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Population fluctuation of pod borer, *Helicoverpa armigera* (Hubner) in relation with abiotic factors

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Abstract
The present experiment was carried out during *Rabi* season, 2020-21 and 2021-22 at Crop Research Centre (CRC), of Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut (U.P). Larval population of pod borer was recorded on 10 randomly selected plants of inner rows per plot. The early incidence of larval population was observed at 46th standard week with the mean larval population of 0.26/plant during which maximum and minimum temperature 27.60 ^{0}C and 9.90 ^{0}C, relative humidity at morning and evening 84.30 and 44.40 per cent and rainfall was 1.30 mm, respectively. The pest activity increased from the third week of November and reached its peak at 10th standard week of March (first week of March) with mean population of 1.33 larvae per plant when maximum and minimum temperature was 32.30 ^{0}C and 14.50 ^{0}C, relative humidity at morning and evening 72.60 and 35.40 per cent and rainfall was 0.00 mm, respectively. The correlation coefficient for both years indicated non significant negative correlation with minimum r= -0.198 and r= -0.195 and maximum temperature r= -0.288 and r= -0.122 with larval population. However, the morning relative humidity showed non significant positive correlation r =0.166 and r= 0.245, respectively. The evening relative humidity showed non-significant positive correlation r =0.171 and r= 0.070, respectively and the rainfall showed non- significant positive correlation (r= 0.078) and non- significant negative correlation (r = 0.020) during *Rabi* 2020-21 and 2021-22, respectively.

Keywords: Chickpea, gram pod borer, *Helicoverpa armigera*, population fluctuation, larva and abiotic factors

Introduction
Chickpea (*Cicer arietinum* L.) is an important pulse crop of India and also known as king of pulses. Chickpea belongs to Fabaceae family. It is native to India, Afghanistan and Ethopia. It is also called as Ceci bean, Bengal gram, Garbanzo bean, Chana and Sanagalu bean. Chickpea is a versatile crop that is grown in almost every part of globe today. Some of the major producers of desi chickpea are India, Pakistan, Myanmar, Australia and Bangladesh, while the top producers of Kabuli chickpeas are Turkey, Iran, Spain, Canada, Syria, USA, Ethiopia, Tanzanzia, Tunisia, Sudan, Malawi and Portugal (Pal *et al*., 2016) [4]. Chickpea pods in raw form are consumed as both whole fried or boiled and salted. It is made into split pulse (Chana dal) which is cooked and eaten and as flour (Besan) out of which a variety of dishes like snacks and sweets are made. Fresh green leaves and grains are used as vegetables (Chhole). It is being used increasingly as a substitute for animal protein. The straw of chickpea is an excellent source of fodder for cattle besides both husk and bits of the 'Dal' serve as valuable cattle feed. Chickpea seed contains 18.22 per cent protein, 16-62 per cent total carbohydrate, 47 per cent starch, 5 per cent fat, 6 per cent crud fibre, 6 per cent soluble sugar and 3 per cent ash (Jukanti *et al*., 2012) [1]. Among the biotic factors responsible for low yield, the damage due to insect pests is the major limiting factor. Many pests infesting chickpea *i.e.*, around 57 species in India are causing economic damage (Lal, 1996) [2]. Among them gram pod borer, *Helicoverpa armigera* (Hubner) are recognized as major pests causing an extent of 25-30 per cent crop loss in India (Rao and Shanower, 1999) [5]. The study of population trend of the pest forms one of the major components of pest management. The studies on population dynamics could provide appropriate planning for pest control strategy prior to its active feeding stage and the distribution of its population determined by different components of environment in nature. Therefore, there is a need of understanding the trends of their population build up and understanding the factors responsible for changes in population dynamics and migration of insect pests which will ultimately affect the monitoring and forecasting system (Yadav, 1990) [7].

Materials and Methods

Population dynamics of *H. armigera* was studied on chickpea variety Surya WCG 2 that was sown in plots of size 4.0 m X 3.0 m on 23 October 2020 and 28 October 2021 respectively. Larval population of pod borer was recorded on 10 randomly selected plants of inner rows per plot. The observations were recorded at weekly intervals during morning hours between 7 to 9 AM throughout the experimental period of crop season in 2020-21 and 2021-22, respectively. The population of the pod borer, *Halicoverpa armigera* was recorded by direct visual counting method from appearance to till harvest of the crop.

