Surveillance of pea leaf miner (*P. horticola*) infesting pea (*Pisum sativum*) in relation with abiotic factors

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ABSTRACT

To study the seasonal incidence of insect pests of pea (*P. sativum*) the investigation was carried out during *Rabi* session of 2016-17 and 2017-18, at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The incidence of pests infesting pea was recorded from 50th SMW to 11th SMW. During the observation it was found that *P. horticola* showed its appearance in the field from 1st to 11th SMW with peak population (71% leaf infestation) in 7th SMW. When population was correlated with abiotic factors it was found that there was positive association with maximum temperature (r = 0.759**), minimum temperature (r = 0.672**), wind speed (r = 0.449).and sunshine hours (r =0.583*) whereas a negative relationship was maintained with morning relative humidity (r =-0.496) and evening relative humidity (r=-0.515), during 2016-17. Similarly, during 2017-18 there was a positive association with maximum temperature (r = 0.360), minimum temperature (r =0.431), wind speed (r = 0.544*) and sunshine hours(r=0.493) whereas a negative relationship was maintained with morning relative humidity (r =-0.277) and evening relative humidity (r=-0.365).

Introduction

Pea (*Pisum sativum*) is cultivated as winter crop all over the world and is utilized as nutritious vegetable. It contributes to about 40 percent of total trading in pulses[1]. The major insect-pests attacking pea are stemfly, *Ophiomyia phaseoli*, leaf miner, *Chromatomyia horticola,* thrips *Caliothrips indicus* and blue butterfly, *Lampides boeticus*, pea pod borer, *Etiella Zinckenella* and gram pod borer, *Helicoverpa armigera* comprises pod borer complex[2]. Among insect pests of peas, pea leaf miner (*Phytomyza horticola* Goureau (Diptera: Agromyzidae) is a serious hold back in cultivation of pea causing 90% damage to the pea crop by mining young leaves which leads to stunting and low flower production[3]. There was maximum leaf damage (40 percent) by Pea leaf miner, *C. hortiola* in early maturing variety HFP-8909[6]. However, very little information is available on seasonal incidence and management of pea leaf miner in this region so by generating the information regarding incidence of pests in pea will help in making strategy and the management options to combat with the pest attacks. Keeping in view the importance of the crop, the present study was undertaken to know the seasonal incidence of *P. horticola* on pea in relation with weather parameters.

Materials and Methods

Moderately high yielding HUDP 15 cultivar of pea was sown in plots of 7 rows of 4-meters length and row to row distance of 30 cm and pant to the spacing of 10 cm in *Rabi* season of 2016-17 and 2017-18. The crop was grown in Randomized Block Design following normal agronomic practices with three replications. To record the Seasonal incidence of pest on pea cultivar HUDP - 15, five plants were randomly selected in each control treatment plot and tagged. The observation affiliated to major insect pests : pea leaf miner (*Phytomyza horticola),* was recorded, the mature, as well as the immature stage of pests present on different parts of the plant, was counted at frequent interval. To establish the relationship between insect infestation and weather parameters, the insect infestation for a particular week was correlated with

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TABLE-1: Weather parameters and population of pea leaf miner, *P. horticola* on pea during *Rabi* 2016-17

