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Impact of density dependent factors on seasonal incidence of *Spodoptera litura* (Fab.) on soybean in Dharwad

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Abstract
Field experiments were conducted at MARS, UAS, Dharwad during *kharif* 2017-18 and 2018-19 on seasonal incidence of *Spodoptera litura* in two different soybean varieties, JS 335 and DSb 21. The crop remained vulnerable to *S. litura* from 31st MSW to 37th MSW which followed an increasing trend from 0.40 to 4.80 larvae per meter row length (mrl) in variety JS 335 during 2017-18. The highest leaf damage of 35.77% were recorded during 37th MSW in JS 335 whereas, it was 28.85% in DSb 21 during the respective MSW. During 2018-19, *S. litura* infestation commenced on 30th MSW in both the varieties which attained peak population during 37th MSW. Correlation studies indicated that a highly significant and positive relationship (r=0.77) between maximum temperature and incidence of *S. litura* during 2017-18 whereas, morning relative humidity showed a significant and negative correlation (r= -0.64) with *S. litura* incidence during 2018-19.

Keywords: Correlation, density dependent factors, dharwad, *Spodoptera litura*

1. Introduction
Soybean [*Glycine max* (L.) Merrill] belonging to family Leguminaceae, sub-family Papilionaceae, is one of an important oilseed cash crop of India. It is a unique crop with high nutritional value, thus it also known as "Miracle bean, Golden bean, and Crop of the planet". It has provided 40% protein, well balanced in essential amino acids; 20% oil, rich in poly unsaturated fats specially Omega 6 and Omega 5 fatty acids; 6-7% total minerals; 5-6% crude fiber and 17-19% carbohydrates [2]. Total area of soybean in India is 10.80 million ha. with production of 12.10 mt in 2018-19 with an average national yield of1120 kg/ha. Soybean occupied 42% of India's total oilseeds and 25% of edible oil production [1]. In Karnataka, the total area of soybean is 3.40 lakh ha. with 3.39 MT production in 2018-19 with an average yield of 1000 kg [1] and it occupies 4th position in both area and production. In Karnataka, the major soybean growing districts are Bidar, Belagavi, Dharwad, Haveri and Bagalkot. The lower productivity of soybean both at national and state level is attributed to abiotic and biotic stresses like drought, weeds, insect pests and diseases. Among these, insect pests often pose a serious threat to soybean production by increasing cost of cultivation and impairing quality of produce in many ways. Soybean crop is reported to be attacked by about 350 species of insects in many parts of the world. About 65 insect pests have been reported to attack soybean crop from cotyledon to harvesting stage [3]. Among them, the defoliator *Spodoptera litura* (Fab.) is one of the important pest cause yield loss. *Spodoptera litura* is an economically important polyphagous insect pest which is widely distributed throughout Asia, causing considerable economic loss to many field, vegetables and fruit crops. Crop loss due to insect varies between 10 to 30 percent for major crops. In case of severe infestation, the entire crop is damaged badly, thus causing 40 percent defoliation of leaf area. It is indicated that climatic changes affect the activity of tobacco caterpillar. Therefore, knowledge of how insect pests respond to density dependent factors *viz.*, weather, temperature, climate variation is of fundamental importance in understanding insect pest management. Keeping these in view, field experiment was conducted to address the importance and impact of density dependent factors on *Spodoptera litura* incidence on soybean crop in Dharwad region.

2. Materials and Methods
Studies on seasonal incidence of *Spodoptera litura* in two soybean varieties JS 335 and DSb

21 spaced at 30 cm x 10 cm was conducted by taking up sowing in the month of July in a plot size of 10 m x 10 m at the Entomology Block, Main Agricultural Research Station (MARS), UAS Dharwad for two consecutive years (2017-18 and 2018-19). All the recommended agronomic practices were followed to grow the crop and the whole plot was exposed to natural infestation wherein no insecticide sprays were taken. Observations on number of larvae per meter row length were taken from ten randomly selected plants per plot at weekly intervals after the appearance of pest till harvesting of the crop. Daily records of maximum and minimum temperature, morning and evening relative humidity and rainfall during the crop growth period were collected from Meteorological observatory, MARS Dharwad. The collected data were subjected to regression analysis [5] to draw inferences on the relationships between weather parameters and the incidence of *Spodoptera litura*. The regression equations were derived by using following formula.

$$\text{Correlation coefficient (r)} = \frac{\Sigma (X - \bar{X})(Y - \bar{Y})}{\sqrt{\Sigma (\bar{X} - X)^2 \Sigma (\bar{Y} - Y)^2}}$$

$$\text{Regression coefficient (b y x)} = \frac{\Sigma (X - \bar{X})(Y - \bar{Y})}{\sqrt{\Sigma (X - \bar{X})^2}}$$