Results and Discussion

The population of pod borer, *Helicoverpa armigera* was recorded on chickpea variety Surya WCG-2 from 46th to 14th standard week during the crop season with mean population ranged from 0.20 to 1.33 per plant during *Rabi*, 2020-21 (Table.1 and Fig.1). The pod borer incidence during *Rabi* 2020-21 was first reported at 46th standard week (second week of November) with mean incidence of 0.26 per plant during which maximum and minimum temperature 27.60 ^{0}C and 9.90 ^{0}C, relative humidity at morning and evening 84.30 and 44.40 per cent and rainfall was 1.30 mm, respectively. The pest activity increased from the third week of November and reached its peak at 10th standard week of March (first week of March) with mean population of 1.33 larvae per plant when maximum and minimum temperature was 32.30 ^{0}C and 14.50 ^{0}C, relative humidity at morning and evening 72.60 and 35.40 per cent and rainfall was 0.00 mm, respectively. The population of larvae of pod borer decline with mean population of 1.00 per plant during 12th standard week (third week of March) when the maximum and minimum temperature was 33.00 ^{0}C and 16.60 ^{0}C. The relative humidity recorded at morning and evening was 75.60 and 38.00 per cent and rainfall was 0.00 mm, respectively. The incidence of pod borer, *Helicoverpa armigera* was observd on chickpea from 45th to 14th standard week during the crop season with mean larval population ranged from 0.06 to 1.73 per plant during *Rabi*, 2021-22 (Table 2 and Fig.2). The pod borer incidence during *Rabi* 2021-22 was first reported at 45th standard week (second week of November) with mean larval population of 0.06 per plant during which maximum and minimum temperature 28.73 ^{0}C and 12.86 ^{0}C, relative humidity at morning and evening 76.86 and 48.00 per cent and rainfall was 0.00 mm, respectively. The pest activity increased from the third week of November and reached its peak at 11th standard week of March (third week of March) with mean larval population of pod borer of 1.73 larvae per plant when maximum and minimum temperature was 34.20 ^{0}C and 17.10 ^{0}C, relative humidity at morning and evening 71.10 and 39.60 per cent and rainfall was 0.00 mm respectively. The population of larvae of pod borer decline with mean population of 0.66 per plant during 13th standard week (last week of March) when the maximum and minimum temperature was 38.70 ^{0}C and 20.30 ^{0}C. The relative humidity recorded at morning and evening was 58.90 and 28.40 per cent and rainfall was 0.00 mm respectively.

The impact of weather factors on the larval population of pod borer was studied by work out correlation coefficient (r). The correlation coefficient for both years indicated non significant negative correlation with minimum r= -0.198 and r= -0.195 and maximum temperature r= -0.288 and r= -0.122 with larval population during *Rabi*, 2020-21 and 2021-22, respectively. However, the morning relative humidity showed non significant positive correlation r =0.166 and r= 0.245 during *Rabi*, 2020-21 and 2021-22, respectively. The evening relative humidity showed non-significant positive correlation r =0.171 and r= 0.070 during *Rabi*, 2020-21 and 2021-22, respectively and The rainfall showed non- significant positive correlation (r= 0.078) and non- significant negative correlation (r = 0.020) during *Rabi* 2020-21 and 2021-22, respectively.

The present findings are in accordance with Sharma *et al.* (2020) [6] who reported that the population of *H. armigera* Hubner. This study assessed the impact of weather parameters on the on the infestation by this pest on chickpea. The highest population of gram pod borer recorded in 9th and 10th S.W. during *Rabi*, 2017 and 2018 with the mean larval population 3.15 and 3.16, respectively and minimum overall mean larvae recorded in 45th S.W. where mean larval population of gram pod borer 0.24 and 0.39 was recorded during *Rabi* 2017 and 2018, respectively. The present findings are in conformity with Ojha *et al.* (2016) **[3]** who reported that the highest population of *H. armigera* during 9th standard week with mean larval population 8.93 at 25.61 ºC maximum temperature, 13.26 ºC minimum temperature, 73.57 per cent morning relative humidity, 42.57 per cent evening relative humidity and 0.00 mm rainfall.