S. No.	Standard Week	Rainfall (mm)	Temperature (°C)		Relative Humidity (%)		Sunshine (hours)	Wind velocity (km/hrs)	Evaporation (mm)	Mean larval population/ plant
			Max.	Min.	Morning	Evening				
1	50	0.0	22.7	11.4	92	56	2.6	3.7	1.5	0.00
2	51	0.0	22.0	8.2	91	43	1.5	3.8	1.4	0.00
3	52	0.0	22.8	8.0	82	37	2.5	5.4	1.6	0.00
4	1	0.0	24.3	9.60	94	47	4.2	2.5	1.2	0.00
5	2	0.0	20.70	8.20	90	44	3.2	2.0	1.6	6.20
6	3	0.0	23.00	8.80	91	49	1.0	1.3	1.6	11.20
7	4	1.0	24.40	10.90	90	58	1.8	1.8	2.4	25.30
8	5	0.0	25.40	10.80	91	47	7.1	2.4	2.3	33.20
9	6	0.0	26.20	12.30	87	53	4.6	1.2	2.3	52.00
10	7	0.0	27.70	13.00	81	41	6.4	3.1	3.3	57.00
11	8	0.0	29.70	13.10	83	43	7.4	2.3	3.3	68.00
12	9	0.0	29.60	14.60	71	38	5.7	3.1	3.8	71.00
13	10	0.0	28.70	12.30	81	39	7.6	2.7	4.0	35.00
14	11	0.0	33.20	17.60	81	36	6.2	2.7	4.3	11.00

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TABLE-2: Weather parameters and population of pea leaf miner, P. horticola on pea during Rabi 2017-18

