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Seasonal incidence of major pests of cabbage in Nalanda district of Bihar

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Abstract
The highest population of Cabbage Butterfly was noticed in last week of February in Rabi season of 2019. Maximum infestation of Diamond back Moth was observed in first week of April. Maximum population of Tobacco leaf eating caterpillar was recorded in third week of February. Infestation of Cabbage Head borer was highest in first week of April. Minimum temperature, Moring relative humidity and Rainfall showed significantly positive correlation with the population of cabbage butterfly, Diamond back moth and Tobacco caterpillar, where as Maximum temperature and Bright sunshine hours showed non-significantly negative correlation with the above three pests of cabbage. Morning relative humidity, rainfall and bright sunshine hours showed significantly positive correlation with the population of cabbage head borer.

Keywords: Cabbage, population, diamond back moth, minimum temperature, bright sunshine hours, morning relative humidity

Introduction
A general view of the pest problem of cabbage in India reveals that this crop is attacked by number of Insect pests *viz*, cabbage butterfly (*Pieris brassicae* Linn.), Diamond-back Moth (*Plutella xylostella* Linn.), Tobacco leaf eating caterpillar (*Spodotera litura* Fab.) and Cabbage head borer (*Hellula undalis* Fab.) Out of these pests, Diamond-back Moth (*Plutella xylostella* Linn.) is considered to be the most destructive. Mushtaque and Mohyuddin (1984) [1] recorded the highest infestation of cabbage butterfly in July. Rai *et al.* (1985) [2] recorded the appearance of the pest in March which continued inflicting severe damage to the cruciferous plants till December in the hills of Uttar Pradesh. Sachan and Gangwar (1990) [3] found that the cabbage butterfly was found to be the major pest present throughout the year having maximum activity during February to October. The diamond back Moth attack was first noticed in the second week of 2005 (0.46 larvae per plant) when the maximum and minimum temperature, morning and evening relative humidity, rainfall and sunshine were 18.8 and 5.8˚C, 96 and 60 percent, 0.50 mm and 5.4 hours respectively. Sachan and Srivastava (1972) [4] reported that the diamond back moth incidence commences from September and gradually increases up to January reaching it's peak by February. It remains high until middle of March and starts declining thereafter. In present studies an attempt was made to study the infestation level of different pests of cabbage in different meteorological weeks in Rabi season of 2019.

Materials and Methods
The experiment was laid out in unprotected plot size 5.0 x 5.0 M. in Rabi season of 2019 at the Research Farm of Nalanda College of Horticulture, Noorsarai (Nalanda). The experimental land was ploughed once and harrowed twice before transplanting the seedlings. Cabbage seedlings of variety, NS-22 (F_1 Hybrid) were grown in raised beds in the field. The healthy and vigorous seedlings of 30 days old were transplanted in the main field. Transplanting was done on the flat beds with 50 x 45 cm spacing on 10-01-2020.Protective irrigation was given immediately after transplanting. Thinning and gap filling of seedlings was done within a week of transplanting.
Population of Cabbage butterfly, Diamond back moth, Tobacco leaf eating caterpillar and Cabbage head borer per plant was recorded at weekly interval since transplanting.

Results and Discussion
The observations of different pests of cabbage were recorded and are presented in Table 1. The data revealed that the highest population of cabbage butterfly was noticed in last week of February (08th meteorological week).

Maximum infestation of Diamond Back moth was observed in first week of April (14th meteorological week). The incidence of Tobacco leaf eating caterpillar was highest in third week of February (07th meteorological week). Maximum population of Cabbage head borer was recorded in first week of April (14th meteorological week).