Table 1: Population fluctuation of pod borer, *H. armigera* (Hubner) in relation with abiotic factors in chickpea during *Rabi*, 2020-21

S.W.	Date	Mean larval population/ plant	Temperature (^{0}C)		Relative humidity %		Rainfall (mm)
			Max.	Min.	Mor.	Eve.	
43	19 Oct. - 25 Oct.	0.00	33.00	16.10	85.40	45.10	0.00
44	26 Oct. - 01 Nov	0.00	31.00	13.40	81.60	43.70	0.00
45	02 Nov. - 08 Nov	0.00	28.40	11.30	83.40	45.30	0.00
46	9 Nov. - 15 Nov	0.26	27.60	9.90	84.30	44.40	1.30
47	16 Nov. - 22 Nov.	0.33	25.00	9.50	82.40	54.70	1.40
48	23 Nov. - 29 Nov.	0.43	25.80	8.40	83.90	45.70	0.00
49	30 Nov. - 06 Dec	0.56	26.30	7.90	85.00	45.00	0.00
50	07 Dec. - 13 Dec	0.66	22.90	6.40	85.60	49.90	5.90
51	14 Dec. - 20 Dec	0.73	20.30	6.00	87.40	51.30	0.00
52	21 Dec. - 27 Dec	0.86	18.70	4.90	92.10	54.40	0.20
1	28 Dec. - 03 Jan.	0.90	19.00	6.20	94.10	66.10	24.00
2	04 Jan. - 10 Jan.	1.06	18.80	5.70	94.90	63.60	0.00
3	11 Jan. - 17 Jan.	1.10	18.10	7.20	93.30	62.30	0.00
4	18 Jan. - 24 Jan.	1.13	18.80	6.50	90.00	57.30	0.00
5	25 Jan. - 31 Jan.	1.16	21.60	7.10	85.70	56.00	1.10
6	01 Feb. - 07 Feb.	1.13	23.90	7.70	86.00	55.30	5.60
7	08 Feb. - 14 Feb.	1.16	26.60	9.80	84.30	43.00	0.00

8	15 Feb. - 21 Feb.	1.23	29.40	12.00	83.30	40.40	0.00
9	22 Feb. - 28 Feb.	1.26	30.50	14.10	76.60	41.30	0.20
10	01 Mar. - 07 Mar.	1.33	32.30	14.50	72.60	35.40	0.00
11	08 Mar. - 14 Mar.	1.13	31.70	15.70	71.00	32.90	0.10
12	15 Mar. - 21 Mar.	1.00	33.00	16.60	75.60	38.00	0.00
13	22 Mar. - 28 Mar.	0.76	34.00	16.90	71.90	35.10	0.00
14	29 Mar. - 04 Apr.	0.20	35.10	17.80	48.60	26.60	0.00

