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To study the seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner, during *Rabi* season 2020-2021 and 2021-2022

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Abstract
The experiments were conducted in completely randomized block design with three replications during the *Rabi*, seasons of 2020-2021 and 2021-2022 at Student Instruction Farm (SIF) Chandra Shekhar Azad University of Agriculture & Technology, Kanpur- 208002 (U.P.). To the study seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner, during *Rabi* season 2020-2021 and 2021-2022. The population was started from December 2020 & 2021 (51st standard meteorological week) to April 2021 & 2022 (15th standard meteorological week) of crop. The larval population was low during December to third week of January. The both years maximum population increased and reaches its peak (14.19 larvae/5 plants) in all control plots on 26 February, 2021 (8th standard meteorological weeks). When the maximum and minimum temperature was 2021 at 28.80°C and 11.90°C, respectively, relative humidity was 57% and rainfall to the tune of nil was recorded. Second year maximum population increased and reaches its peak (14.79 larvae/5 plants) on 22 February, 2022 (8th standard meteorological weeks) and the maximum and minimum temperature was 27.40°C and 12.30°C, respectively, relative humidity was 64.50% and the rainfall to the tune of nil was recorded.

Keywords: *Helicoverpa armigera* Hubner, population, peak, increased, temperature, humidity

Introduction
Field Pea, *Pisum sativum* L. is an important leguminous vegetable crop & mostly grown in all states of the country during *Rabi* season (Singh *et al*, 2001) [13] and because of its taste, nutritive value, fast growth and high yield this crop is patronized throughout the world. It is used as vegetable purpose as well as pulse (Singh and Joshi, 1970) [11]. Pea is one of the most important food legumes being grown around the world and Canada, France, China, Russia, Ukraine, and the Western United States are the primary growers. India is the world's largest producer and the largest consumer of pulses. In the world sharing 36.6% in area and 27% in production with 0.6 tones/ha in productivity of the world. In India area under pulse cultivation is 30.20 million ha and production is estimated to 28.42 metric tons (Report of Ministry of Agriculture, Govt. of India 2021-2022). The cultivation of pea for vegetable purpose in Kanpur district has attained grand success due to good market price particularly in the adjacent state market.

In India two types of pea are commonly grown in which garden pea, *Pisum sativum* var. hortance. And field pea, *Pisum sativum* var. arvens. The matured pea grain are used as a whole for 'Chat', as in split form for *Dal*' and as in grind flour called 'Besan' for the use of making many sweets materials.

The protein content in this crop is 19 to 27%. It has high caloric value and is a great source of ascorbic acid. The cooked 100 gm green pea contains 74% moisture, 7% protein, 18 gm carbohydrates, 22mg calcium, 122 mg phosphorus and 2 mg iron with vitamin A (680 I.U), 81, 82, and vitamin C, 0.34, 0.16, and 26 mg, respectively. In addition to its food value it has proved to be an excellent source of fodder and the vines used in silage making in off season for feeding to livestock. The nitrogen fixing capacity of this crop restores soil fertility. (Singh *et al*., 2002) [12].

There are many abiotic and biotic factors responsible for low productivity. Among abiotic factors i.e. temperature, humidity, rainfall, soil fertility etc. play an important role on productivity of pea. Insect pest are the major constrains for the low productivity of pea under biotic factors. The high yield could not be achieved due to number of insect pests attacking. The crop is known to suffer from a series of pests. The insect pests i.e. gram pod borer, *Helicoverpa armigera* Hubner, appear in great in number during vegetative growth to pod maturation stage of pea. (Lal *et al*., 2006) [6].

The period of insect attack in relation to plant growth, the intensity of injury, the duration of attack and the environment factors affecting both insect activities and plant growth are the factors that control the relationship between an insect infestation and its effect on yield (Kushwaha, 2002) [5]. Hence, the prevention of crop losses from pest attack is necessary for massive production of high yield potential of the new pea varieties.

Insect pests are probably the main factor limiting the legume production. More than 150 species of insect pests are known to attack pulse crops in India. Among these, about 25 species cause serious damage to pulse crops grown in monsoon and winter (Bindra, 1968) [2]. Out of them, gram pod borer, *H.armigera* Hubner, (Lepidoptera: Noctuidae) is one of the most devastating crop pest worldwide (Sigsgaard *et al*., 2002) [10]. Sixty cultivated and sixty-seven wild host plants attacked by *H. armigera* have been recorded from India (Karim, 2000) [14]. In western Uttar Pradesh, in addition to other insect pests, the gram pod borer *H. armigera* seriously damages the crop during fruiting stage and is considered to be a major limiting factor for the production of chickpea. A single larva may destroy several pods before reaching to maturity and this pest is reported to damage 5 to 40 per cent pods of chickpea crop during different year (Chaudhary *et al*., 1982) [3] and (Chauhan, 1992) [4].

