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Studies on seasonal incidence of leaf eating caterpillar, *Spodoptera litura* (Fab.) infesting capsicum under polyhouse condition

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Abstract
The present investigation was conducted to study the seasonal incidence of leaf eating caterpillar, *Spodoptera litura* infesting capsicum under polyhouse condition indicated that 0.67 moths per trap was first noticed in 27 MW and then it gradually increased to 7.67 moths per trap in 38 MW and finally declined to 0.5 moths per trap in 48 MW. While larval population of *S. litura* was noticed from 29 to 49 MW; which was ranged from 0.17 to 9.12 larvae per plant. The peak larval incidence was noticed during 39 MW; which was then gradually declined at 49 MW. The meteorological parameters T_{max}, T_{min}, RH-I and RH-II as 30.2 ºC, 20.8 ºC, 87% and 56%, respectively, prevailed during previous week *i. e* 38 MW appeared to be congenial for the multiplication of leaf eating caterpillar recorded in 39 MW. The per cent fruit damage ranged from 3.14 to 38.10, however, maximum and minimum per cent fruit damage recorded in 40 and 49 MWs, respectively.
Correlation of weather parameters with *S. litura* infestation on capsicum revealed that maximum temperature and morning relative humidity had positive correlation with moth population and fruit infestation by this pest. On the contrary minimum temperature and evening relative humidity had negative correlation with the pest; while larval population of *S. litura* had positively significant correlation with maximum temperature and evening relative humidity.

Keywords: Capsicum, *S. litura*, seasonal incidence, weather parameters, correlation

1. Introduction
Capsicum (*Capsicum annum* L.) is an important spice and vegetable crop from family Solanaceae and origin from the Central America and is now cultivated worldwide. It is also called as hot pepper, sweet pepper, bell pepper and Shimla mirchi etc. (Baikar and Naik, 2016) [1]. It is rich in vitamins A, C, E and alkaloids like oleroresin and capsanthin. Fruit of capsicum mainly used as impart pungency to food. The seeds contain traces of starch, which are used as ingredient of certain medicines. Oleoresins present in capsicum is active constituents for providing characteristic pungency, flavour, and aroma have number of uses in capsaicin industries as well as in meat seasoning and other food industries (Guru and Patil., 2018) [2]. Worldwide it is cultivated in an area of 15 lakh ha with 70 lakh t of productivity (Vijayalakshmi *et al.*, 2016) [3]. India is the world leader in capsicum production followed by China and Pakistan. The major capsicum exporting countries with their percentage share in world exports are India (25%), China (24%), Spain (17%), Mexico (8%), Pakistan (7.2%), Morocco (7%) and Turkey (4.5%) (Gopal *et al.*, 2018) [4]. The area under capsicum cultivation is about 0.96 million hectares with annual production of 1.05 million tons in India (Sreenivas *et al*., 2008) [5]. Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Maharashtra are the major capsicum producing states in the country. In Maharashtra, the crop is mainly grown in Nagpur, Chandrapur, Dhule, Nanded, Pune, Kolhapur and Amaravati districts (Guru and Patil., 2018) [2] leaf eating caterpillar, (*Spodoptera litura* Fab.) are very important, causing maximum damage to capsicum crop (Shreenivas *et al*., 2008) [5].
Leaf eating caterpillar, *S. litura* (Fab) (Lepidoptera: Noctuidae) is a polyphagous insect pest of national importance causing economic damage to a number of agricultural crops and about 40-50% yield loss was reported by (Vijayalaxmi *et al.*, 2016) [3]. The young larvae of *S. litura* feed gregariously for few days on green material of leaf and skeletonize it, then disperse to feed individually. Larva feeds on leaves by making big holes. Fruits are also bored by this pest. They are voracious feeders and are reported to cause damage in all stages of crop growth (Sharma and Sharma, 2018) [6].

The habit of larvae is to hide under the plants, cracks and crevices of soil debris during the day time and feeds during night hours. The life cycle completes on average of 25 days (Natikar and Balikai., 2017) [7].

