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Effect of weather parameters on populations dynamics of tobacco caterpillar (*Spodoptera litura*) for soybean crop in Raipur district of Chhattisgarh

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Abstract
The present study on 'Effect of weather parameters on populations dynamics of tobacco caterpillar (*Spodoptera litura*) for Soybean crop in Raipur district of Chhattisgarh' was conducted during the 2019 *Kharif* season at the Indira Gandhi Krishi Vishwavidyalaya Instructional Research Farm, Raipur Chhattisgarh, to validate the findings of the effect of weather parameters on population dynamics of soybean tobacco caterpillar. Tobacco caterpillar insects often cause soybean crop damage, resulting in significant losses in yield. The purpose of the current study is to establish the effects of these environmental factors on the severity of this insect pest. Such findings may provide reliable methods for identifying environmental conditions that are conducive to the growth of the specific insect pest. Correlation analysis of current insect population data of soybean tobacco caterpillar and weather parameters was carried out. The findings showed that there was a substantial negative correlation between the population of Soybean tobacco caterpillars and the maximum temperature (r = -0.43*), while there was a significant positive correlation between the minimum temperature (r = 0.42*), the morning relative humidity (r = 0.41*) and the evening relative humidity (r = 0.43*). There was a non-significant relationship between rainfall (r= 0.28) and hours of sunshine (r= -0.26). The minimum temperature and relative humidity showed the highest degree of association with the soybean tobacco caterpillar among all the weather parameters.

Keywords: soybean tobacco caterpillar, population dynamic, weather parameter, regression analysis, forewarning

1. Introduction
In world Soybean (*Glycine max* (L.) Merril) has a prominent place among modern agricultural commodities, as the world's most important seed legume, which contributes about 25% to the global edible oil production, about two thirds of the world's protein concentrate for livestock feeding and is a valuable ingredient in formulated feeds for poultry and fish. It is also an important commodity for food manufacturers, pharma industry and many more industrial uses. It is therefore no surprise that global soybean demand is increasing rapidly.

Global production of Soybean continues to increase and a record world production of Soybean is expected this year of 364.33 million tonnes from an area of 127.19 million hectares, an increase of 3.3 per cent and 2.9 per cent, respectively over 2017-18. The increased global Soybean production is mainly due to increase in production in USA, Brazil, China and India, although soybean production is expected to marginally decline in Argentina on weather woes. The global Soybean productivity is also expected to marginally increase from 2854 kg/ha in 2017-18 to 2864 kg/ha in 2018-19. Among the major Soybean growing countries, India ranks fourth in terms of area under Soybean and fifth in terms of production as per AMIS, FAO estimates (Bhatia and Sharma 2018-19) [1].

In Chhattisgarh state, major Soybean growing districts are Rajnandgaon, Durg, Mungeli, Bemetara and Kabirdham. Optimum temperature for germination of Soybean is approximately 30 °C with base temperature of 10 °C (Ghadekar, 2001) [2]. Soybean is one of the classical short day plants and most of its genotypes respond as quantitative short day plant. The variation of photo period sensitivity among Soybean genotypes allows the crop to grow successfully across a wide range of latitudes. Photo period influences the rate of development during pre and post flowering stages.

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Changes in photoperiod and temperature are reported to alter the happening of growth stages, the growth and partitioning of dry matter of this photoperiod and thermo sensitive short day C3 crop.

The management of tobacco caterpillar at their peak time is to be needed for maximization of yield of soybean. Weather plays an important role on the population dynamics and distribution of pests. Temperature, rainfall, relative humidity, sunshine hours and wind speed are the weather parameters influencing the pest incidence. Activity of *Spodoptera litura* in relation to weather factors have been investigated in soybean cropping systems (Prasad *et al*., 2013 and Punithavalli *et al*., 2013) [3, 4]. A location based model for pest forecast in soybean crop is essential for effective integrated pest management strategy. Hence an attempt has been made for five consecutive years to monitor and develop pest forewarning models based on pheromone trap catches of moths and field population (eggs and larvae) that would help farmers in timely management of *S. litura* in soybean crop.

The multiple-pest complex of soybean crop poses serious limitations in the intensification of soybean cultivation in different agro climatic regions of India. Among the defoliators *Spodoptera litura* is one of the important pests that cause huge yield loss. *Spodoptera litura* is an economically important polyphagous insect which is widely distributed throughout Asia (Sundar *et al*. 2015).

