharif* 2013 the area sown under soybean was cultivated on 20.93 lakh ha with total production of 26.62 lakh MT and productivity 11.55 q/ha (Anonymous, 2013).

Three hundred species of insect pests infesting soybean were reported by Singh *et al*. (2000). Of which, blue beetle, grey semilooper, green semilooper and stem fly were major insect pests in Madhya Pradesh.

Abiotic factors impacts on world agriculture, but countries like India are more vulnerable in view of higher demographic pressure on natural resources and poor coping up mechanisms. Thus, pest scenario will help in generation of preventive crop protection measures as one of the best tool in coming decades. Present investigation was carried out to incidence of major defoliators in soybean and its relationship with abiotic factors such as minimum, maximum temperatures, rainfall and relative humidity.

## MATERIAL AND METHODS

A field trial was conducted to know the incidence of major defoliators in unprotected conditions during *Kharif* 2014-2015 in College Agriculture, Nagpur. Ruling cultivar of soybean (JS-335) was selected and crop was allowed for natural incidence without any plant protection measures. Observations were taken from seedling to harvesting stage on number of larvae per meter row length and per cent defoliation. Incidence of insect pests were correlated with weather parameters *viz.*, maximum temperature, minimum temperature, rainfall, morning relative humidity (RH), evening RH and evaporation.

## RESULTS AND DISCUSSION

The findings of the present study as well as relevant discussion have been presented under the following heads:

**Seasonal incidence of *Spodoptera litura* :**

Incidence of *Spodoptera litura* began during 35$^{th}$ standard week (0.20 $\pm$ 0.12) gradually attained maximum (1.80$\pm$0.11) during 41$^{st}$ standard week. Population was decreased from 42$^{nd}$ standard week onwards. Whereas, negligible population was recorded during 46$^{th}$ standard week (0.20±0.13) (Table 1).

**Correlation and regression analysis :**

*Defoliator* (*Spodoptera litura*) :

Incidence of larvae per meter row length revealed negative and highly significant correlation relationship with morning relative humidity (r = -0.735**) and evening relative humidity (r = -0.763**), while, the association was negative and significant correlation relationship with minimum temperature (r= -0.519*) (Table 2). Similarly, a significant positive relationship was noticed with maximum temperature (r=0.455*) and positive non-significant relation with rainfall (r= 0.371) and evaporation

**Table 1: Seasonal incidence of major defoliators in soybean ecosystem**

| Standard week | *Spodoptera litura* | *Thysanoplusia orechalsia* |
|---|---|---|
| (Jul.) 32nd | 0.00 | 0.00 |
| (Aug.) 33rd | 0.00 | 0.00 |
| (Aug.) 34th | 0.00 | 0.00 |
| (Aug.) 35th | 0.20±0.12 | 0.20±0.15 |
| (Sept.) 36th | 0.20±0.19 | 0.20±0.21 |
| (Sept.) 37th | 0.60±0.17 | 0.20±0.21 |
| (Sept.) 38th | 0.80±0.14 | 0.40±0.10 |
| (Sept.) 39th | 1.20±0.12 | 0.60±0.10 |
| (Sept.- Oct.) 40th | 1.40±0.15 | 0.60±0.10 |
| (Oct.) 41th | 1.80± 0.11 | 0.80±0.10 |
| (Oct.) 42th | 1.20±0.16 | 1.00± 0.12 |
| (Oct.) 43th | 1.00±0.14 | 0.80±0.10 |
| (Oct.) 44th | 0.80±0.12 | 0.60±0.10 |
| (Oct.) 45th | 0.60±0.18 | 0.20±0.12 |
| (Oct.) 46 | 0.20±0.13 | 0.20±0.11 |

(r= 0.157) (Table 2).

The multiple linear regression analysis between weather parameters and the larval population showed a value of 0.687 indicating 68.70 per cent influence of incidence of larval population and the multiple regression equation between them is as follows:

$$Y= 3.959-0.019\ X_3\ -0.014\ X_4$$

The results indicated that with decrease in 1 per cent of morning relative and evening relative humidity would lead to increase of 0.019 and 0.014 mean number of larvae per meter row length.

*Seasonal incidence of Thysanoplusia orechalsia* :

Incidence of *Thysanoplusia orechalsia* began during 35th standard week (0.20 ± 0.15) gradually attained maximum (1.00 ± 0.12) during 42nd standard week. Population was decreased from 43rd standard week onwards. Whereas, negligible population was recorded during 46th standard week (0.20±0.11) (Table 1).