Environmental factors play an important role in determining the seasonal abundance and damage caused by the insect pest. Hence, it is necessary to study the influence of various abiotic factors effecting the population fluctuation of capsicum pests. These studies would give an idea about the peak period of their activity which in turn may be helpful in developing better pest management strategies (Reddy *et al*., 2017) [8]. The study on the influence of various factors responsible for population fluctuation on a particular crop might help in the prediction of its incidence in the particular area and further, it will be helpful for successful pest management (Havanoor and Rafee, 2018) [9]**.** Therefore, the present experiment carried out to study relationship between *S. litura* and weather parameters under polyhouse condition for further management of *S. litura* infestation.

2. Materials and Methods

An experiment on seasonal incidence of leaf eating caterpillar, *S. litura* infesting capsicum under polyhouse condition was carried out at High Tech Floriculture and Vegetable Project, College of Agriculture, Pune-411 005, Maharashtra during *kharif* 2018. All the recommended agronomical practices were followed from time to time to raise good crop. No plant protection measures were taken throughout the crop season. Observations on the incidence of leaf eating caterpillar, *S. litura* were recorded at weekly interval in the morning hours between 6-7 am starting from initial appearance to final disappearance or up to the harvest of the crop regularly from 15 randomly selected and tagged plants. The population of *S. litura* were counted as number of larvae per plant, fruits in terms of per cent damage per plant and expressed accordance with meteorological weeks. The pest population fluctuates with climatic conditions hence, the studies on seasonal incidence of pest was undertaken to ascertain the peak and lean periods of pest activity under polyhouse condition on bell pepper to determine the appropriate time to undertake the control measures. These studies were undertaken during 26th June to 8th December 2018 on bell pepper grown under polyhouse conditions.

Pheromone traps were used for monitoring moths. Pheromone-lures were replaced every three weeks in respective traps. Moths were collected weekly from each trap early in the morning during the study period. Caterpillars were monitored for by visual inspection *viz*., chewing damage, dark faecal pellets (frass) on chewed plants and on media beneath the plant was done for caterpillars by randomly selected leaves, growth terminals and also on entire plants. Observations on number of larvae were recorded on five randomly selected plants from each plot. The plants were examined thoroughly and absolute population of larvae was recorded at weekly interval (Patel and Koshiya, 1997) [10]. The data on larval and moth population of *S. litura* and per cent fruit infestation due to leaf eating caterpillar were correlated with meteorological parameters like temperature and relative humidity during the experimental period under polyhouse condition.

3. Results

3.1 Seasonal incidence of *S. litura*

Table 1: Seasonal incidence of leaf eating caterpillar, *S. litura* on capsicum under polyhouse Condition

Month 2018	MW	Moths/trap*	Larvae/plant*	Fruit infestation (%)*
June	26	0	0	0
July	27	0.67	0	0
	28	1.33	0	0
	29	2.33	0.17	0
	30	2.50	0.85	3.17
	31	3.00	0.98	6.22
August	32	4.33	1.36	12.12
	33	4.80	1.50	14.30
	34	5.10	2.56	14.78
	35	5.48	3.40	16.42
September	36	6.00	4.28	18.17
	37	6.40	5.94	24.86
	38	7.67	7.56	29.30
	39	5.33	9.12	35.69
October	40	4.20	7.61	38.10
	41	4.00	5.78	33.11
	42	3.33	3.83	26.15
	43	3.00	3.06	22.63
	44	2.58	2.94	20.97
November	45	2.33	1.61	20.46
	46	2.08	1.54	18.70
	47	1.50	1.33	14.61
	48	0.50	0.49	11.16
December	49	0	0.17	3.14
	SE(m)±	0.09	0.16	0.18
	CD at 5%	0.28	0.43	0.32
	CV	5.86	6.12	10.12

*Averages of observations recorded on 15 plants

During experimental period, 0.67 *S. litura* moths per trap was first noticed in 27 MW and then it gradually increased to 7.67 moths per trap in 38 MW and finally declined to 0.5 moth per trap in 48 MW. While the larval population of *S. litura* was

noticed from 29 to 49 MW; which was ranged from 0.17 to 9.12 larvae per plant. The peak incidence was notice during 39 MW; which was then gradually declined at 49 MW. The per cent fruit damage was ranged from 3.14 to 38.10, however, the maximum and minimum per cent infestation was recorded in the 40 and 49 MW, respectively and presented in table 1.