2. Materials and Methods
The field experiment was carried out during *kharif* 2019 at College of Agriculture Research Farm, Department of Entomology, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh).

Raipur is situated in the central- eastern part of Chhattisgarh at 22°33' N to 21°14' N latitude and 82°6' to 81°38' E longitude and at an altitude of 298.15 meters from mean sea level. The experiment was conducted at the research farm of IGKV Raipur (CG) during *Kharif* 2019. Soybean tobacco caterpillar (*Spodoptera litura*) was found most active in *kharif* season. The maximum *Spodoptera litura* adult population was daily observation at growing stages of Soybean crop. The pest succession of major insect pests of Soybean was co- related with weather parameters to observe the effect of individual parameters on pest incidence. The observation were taken during the cropping period and recorded the pest population at the time of maximum insect pest occurrence in which the larval population was counted in one meter row length and pest like *Spodoptera litura* was recorded in three leaves (upper, middle and bottom part of the plant) per plant from five randomly selected plants.

For this study daily rainfall, maximum temperature and minimum temperature data were collected from the Department of Agrometeorology IGKV Raipur (Chhattisgarh). Using meteorological data derived indices like day temperature (DT), night temperature (NT), diurnal variation (DV.) and heat sum (HS) were calculated as per Venkataraman and Krishnan (1992) formula which given below-

$$DT = Tmax – 0.4 (Tmax – Tmin)$$
$$NT = Tmin + 0.4 (Tmax – Tmin)$$
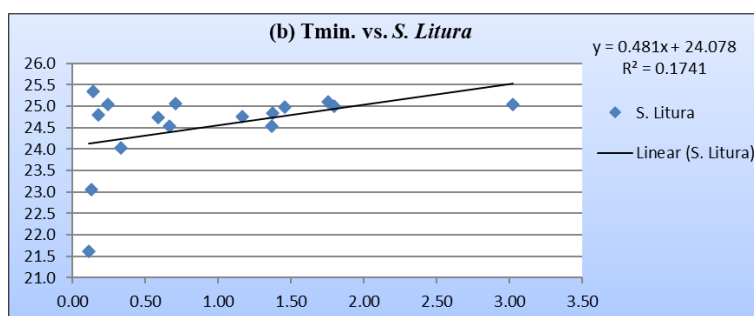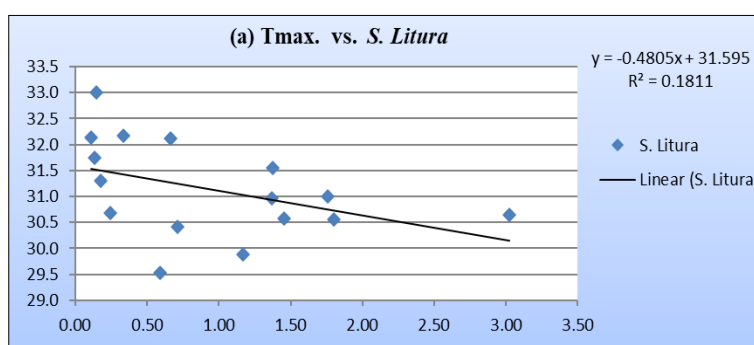$$DV = DT – NT$$

$$HS = \sum \frac{Tmax + Tmin}{2} - \text{Base Temperature}$$

Summarized information on different meteorological parameters was correlated with the insect population. Correlation studies between weather parameters and insect population were made using crop growing period data.