3. Results and Discussion

The results presented in Table 1 revealed that *Spodoptera litura* incidence commenced from 31st Meteorological Standard Week (MSW) and continued up to 42nd MSW during both the years of study *viz.*, 2017-18 and 2018-19. The lowest number of 0.40 larvae per meter row length (mrl) was recorded on 31st MSW during the last week of August in JS 335 which increased gradually and attained a peak of 4.80 larvae per mrl on 37th MSW during the second week of September in the year 2017-18. Similarly in DSb 21, the lowest pest population recorded was 0.20 larvae per mrl on 31st MSW which gradually increased and attained a peak of 4.05 larvae per mrl on 37th MSW. Thus, it indicated that the pest was active from late August to mid-September. However, during the year 2018-19, the incidence of *S. litura* commenced after two weeks after sowing *i.e.* on 30th MSW during the last week of July in varieties JS 335 and DSb 21 during *kharif* season with 0.10 and 0.05 larvae per mrl, respectively. Further, the pest density increased gradually with the age of the crop and attained a peak of 5.10 and 4.20 larvae/mrl, respectively in both the varieties on 37th MSW during second week of September (Table 1). Thus, the pest was active from last week of July to third week of October. In the present study, it was noted that JS 335 was most preferred by the larvae and clearly indicates that it was more susceptible to *S. litura* compared to DSb 21.

The main reason for the activity of this pest during late August to October is it prefers to feed on younger foliage. The continuous availability of preferred food resulted in increased incidence of these larvae until the harvest of the crop, during which it has attained the peak incidence. The present findings are in agreement with the reports wherein estimated population densities of *Spilosoma obliqua* (Walker) and *Spodoptera litura* are in peak number during August to October months [4]. The maximum population of tobacco cutworm (*Spodoptera litura* F.) was 4.72 per plant, which recorded 32.25 percent damage in the crop at 19.97ºc temperature and 75.8 percent relative humidity [12]. The pest activity for ten weeks commencing from the 46th to 3rd standard week with a peak larval density of 23.83 per ten plants during the 52nd standard week with respect to *S. litura* [11].

With regard to leaf damage due to *S. litura* in variety JS 335 in the first year of study, the least leaf damage of 10.87 per cent and the highest of 35.77 per cent were recorded during 31st and 37th MSW, respectively (Table 1). Whereas, in DSb 21 it revealed that least leaf damage (6.54%) was recorded during 31st MSW which gradually increased and attained a peak (28.85%) during 37th MSW. From the results obtained, it was noticed that higher incidence of *S. litura* and leaf damage was recorded during the year 2017-18 in comparison with the data recorded during the year 2018-19. These results are in accordance with the findings wherein the incidence of *S. litura* on soybean from May to September [6]. May sown crop had the minimum leaf damage with very low larval population whereas, the July sown crop had maximum damage to leaves with very high larval population. The highest leaf damage (59.22%) was recorded on variety JS 335 sown during first fortnight of July, at the time of harvest [13]. In confirmation, the highest leaf damage (29.10%) due to *S. litura* was recorded in the month of October in dolichos bean [10]. Similarly, the highest per cent leaf damage of 46.00 per cent in late June sown crop. This clearly depicts that the incidence of *S. litura* commences from August and extends up to October. The July month sown crop suffers maximum leaf damage by *S. litura* larva [8].

The analytical data on correlation coefficient between population of *S. litura* and weather parameters during both the years of study are presented in Table 2. The data indicated that during 2017-18, that the larval population of *S. litura* exhibited a highly significant and positive correlation with maximum temperature (r = 0.77). However, the rest of the weather parameters *viz.*, minimum temperature, morning and evening relative humidity exhibited a non-significant and negative correlation with the *S. litura* incidence. During the year 2018-19, the larval population of *S. litura* exhibited a non-significant positive correlation with maximum temperature (r = 0.47) whereas, a significant negative correlation (r = -0.64) was exhibited by the larval population with morning relative humidity. The rest of the weather parameters exhibited a non-significant and negative correlation with the *S. litura* incidence. The significant and negative correlation which existed between the incidence of *S. litura* and morning relative humidity during 2018-19 throws light upon the fact that lower the morning relative humidity, higher was the incidence of *S. litura*. The lower morning relative humidity which prevailed during August to September months of experiment was favourable for the growth and development of *S. litura* which in turn increased its incidence. The present findings are in line wherein the *S. litura* was negatively correlated with morning vapour pressure and minimum temperature on soybean [14]. The highly significant negative correlation (r=0.97) between incidence of *S. litura* and morning relative humidity [7]. The non-significant negative correlation between incidence of *S. litura* and minimum temperature (r = -0.09171), evening relative humidity (r = -0.03192) and rainfall (r = -0.40056) [9].

4. Conclusion

The tobacco caterpillar, *Spodoptera litura* outbreaks are more

likely to occur in seasons experiencing delayed planting of soybean during late July and due to delay in onset of monsoon, coupled with normal rainy days and rainfall events of >20 mm during July to mid-August. The activity of this pest is higher during late August to October as it prefers to feed on younger foliage. The continuous availability of preferred food and lower morning relative humidity which prevailed during August to September months was favourable for the growth and development of *S. litura* larvae which in turn it has attained the peak incidence in Dharwad region.

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