3.2 Correlation between incidence of *S. litura* and weather parameters

Table 2: Correlation between *S. litura* and weather parameters

Coefficient of correlation (r)				
Weather parameters		**Moths/trap**	**Larvae/plant**	**Fruit Damage (%)**
Temperature (ºC)	T_{max}	0.30	0.30	0.34
	T_{min}	-0.89**	-0.30	-0.36
Relative humidity (%)	RH-I	0.42	-0.45*	0.48*
	RH-II	-0.22	0.48*	-0.52*

* Significant at 5 per cent level of significance
** Significant at 1 per cent level of significance

The data on correlation coefficient between pest and weather parameters are presented in Table 2. It could be seen that larval population was found significantly negatively correlated with T_{min} (r= -0.30) and RH-I (r = -0.45); while significantly positively correlated with T_{max} (r = 0.30) and RH-II (r= 0.48). However, number of trapped moth had showed highly significant negative correlation with T_{min} (r = -0.89), RH-II (r= -0.22) and positive correlation with T_{max} (r = 0.30), RH-I (r=0.42). The fruit infestation showed negative correlation with T_{min} (r = -0.36) and RH-II (r = -0.52); while positively correlated with T_{max} (r= 0.33) and RH-I (r= 0.48).

4. Discussion

Present experiment which were carried out to study seasonal incidence of *S. litura* infesting capsicum under polyhouse condition reported that the highest moth population of *S.litura* observed in 38 MW ; while, larval population observed at 39 MW.

Correlation between moth population of *S. litura* and weather factors showed larval population was found significantly negatively correlated with T_{min} and RH-I; while significantly positively correlated with T_{max} and. However, number of trapped moth had showed highly significant negative correlation with T_{min} and RH-II and positive correlation with T_{max} and RH-I The fruit infestation showed negative correlation with T_{min} and RH-II; while positively correlated with T_{max} and RH-I.

Present finding are in accordance with (Nadaf and Kulkarni, 2006) [11] who stated that peak incidence larvae of *S. litura* larvae which was observed during first fortnight of October. Larval population ranged from 0.162 to 0.573 larvae per plant. Relation between larvae of *S. litura* and weather parameters was highly significant with minimum temperature (r = 0.863**). The per cent fruit damage by fruit borers was maximum (31.66%) during second picking whereas, minimum during fourth picking (27.66%). (Ahir *et al*., 2017) [12] observed that the incidence of tobacco caterpillar (0.20 caterpillar/plant) appeared in 2nd week of September (37th MW). The population of tobacco caterpillar, *S. litura* slowly increased and reached to its peak in the 2nd week of October (41 MW) with a mean of 1.40 caterpillar per plant, when the mean atmosphere temperature and relative humidity were 26.25 °C and 56.50 per cent, respectively. Thereafter, the population declined gradually and reached to a minimum level of 0.40 per plant during 4th week of October (43 MW). (Pathipathi *et al*., 2014) [13] studied that the population of *S. litura* showed significant negative correlation with maximum and maximum temperature (T_{max} r = -0.303 r = -0.158 and positive correlation with minimum temperature (T_{min} r = 0.519, r = 0.546. (Roopa and Kumar, 2014) [14] The population of *S. litura* exhibited a negative correlation with incidence of fruit borer and maximum temp (-0.67**), minimum temperature (-0.64**) and morning RH (-0.23) whereas, positive correlation was observed with the evening RH (0.31).

5. Conclusion

The moth population of *S. litura* 0.67 per trap was first noticed in 27 MW and then it gradually increased to 7.67 moths per trap in 38 MW and finally declined to 0.5 moths per trap in 48 MW. Larval population of *S. litura* was observed from 29 to 49 MW; which was ranged from 0.17 to 9.12 larvae per plant. However, the peak incidence was found during 39 MW; which was then gradually declined at 49 MW. The per cent fruit damage was ranged from 3.17 to 38.10 in different weeks, however, the maximum fruit damage was recorded in 40 MW and minimum in 49 MW. Correlation of leaf eating caterpillar, *S. litura* with meteorological parameters indicated that larval population showed negative correlation with minimum temperature and morning humidity; while positive correlation with maximum temperature and evening relative humidity. However, moth population and per cent fruit damage showed negative correlation with minimum temperature and evening relative humidity; while positive correlated with maximum temperature and morning relative humidity.

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