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Short Communication

Agrometeorological determinants of population dynamics of semilooper, *Trichoplusia ni* (Hubner) and cabbage butterfly, *Pieris brassicae*

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Insect-pests population in any crop is determined by prevailing weather parameters as they determined growth as well as reproduction of insect-pests. Cabbage (*Brassica oleracea* var. *capitata*) a member of *Brassicaceae* family, is an important edible cole crop grown throughout the India. It contains protein, minerals, vitamins, amino acids, essential fatty acids and dietary fibers. It is one of the best natural antioxidant and sources of vitamin C. In the local farming system, cabbage is usually part of a diversified cropping pattern and mostly grown as a cash crop for local market (Macharia *et al*., 2005). Cabbage is grown in winter month arranging from end of December to 1st week of April. This period is marked with considerably variations in day and night temperature as well as photoperiod. A major constraint in the production of cabbage is the damage of insect-pests. Insect-pests are reducing 40 per cent of the total attainable yield of vegetables and nearly 60-80 per cent on an average yield loss in crucifer crops. The important insect-pests that infest cabbage crop are the tobacco caterpillar, diamond back moth, cabbage semilooper, painted bug, cabbage butterfly, flea beetle, cabbage aphid, cabbage leaf webber and the mustard saw fly (Ahuja *et al.,* 2012). The cabbage semilooper is a cosmopolitan insect that causes damage in more than 160 species of plants (Sutherland and Greene, 1984). Cabbage butterfly alone causes 40 per cent yield loss annually in India (Hasan and Ansari, 2010) in cruciferous vegetables. This transition in meteorological parameters coincides with one of the other phases of insect-pests etiology like oviposition, hatching, larval, pupal and adult longevity. Likewise, these agrometeorological parameters coincide with growth and development in cabbage crops. Tri part type interaction between agrometeorological parameters growth stages in insect-pests and host plant physiology and resistance determine the population dynamics. In view of these facts the study was conducted on corollary between agrometeorological parameters and insect-pests growth as well as population dynamics and crop variety 'Golden acre' in cabbage as a host plant. This study deals with association between weather parameters and insect-pests dynamics.

The field experiment was conducted at Experimental Area, Department of Entomology, CCS Haryana Agricultural University, Hisar, during the '*rabi*' season of 2017-18 and 2018-19. Cabbage seedlings of variety 'Golden Acre' were transplanted in end of December in 100 m^2 area by adopting 60× 45 cm spacing. The area was divided into four quadrates each of size 5m × 5m. All the recommended agronomic practices were followed to raise the healthy cabbage crop. The experiment excluded all kind of insecticidal treatment on any growth stage of crop for avoiding the disturbance in natural habitat of insect-pests. The population of semilooper, *Trichoplusia ni* and cabbage butterfly, *Pieris brassicae* was recorded by counting the number of larvae on whole plant by adopting the direct visual count method. All the open leaves and heads of the selected plants were observed thoroughly and count the number of larvae per plant. Only larval stage of both pests was considered and the observations were recorded at vegetative stage (28 DAT) till harvesting stage of cabbage. Plants were tagged for further observations. The observations were recorded from five randomly selected plants and subsequent observations were recorded at weekly interval. The data on important weather parameters *viz.,* maximum temperature, minimum temperature, relative humidity (both morning and evening), wind speed, sunshine hours and rainfall were obtained from the Agrometeorological Observatory, CCS Haryana Agricultural University, Hisar. The population of semilooper and cabbage butterfly on cabbage crop was correlated with different weather parameters in both the years. In addition to correlation, regression coefficients for environmental parameters were also estimated by multiple linear-regressions. Correlation of population fluctuations of insect-pests with different meteorological parameters was worked out and multiple linear-regressions were determined by using SPSS 20.0 version.