The relation between weather parameters and percent incidence of different pests of cabbage was studied, path analysis was performed to the correlation. Combined effects as well as direct and indirect effects of weather parameters on incidence of different pests of cabbage during Rabi seasons of 2019 were worked out. The results of direct-indirect effects and correlation between insect pests and abiotic factors in Cabbage are present in Table 2. It is observed from the data that Minimum temperature, Morning relative humidity and Rainfall showed significantly positive correlation with the population of Cabbage butterfly, Diamond back moth and Tobacco caterpillar, where as Maximum temperature and Bright sunshine hours showed non-significantly negative correlation with the above three pests of cabbage. Morning relative humidity, rainfall and bright sunshine hours showed significantly positive correlation with the population of cabbage head borer. These results are in confirmation with those obtained by Mohan (1994) [5] who found that Diamond back moth was prevalent from December to May with its peak activity during April in Nilgiri hills of Tamil Nadu.

Table 1: Population dynamics of different pests of cabbage in Rabi Season 2019

Obs. No.	Date of obs.	Meteo weeks	Cabbage butterfly/ plant	Diamond back Moth/ plant	Tobacco caterpillar/ plant	Cabbage Head borer/ plant
01.	03.02. 2020	05	0.00 (0.70)	0.00 (0.70)	0.82 (1.14)	0.00 (0.70)
02.	10.02. 2020	06	1.08 (1.25)	0.00 (0.70)	1.22 (1.31)	0.00 (0.70)
03.	17.02. 2020	07	1.20 (1.30)	0.00 (0.70)	**1.84 (1.52)**	0.00 (0.70)
04.	24.02. 2020	08	**1.84 (1.52)**	0.78 (1.13)	1.36 (1.36)	0.00 (0.70)
05.	02.03. 2020	09	0.96 (1.20)	1.47 (1.40)	0.54 (1.01)	0.25 (0.86)
06.	09.03. 2020	10	0.20 (0.83)	1.96 (1.56)	0.12 (0.78)	0.75 (1.11)
07.	16.03. 2020	11	0.00 (0.70)	2.82 (1.82)	0.00 (0.70)	0.94 (1.20)
08.	23.03. 2020	12	0.00 (0.70)	3.70 (2.04)	0.00 (0.70)	1.24 (1.31)
09.	30.03. 2020	13	0.00 (0.70)	3.96 (2.11)	0.00 (0.70)	1.72 (1.48)
10.	06.04. 2020	14	0.00 (0.70)	**4.32 (2.19)**	0.00 (0.70)	**2.40 (1.70)**
11.	13.04. 2020	15	0.00 (0.70)	2.28 (1.66)	0.00 (0.70)	1.90 (1.54)
12.	20.04. 2020	16	0.00 (0.70)	0.36 (0.92)	0.00 (0.70)	0.14 (0.80)
13.	27.04. 2020	17	0.00 (0.70)	0.10 (0.77)	0.00 (0.70)	0.10 (0.77)
The average population throughout season.	--		(0.40)	(1.67)	(0.45)	(0.72)

Table 2: Combined direct and indirect effect of the abiotic factors on the population of different pests of cabbage in Rabi Season 2019

Abiotic Factor	Temperature		% RH		Rain fall (mm)	Wind Speed (Km/hr.)	Bright Sunshine hrs.
	Max.	Min.	Mor.	Even.			
Cabbage butterfly	-0.189	0.561*	0.553*	0.468*	0.500*	0.146	-0.436
Diamond back Moth	-0.094	0.415*	0.526*	0.264	0.433*	-0.145	-0.069
Tobacco catterpillar	-0.179	0.438*	0.483*	0.262	0.324*	0.329*	-0.231
Cabbage Head borer	0.128	0.034	0.439*	0.007	0.501*	-0.310	0.417*

* Significant at 5 per cent level.

Conclusion

The highest population of Cabbage Butterfly was noticed in last week of February in Rabi season of 2019. Maximum infestation of Diamond back Moth was observed in first week of April. Maximum population of Tobacco leaf eating caterpillar was recorded in third week of February. Infestation of Cabbage Head borer was highest in first week of April. Minimum temperature, Moring relative humidity and Rainfall showed significantly positive correlation with the population of cabbage butterfly, Diamond back moth and Tobacco caterpillar, where as Maximum temperature and Bright sunshine hours showed non-significantly negative correlation with the above three pests of cabbage. Morning relative humidity, rainfall and bright sunshine hours showed significantly positive correlation with the population of cabbage head borer.

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