S. No.	Standard Week	Rainfall (mm)	Temperature (°C) Max.	Min.	Relative Humidity (%) Morning	Evening	Sunshine (hours)	Wind velocity (km/hrs)	Evaporation (mm)	Mean larval population/ plant
1	50	0.0	20.2	10.0	94	73	0.8	1.2	0.7	0.00
2	51	0.0	23.3	9.8	89	50	2.4	3.2	1.8	0.00
3	52	0.0	20.5	10.9	94	69	1.4	0.2	0.9	0.00
4	1	0.0	20.1	11.6	95	76	2.2	0.2	0.8	1.80
5	2	0.0	20.7	8.2	91	44	2.0	3.2	1.6	6.20
6	3	0.0	26.30	7.00	91	62	9.3	1.4	1.7	12.30
7	4	0.0	22.70	8.20	91	64	8.7	2.7	2.3	23.90
8	5	0.0	24.70	10.20	93	74	7.6	2.0	2.3	35.60
9	6	0.0	27.60	10.90	66	54	7.0	2.8	2.2	58.00
10	7	0.0	31.80	12.80	93	53	10.4	1.5	2.8	73.00
11	8	0.0	29.20	17.50	61	49	10.2	1.8	3.6	1.55
12	9	0.0	28.60	15.90	85	38	9.1	2.7	4.5	0.97
13	10	0.0	37.70	17.51	84	56	9.8	2.7	5.3	0.66
14	11	0.0	28.80	17.40	80	44	7.1	3.2	4.0	1.38
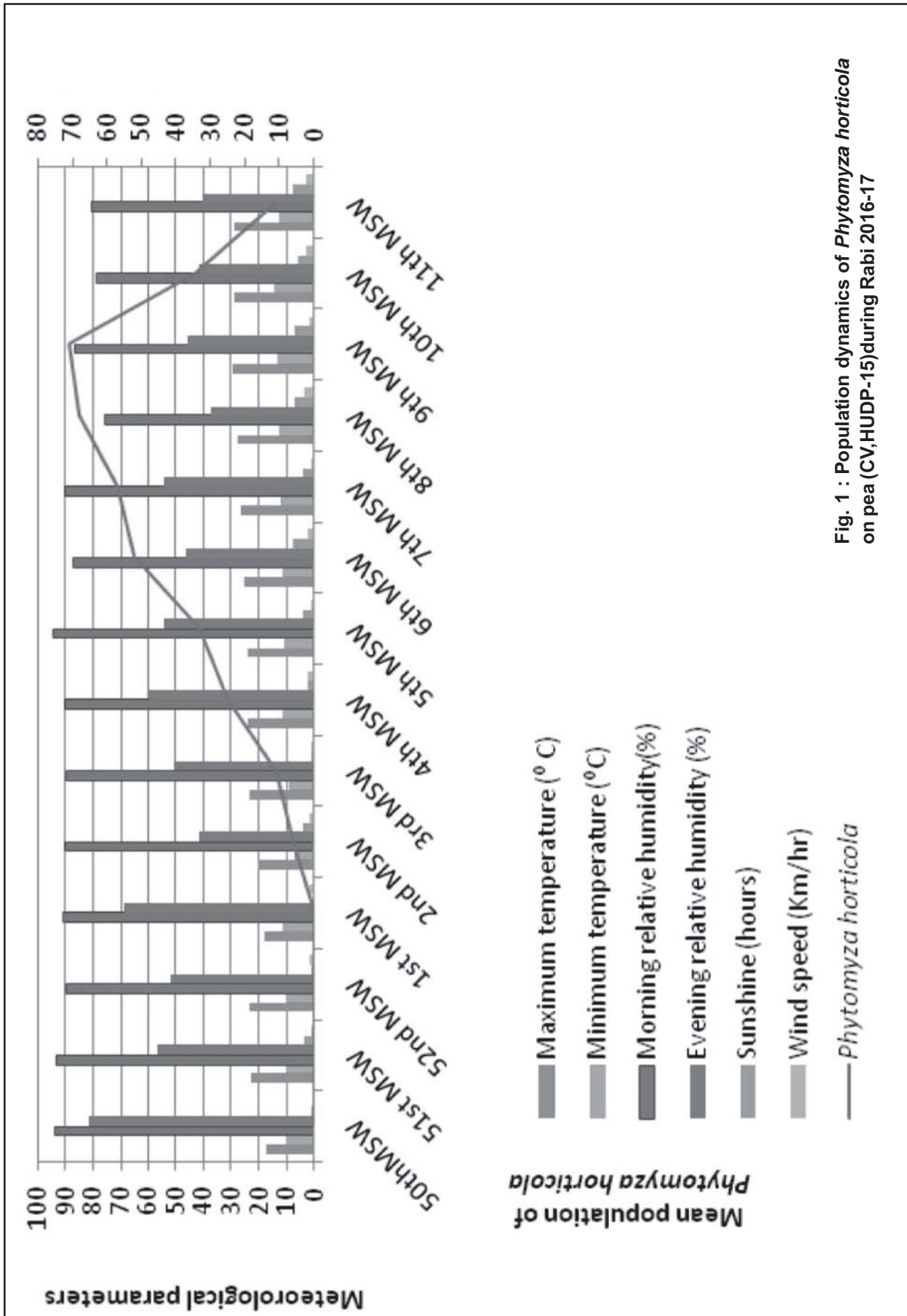
Fig. 1 : Population dynamics of *Phytomyza horticola* on pea (CV,HUDP-15)during Rabi 2016-17