The correlation coefficient between larval population

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Table 1: Correlation coefficient between larval population of semilooper, *Trichoplusia ni* and the weather parameters

Abiotic factors	Larval population of semilooper	
	2017-18	2018-19
Maximum temperature (ºC)	0.92*	0.92*
Minimum temperature (ºC)	0.85*	0.79*
Relative humidity morning (%)	-0.81*	-0.86*
Relative humidity evening (%)	-0.88*	-0.92*
Wind speed (kmph)	0.25NS	-0.47 NS
Sunshine (hrs)	0.56NS	0.89*
Rainfall (mm)	-0.63NS	-0.12NS

*Significant at 5 per cent level

Table 2: Correlation coefficient between larval population of cabbage butterfly, *Pieris brassicae* and the weather parameters

Abiotic factors	Larval population of cabbage butterfly	
	2017-18	2018-19
Maximum temperature (ºC)	0.08NS	0.04 NS
Minimum temperature (ºC)	-0.39NS	-0.04 NS
Relative humidity morning (%)	0.13NS	0.09 NS
Relative humidity evening (%)	-0.35NS	-0.06 NS
Wind speed (kmph)	-0.27NS	-0.43NS
Sunshine (hrs)	0.83*	-0.11 NS
Rainfall (mm)	0.33NS	0.42NS

*Significant at 5 per cent level

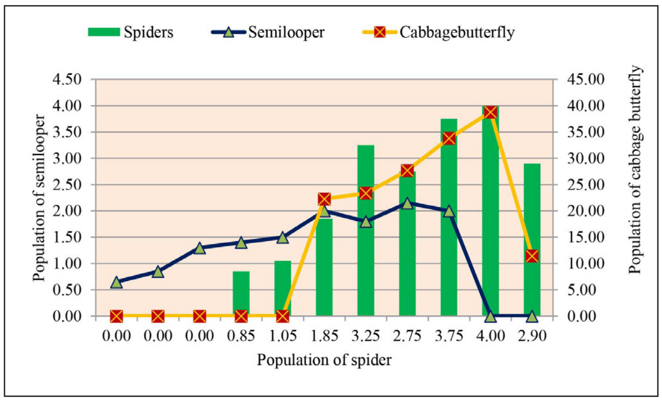

Fig. 1: Population of spiders in relation to lepidopteran pests (Semilooper and cabbage butterfly)

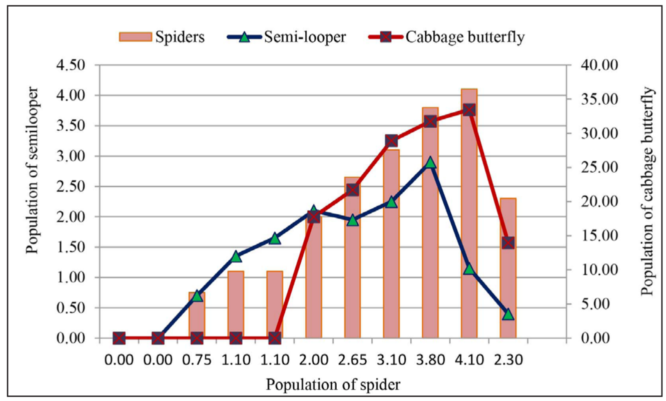

Fig. 2: Population of spiders in relation to lepidopteran pests (Semilooper and cabbage butterfly)

of semilooper and abiotic factors revealed that the maximum (r= 0.92) and minimum temperature (r= 0.85) had significantly positive correlation with larval population (Table 1) during 2017-18. Morning (r = -0.81) and evening (r = -0.88) relative humidity had negative influence on the population buildup of the pest. During 2018-19, larval population of semilooper had a positive and significant correlation (Table 2) with maximum temperature (r= 0.92), minimum temperature (r= 0.79) and sunshine hours (r= 0.89) whereas, negative but significant correlation with morning (r=-0.86) and evening relative humidity (r=-0.92). The present findings are in contrast with the results obtained by Jat *et al.* (2017) they found that the population of cabbage semilooper exhibited a negative correlation with mean temperature and positive correlation with mean relative humidity during '*rabi'* season of 2012-13 and 2013-14. Similarly Nale *et al.* (2016) reported that the morning relative humidity (r=-0.22) and bright sunshine hours (r=-0.159) were negative and significantly correlated with population of semilooper.