Materials and Methods

The present study was carried out during the *Rabi* season of the year 2020-2021 and 2021-2022. The details of materials used, experimental procedures followed & statistical analysis adopted during the course of investigation were as follows:

General climatic information of experimental site

Kanpur has subtropical and semi-arid climate with hot summer and severe cold winter. The winters are severe with a minimum temperature of about 2 °C with occasional ground frost. In summer the temperature often goes up to 40 to 47 °C in the month of May and June. The south-west monsoon commence generally during third week of June and cessation of it by the end of September. The mean precipitation is about 800 mm of which about 80-90 per cent is received during July to September. Few showers of cyclonic rains are also received during December to January & late spring also.

Soil of the experimental field and Preparation of the field

The soil of the experimental field was sandy loam with an average fertility level. Field were ploughed twice with the help of tractor mounted disc harrow. Each ploughing was followed by leveling with the help of leveler. Pre sowing irrigation was given to ensure suitable moisture in soil for good germination.

Layout and sowing of experiment

The field trial with field pea variety KPMR-400 in randomized block design in a plot measuring 3 X 5 m. area and 12 treatments including control with 3 replications were laid out on 25 November 2020 and 20 November2021 in a well prepared field and the seed was sown @ 100kg/ha. The furrows were opened with the help of furrow opener adjusted at a row distance of 30 cm and plant to plant of 5 cm apart. The furrows were covered with soil and field was made smooth after completing the total sowing.

Fertilizer application

Recommended dose of 20 kg/ha N, and 40 kg/ha P_2O_5 were applied for good crop production. Total dose of the nitrogen as starter dose which can meet plant requirement before the formation of nodules and total quantity of phosphorus were applied as basal at the time of final field preparation. All the fertilizers are drilled in furrows at a depth of 7-10 centimeters.

Weeding

First weeding was done at 15 days after germination with the help of "Khurpi" and second weeding was done when the crop was 35 days old.

Counting of larval population

Experiments were laid out with KPMR-400 grown promising variety of field pea for the study of seasonal incidence of gram pod borer, *H.armigera* Hubner, in relation to abiotic factors. Gram pod borer, *H.armigera* Hubner, are specific borers pest of field pea, hence the initial seasonal incidence of the borers pest is to be appeared earliest at the time of flowering and pod formation of the crop. The population of tested insect is to be monitored closely as soon as it appears on the plant. The data regarding the population of borers pest will be recorded on 5 randomly selected plants at weekly intervals till the harvesting of the crop. At the same time the meteorological data of the crop period will be collected from the observatory, department of Agronomy, C. S. Azad University of Agriculture and Technology Kanpur. The existence of the seasonal incidence of borers pest will be analyses statistically and correlate with these data accordingly.

Result and Discussion

Year-2020-2021

The observations on larval population of gram pod borer, *Helicoverpa armigera* Hubner recorded from third week of December 2020 (51st standard meteorological week) to April 2021(15th meteorological standard week) of crop. The pest population recorded as number of larvae range from 0.08 to 14.19 larvae/5 plants during *Rabi* season 2020-2021 (Table 1). The larval population was low during third week of December to third week of January and varied from 0.08 to 1.79 larvae/5 plants. The post population increased and reaches its peak (14.19 larvae/5 plants) on 26 February (8 standard week). When the maximum and minimum was *i.e.* 28.8 °C and 11.90 °C. respectively, relative humidity was *i.e.* 57 % and rainfall to the tune of nil was recorded. The correlation matrix indicated a significant positive correlation with maximum temperature ($r = 0.548^{*}$) with gram pod borer infestation. However, significant positive correlation was observed with minimum temperature ($r = 0.545^{*}$) and total rainfall (r = 0.098), while non significant negative correlation was found with average relative humidity (r = -0.342).

Table 1: Seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner in relation to abiotic factors during 2020-2021

S.W.	Larval population of *H. armigera*/5 plants	Temperature max. (°C)	Temperature min. (°C)	Relative humidity (%)	Rainfall (mm)
51	0.08	21.40	6.00	60.50	0.00
52	0.21	21.30	6.50	64.50	0.00
1	0.44	23.60	10.60	71.00	0.30
2	0.87	19.90	8.60	78.50	0.00
3	1.79	20.50	7.50	76.50	0.00
4	2.71	17.00	7.90	81.00	0.00
5	4.23	23.80	6.80	62.00	0.00
6	7.39	24.50	10.10	69.00	4.80
7	8.71	27.30	10.30	67.50	0.00
8	14.19	28.80	11.90	57.00	0.00
9	12.56	30.50	15.10	49.00	0.00
10	10.07	32.50	16.70	56.50	0.00
11	9.65	32.10	16.80	60.00	0.60
12	8.88	34.20	18.50	47.50	0.00
13	6.94	36.50	18.60	35.50	0.00
14	5.51	38.40	18.50	26.00	0.00
15	4.69	39.60	20.10	25.00	0.00