**Correlation and regression analysis of Semilooper:**

Larval population per-meter row length was negative and highly significantly correlated with morning relative humidity (r = - 0.666**) and highly significant positive relationship with evening relative humidity (r=0.577**), while, the association was significant negative relationship with minimum temperature (r= -0.487*). Similarly, a significant positive relationship was noticed with maximum temperature (r = 0.524*) whereas, non-significant positive relationship with evaporation (r = 0.318) and negative non-significant relationship with rainfall (r= -0.373) (Table 2).

The value of 0.548 was noticed with multiple linear regression analysis between independent weather parameters and dependent factor larval population, indicating 54.8 per cent influence of morning RH on incidence of number of larvae per meter row length. The multiple regression equation fitted with weather parameters and the semilooper population is as follows:

$$Y=1.872\ -\ 0.010X_3$$

The results indicated that, with a decrease in 1 per cent of morning relative humidity would lead to increase of 0.010 mean number of larvae per meter row length.

*Correlation and regression analysis of per cent foliage damage*:

Per cent foliage damage was negative and highly significantly correlated with evening relative humidity (r = -0.548**) and highly significant positive relationship with morning relative humidity (r= 0.569**), while the association was significant negative relationship with minimum temperature (r= -0.516*). Similarly, a significant positive relationship was noticed with maximum temperature (r = 0.527*) whereas, non-significant positive relationship with evaporation (r= 0.348) and non-significant negative correlation with rainfall (r= 0.362) (Table 2).

The value of 0.546 was noticed with multiple linear regression analysis between independent weather parameters and dependent factor larval population, indicating 54.6 per cent influence of minimum temperature on per cent foliage damage. The multiple regression equation fitted with weather parameters and the defoliation is as follows:

$$Y= 41.385-2.264X_2$$

The results indicated that, with a decrease in 1°C of morning relative humidity would lead to increase of 2.264 per cent foliage damage.

The present findings are in line with Kucharik and Serbin (2008) reported that for each additional degree (°C) of future warming during summer months, soybean yield could potentially decrease by 16 per cent, whereas, if modest increase in total summer precipitation (*i.e.* 50 mm) were to occur yields may be boosted by 5–10 per cent, counteracting a portion of the negative effects associated with increased temperature. Vinaykumar *et al.* (2013) reported that, minimum temperature (r = 0.518) exhibited significantly positive correlation with larval

**Table 2 : Correlation co-efficients for defoliators in soybean crop and abiotic factors in *Kharif* under unprotected condition during 2014-15**

| Defoliators | Max. T ($X_1$) | Min. T ($X_2$) | RHm ($X_3$) | RHe ($X_4$) | RF ($X_5$) | Evaptn ($X_6$) |
|---|---|---|---|---|---|---|
| *Spodoptera litura* | 0.455* | -0.519* | -0.735** | -0.763** | 0.371 | 0.157 |
| *Thysanoplusia orechalsia* | 0.524* | -0.487* | -0.666** | 0.577** | -0.373 | 0.318 |
| Foliage damage (%) | 0.527* | -0.516* | 0.569** | -0.548* | -0.362 | 0.348 |

* and ** indicate significance of values at P=0.05 and 0.01, respectively

population of *S. litura*. Lewin *et al*. (1979) and Logiswaran *et al*. (1982) reached different conclusions concerning the effect of temperature and rainfall. Lewin *et al*. (1979) found temperature positively and rainfall negatively correlated with leafminer incidence while Logiswaran *et al*. (1982) reported significant negatively correlation between maximum and minimum temperature and GLM infestation levels, and no correlation with rainfall.

Wakil *et al*. (2010) conducted a survey in tomato fields at different localities to assess the distribution of tomato fruit worm, *H. armigera* (Lepidoptera: noctuidae) in Punjab province, Pakistan. The effect of weather factor on the population was also investigated. Elevens tomato growing district were selected and data for larval population and fruit infestation were recorded. The maximum larval population (5.20 larvae per plant) of *H. armigera* was recorded in Bahawalpur district with 32.6 per cent fruit infestation. However, the minimum larval population (1.4 larvae per plant) inflicted 14.70 per cent fruit infestation in Rawalpindi district. The temperature was a positively correlated while relative humidity showed negative interaction with the larval population and fruit infestation.

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