In 2017-18, the population of cabbage butterfly commenced from 9th SMW (First week of March) with an average population of 22.26 larvae/plant while the maximum population was recorded in 13th SMW (First week of April) with an average population of 38.80 larvae/plant. The incidence of cabbage butterfly was recorded in 9th SMW (1st week of March) with a mean population of 17.75 larvae/plant. The larval population of cabbage butterfly increased gradually and reached its peak with a mean population of 33.45 larvae/plant in the 13th SMW (1st week of April). After attaining the peak the population of cabbage butterfly started declining. Afterwards, the crop became mature and ready to harvest. Similarly, Jainulabdeen and Prasad (2004) reported that *P. brassicae* appeared in the 9th standard week and reached its peak in the 11th standard week (3rd week of March) and thereafter, the population declined but pest remained in the field till 13th standard week. According to Palande *et al.* (2004) the pest was active during February to April and later on, the pest population declined. Similarly, Singh and Sandhu (2016) reported that on the super late crop, the larvae were first recorded during 8th WAT, with peak larval population (9.50 larvae/plant) during 13th WAT (April, 5).The correlation coefficient studies indicated that the larval population of cabbage butterfly had a positive and significant correlation with sunshine hours in 2017-18. In 2018-19, no significant correlation was found between the population of cabbage butterfly larvae and different weather parameters (Table 2). Jainulabdeen and Prasad (2004) also reported that population of cabbage butterfly was non-significantly and negatively correlated with different weather parameters but sunshine hours showed non-significant positive correlation with population of cabbage butterfly. On contrary, Venkateswarlu *et al.*, (2011) reported that maximum temperature (r=0.43), minimum temperature (r=0.35), rainfall (r= 0.36), sunshine hours (r = 0.67) and evaporation (r = 0.51) had significant positive influence on the cabbage butterfly caterpillars. Kumar *et al.,* (2022) and Moanaro and Jaipal (2016) reported that a strong significant positive correlation existed between the

Table 3: Regression equation of larval population of semilooper, *Trichoplusia ni* with different weather parameters

Year	Regression Equation	R^2 value
2017-18	$Y= 49.908- 2.488\ x_1 + 2.431\ x_2 - 0.169\ x_3 - 0.132\ x_4 – 1.302\ x_5 + 2.914\ x_6 – 1.535\ x_7$	0.87
2018-19	$Y= -14.596 + 0.305\ x_1 - 0.118\ x_2 + 0.121\ x_3 - 0.029\ x_4 + 0.309\ x_5 – 0.139 + 0.2303\ x_7$	0.84

Y= Larval population of semilooper, x_1= Temperature (max.), x_2= Temperature (min.), x_3=Relative humidity (morning), x_4=Relative humidity (evening), x_5= Wind speed (Km/hr), x_6= Sunshine (hrs) and x_7= Rainfall (mm)

number of thrips and maximum temperature, whereas, significant negative correlation between thrips population and rainfall.

Major natural enemies of cabbage insect-pests *viz.,* coccinellids, syrphid fly and spiders are predacious in nature. Among them spider was found associated with the larval population of semilooper and cabbage butterfly. Spiders are general predator and are found in terrestrial agro-ecosystem abundantly. The correlation studies as presented in Fig. 1 & 2 indicated that the population of semilooper and cabbage butterfly had positive and significant correlation with the population of spiders during 2017-18 (r= 0.90 and 0.90) and 2018-19 (r= 0.88 and 0.97), respectively. Population buildup of spiders was increased as the population of respective insect-pests increased. Similarly, Basit *et al.* (2016) found that among natural enemies, spiders were observed during the whole crop season. Their maximum population of 3.54 spiders/plant was recorded during 4th week of April in 2008 and 2009.

The multiple regression analysis between larval population of semilooper and weather parameters (Table 3) indicated that all the weather parameters collectively accounted for 87 per cent variability in larval population of semilooper in 2017-18 and 84 per cent in 2018-19, respectively. Nale *et al.* (2016) reported that the weather parameters contributed 94.28 per cent of total variation in the population of cabbage semilooper on cabbage.

From the data of two years studies it is concluded that the peak population of semilooper and cabbage butterfly was recorded in 11th SMW and in 13th SMW, respectively in 2017-18 whereas, 12th and 13th in 2018-19, respectively. The larval population of semi looper had positive and significant correlation with maximum and minimum temperature and significantly negative correlation with morning and evening relative humidity in both years. All the weather parameters collectively explained 87 per cent variability in larval population of semilooper in 2017-18 and 84 per cent in 2018-19, respectively. The larval population of cabbage butterfly had no significant correlation with the different weather parameters.

Conflict of Interest Statement: The author (s) declares (s) that there is no conflict of interest.

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