Year-2021-2022

The observations on larval population of *Helicoverpa armigera* Hubner recorded from third week of December 2021 (51st meteorological standard week) to April 2022 (15th meteorological standard week) of crop. The pest population recorded as number of larvae range from 0.16 to 14.79 larvae/5 plants during *Rabi* season 2021-2022 (Table 2). The larval population was low during third week of December to third week of January and varied from 0.16 to 1.34 larvae/5 plants.

The pest population increased and reaches its peak (14.79 larvae/5 plants) on 22 February 2022 (8 standard weeks) when the maximum and minimum temperature was *i.e.* 27.4 °C and 12.3 °C, respectively, relative humidity was *i.e.* 64.50% and rainfall to the tune of nil was recorded. The correlation matrix indicated a significant positive correlation with maximum temperature (r = 0.510*) with gram pod borer infestation. However, significant positive correlation was observed with minimum temperature (r = 0.458) and total rainfall (r = -0.548*), while non significant negative correlation was found with average relative humidity (r = -0.464*).

Table 2: Seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner in relation to abiotic factors during 2021-2022

S.W.	Larval population of *H. armigera*/5 plants	Temperature maxi. (°C)	Temperature mini. (°C)	Relative humidity (%)	Rainfall (mm)
51	0.16	22.10	7.10	64.00	0.00
52	0.28	20.00	9.00	86.00	8.60
1	0.47	20.40	8.50	83.00	23.50
2	0.62	19.60	10.30	84.00	14.60
3	1.34	15.70	4.90	82.50	0.00
4	2.26	17.90	7.70	80.50	3.00
5	4.30	21.20	7.50	74.50	13.00
6	7.13	22.70	8.10	72.50	0.00
7	8.85	25.00	8.10	71.50	0.00
8	14.79	27.40	12.30	64.50	0.00
9	11.16	27.80	11.70	68.00	0.00
10	10.16	29.20	13.90	65.50	0.00
11	10.05	33.40	17.40	63.50	0.00
12	9.58	36.40	18.60	54.50	0.00
13	7.63	38.20	18.40	50.00	0.00
14	5.48	40.00	17.60	45.00	0.00
15	4.72	40.80	21.10	44.50	0.00

Table 3: Correlation coefficient between abiotic factors with *Helicoverpa armigera* Hubner on field pea during 2020-2021 and 2021-2022.

Weather variables	H. *armigera* Hubner	
	2020-21	2021-22
Min. Temperature(°C) (X_1)	0.545*	0.458
		NS
Max. Temperature(°C) (X_2)	0.548*	0.510*
Relative humidity (%)(X_3)	-0.342	-0.464*
	NS	
Total Rainfall (mm.)(X_4)	0.098	-0.548*
	NS	NS

*Significance at 5% level

These findings are supported by Shinde *et al.* (2013) [9] who also reported that the activity of H. *armigera* continued throughout the crop season with larval population peaking twice the first was during the 47th to 50th standard weeks and the second from the 10th to the 14th standard weeks in both years.

Ramteke *et al.* (2013) [8] reported that the larval population of H. *armigera* commenced from 4th SW (January 4th week) with an average population of 0.34 larval plant. The larval population increased gradually, reached peak level of 9.97 larval plant.

Pal *et al.* (2020) [7] reported that the peak larval population was recorded on 12 weeks after sowing in both years at fifty

percent pod maturity stage. Temperature (Maximum and Minimum) showed positive and significant correlation with intensity of gram pod borer during both seasons but maximum relative humidity and rainfall showed negative and non-significant correlation.

Conclusion

To the study seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner, during *Rabi* season 2020-2021 and 2021-2022. The population was started from December 2020 & 2021 (51st standard meteorological week) to April 2021 & 2022 (15th standard meteorological week) of crop. The larval population was low during December to third week of January. The both years maximum population increased and reaches its peak (14.19 larvae/5 plants) in all control plots on 26 February, 2021 (8th standard meteorological weeks). When the maximum and minimum temperature was 2021 at 28.80 °C and 11.90 °C, respectively, relative humidity was 57% and rainfall to the tune of nil was recorded. Second year maximum population increased and reaches its peak (14.79 larvae/5 plants) on 22 February, 2022 (8th standard meteorological week) and the maximum and minimum temperature was 27.40 °C and 12.30 °C, respectively, relative humidity was 64.50% and the rainfall to the tune of nil was recorded.

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