3. Result and Discussion
This statistical analysis revealed negative correlation between Soybean tobacco caterpillar population and maximum temperature (r = -0.43*) while a significant positive correlation with minimum temperature (r = 0.42*), morning relative humidity (r = 0.41*) and evening relative humidity (r = 0.43*) was observed. Non significant relationship with the rainfall (r= 0.28) and sunshine hours (r = -0.26) was observed from this statistics we can conclude that minimum temperature and humid climate is favourable for the moth population to develop and cause significant infestation fig 1. (a-f).
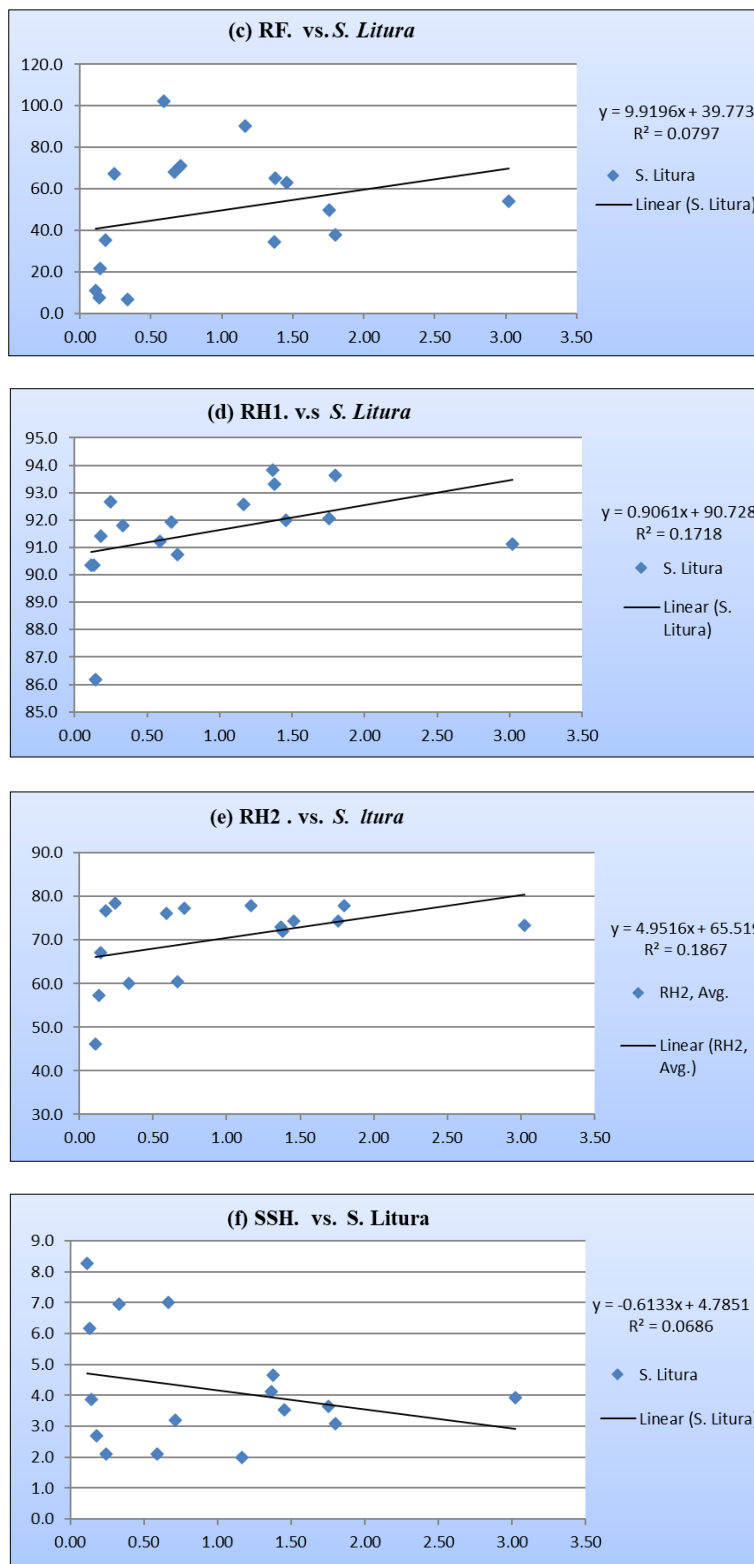

(a) Tmax. vs. *S. Litura*

$y = -0.4805x + 31.595$
$R^2 = 0.1811$

(b) Tmin. vs. *S. Litura*

$y = 0.481x + 24.078$
$R^2 = 0.1741$

Fig 1(a-f): Line chart between average of weather parameter and Soybean tobacco caterpillar population between years 2010 to 2018

4. Conclusions

The population dynamics of soybean tobacco caterpillar for nine consecutive years (2010 to 2018) were correlated, with the weather parameters like maximum temperature and minimum temperature, bright sunshine hours, relative humidity (morning and evening), and rainfall. A correlation coefficient' can be worked out for corresponding, and four previous weeks taken as lag weeks. The significant correlation coefficients can be worked for further examination of relation with weather for soybean tobacco caterpillar under different model. For soybean tobacco caterpillar, a vital

review of the significant coefficient of correlation between the population of soybean tobacco caterpillar and weather variables can be separately worked out. There is favorable effect of increasing morning and evening relative humidity. Increasing minimum temperature and decreasing maximum temperature is also found to be favorable for *S. litura* Lower sunshine duration of 3-4 hours during SMW33 to SMW38 (i.e. mid August to mid September) is found conducive for multiplication of pest.

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