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TABLE- 3: Correlation matrix of *P. horticola* in relation to weather parameters on pea (cv, HUDP-15) during *Rabi* 2016-17 and 2017-18.

Sl. No	Name of the Insect species	Year	Temperature (°C)		Relative humidity (%)		Sunshine (Hours)	Windspeed (Km/hour)
			Max	Min	Morning	Evening		
1	*P. horticola*	2016-17	0.759**	0.672**	-0.496	-0.515	0.583*	0.449
2	*P. horticola*	2017-18	0.360	0.431	-0.277	-0.365	0.493	0.544*

** Correlation is significant at the 0.01 level (2-tailed)

* Correlation is significant at the 0.05 level (2-tailed)

TABLE-4: Regression equations showing impact of weather parameters on population of *P. horticola* during *Rabi* 2016-17 and 2017-18.

Insect pest	Year	Regression equation	R^2 value
P. horticola	2016-17	$Y=-177.936+ 2.728 (X_1) + 1.743 (X_2) - 0.198 (X_3) +1.193 (X_4) -2.478(X_5)+7.353(X_6$	0.706
P. horticola	2017-18	$Y= -82.99+0.309 (X_{1a}) + 1.183 (X_{2a}) -0.094 (X_{3a}) + 0.886 (X_{4a}) +1.575 (X_{5a}) +4.0929(X_{6a})$	0.669

Where, X_1 and X_{1a} = Maximum temperature (°C), X_2 and X_{2a} = Minimum temperature (°C), X_3 and X_{3a} =evening relative humidity (%), X_4 and X_{4a} = morning relative humidity (%), X_5 and X_{5a} = sunshine(hours), X_6 and $X_{6a=}$ Wind speed 2016 and 2017 respectively
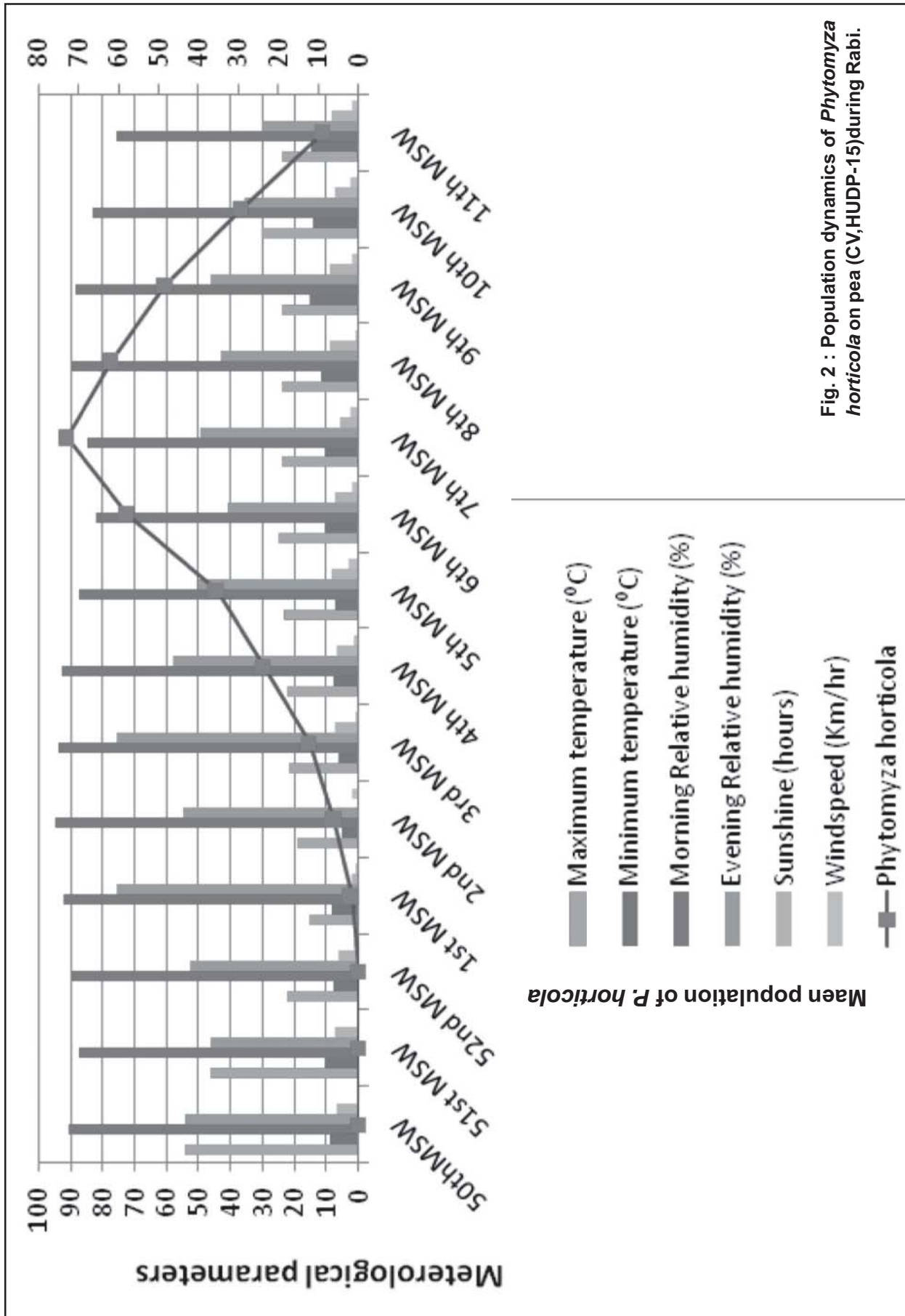
Fig. 2 : Population dynamics of *Phytomyza horticola* on pea (CV,HUDP-15)during Rabi.

weather parameters like- maximum temperature, minimum temperature, morning and evening relative humidity, sunshine hours and wind speed prevailed during same week. Multiple regression analysis with weather parameters was also worked out. The metrological data were obtained from metrological observatory of Agricultural Research Farm Institute of Agricultural Sciences, Banaras Hindu University, Varanasi.

Results and Discussion

Seasonal Incidence of *P. horticola*

During 2016-17, the first incidence of *Phytomyza horticola* was observed in 2nd standard week. The population persisted in the field from 2nd to 11th standard week. The population of leaf miner attained its peak level during 9th standard week (71 %leaf infestation) followed by 8th standard week (68% leaf infestation). The lowest mean population of leaf miner was recorded on 2nd standard week (6.2 % leaf infestation). Similarly, during 2017-18 the first incidence of *P. horticola* was observed in 1st standard week. The population persisted in the field from 1st to 11th standard week. The population of leaf miner attained its peak level during 7th standard week (73% leaf infestation) followed by 6th standard week (58% leaf infestation). The lowest mean population of leaf miner was recorded on 1st standard week (1.80% leaf infestation). The present findings were in close agreement with the earlier findings[4] which reported that the infestation of leaves was maximum from the third week of February to the second week of March with an average percentage infestation of 18.7%; the maximum damage to leaves reached 22.0% in the first week of March. The infestation continued till the harvesting of the crop. These findings were also somewhat similar with the previous results[7] which stated that maximum infestation was observed during the last week of February and second week of March, when the maximum temperature was 17.7^0C, mean temperature 6.5^0 C and total rainfall 2.5mm in the year 2010.

Effect of abiotic factors on *P. horticola* incidence

Simple correlation was worked out between *P. horticola* population and the weather parameters during 2016-17 and revealed that there was a positive highly significant association with maximum temperature (r = 0.759**), minimum temperature (r = 0.672**) and positive significant association with sunshine hours(r =0.583*) whereas a negative relationship was maintained with morning relative humidity (r =-0.496) and evening relative humidity (r=-0.515) and positive association was also maintained with wind speed (r = 0.449). Similarly during2017-18 there was a positive association with maximum temperature (r = 0.360), minimum temperature (r =0.431) and sunshine hours(r=0.493) whereas a negative relationship was maintained with morning relative humidity (r =-0.277) and evening relative humidity (r=-0.365) and significant positive association was also maintained with wind speed (r = 0.544*). The regression coefficient revealed that the various abiotic factors contributed (R^2= 0.706 and 0.669) 70 and 66.9 per cent variation in *P. horticola* population during both the years 2017 and 2018 respectively. The present findings were in accordance with the another findings[5] which observed the leaf miner population was positively correlated with increasing maximum temperature, slight rainfall and morning relative humidity and wind velocity and negative correlation with minimum temperature, evening relative humidity, wind velocity and sunshine hours.

Thus it can be concluded that pea crop in Varanasi region is infested with pea leaf miner [*Phytomyza. Horticola,* (Goureau)] The incidence of the pest starts from the 1st SW and persisted up to 11th SW during the crop seasons and their population is greatly influenced by maximum and minimum temperature and relative humidity. The regression coefficient revealed that the various abiotic factors contributed (R^2= 0.706 and 0.669) 70.00 and 66.9 percent variation in *P. horticola* population during both the years 2017 and 2018 respectively.

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