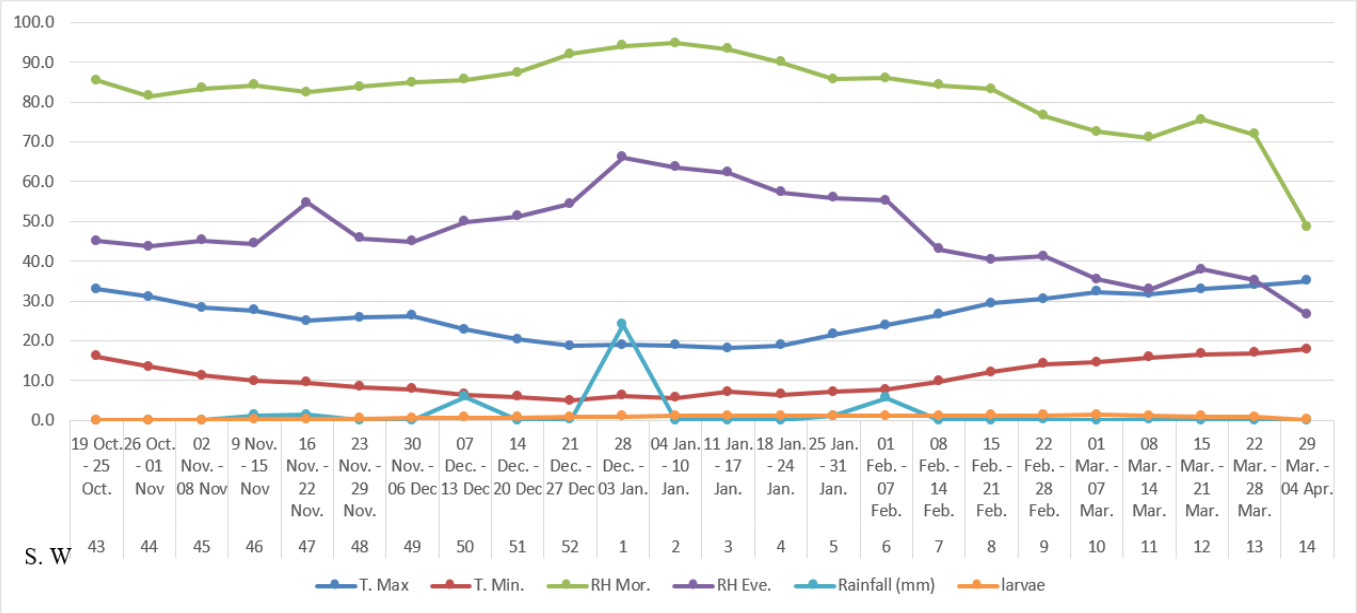

Fig 1: Population fluctuation of pod borer, *H. armigera* (Hubner) in relation with abiotic factors in chickpea during *Rabi*, 2020-21

Table 2: Population fluctuation of pod borer, *H. armigera* (Hubner) in relation with abiotic factors in chickpea during *Rabi*, 2021-22

S.W.	Date	Mean larval population/ plant	Temperature (^{0}C)		Relative humidity %		Rainfall (mm)
			Max.	Min.	Mor.	Eve.	
43	25 Oct. - 31 Oct.	0.00	30.94	18.00	69.86	49.57	12.60
44	01 Nov. 07 Nov.	0.00	30.06	14.86	72.00	50.14	0.00
45	08 Nov. - 14 Nov	0.06	28.73	12.86	76.86	48.00	0.00
46	15 Nov. - 21 Nov.	0.16	29.01	13.86	76.43	49.71	0.00
47	22 Nov. - 28 Nov.	0.30	28.11	11.00	80.57	46.86	0.00
48	29 Nov. - 05 Dec	0.43	26.76	9.71	81.57	46.29	0.00
49	06 Dec. - 12 Dec	0.60	23.07	11.64	84.29	48.14	0.90
50	13 Dec. - 19 Dec	0.73	22.40	9.36	83.43	39.43	0.00
51	20 Dec. - 26 Dec	0.80	20.74	7.17	82.43	38.43	0.00
52	27 Dec. - 02 Jan.	0.90	20.00	6.49	88.63	49.50	2.50
1	03 Jan. - 09 Jan.	0.96	20.60	7.50	84.60	61.10	9.90
2	10 Jan. - 16 Jan.	0.86	17.70	5.30	91.90	80.60	67.50
3	17 Jan. - 23 Jan.	1.00	16.20	4.70	92.60	71.10	3.70
4	24 Jan. - 30 Jan.	1.03	16.60	5.30	91.60	67.90	33.90
5	31 Jan. - 06 Feb.	1.10	20.10	6.00	88.60	67.00	18.40
6	07 Feb. - 13 Feb.	1.16	20.50	7.30	85.90	64.10	4.50
7	14 Feb. - 20 Feb.	1.23	24.30	8.30	82.60	57.40	0.00
8	21 Feb. - 27 Feb.	1.30	25.90	9.90	82.70	50.30	0.70
9	28 Feb. - 06 Mar.	1.33	26.00	10.50	88.60	53.10	31.50
10	07 Mar. - 13 Mar.	1.46	30.30	13.40	76.00	43.00	0.00
11	14 Mar. - 20 Mar.	1.73	34.20	17.10	71.10	39.60	0.00
12	21 Mar. - 27 Mar.	1.43	37.50	20.10	67.40	34.30	0.00
13	28 Mar. - 03 Apr.	0.66	38.70	20.30	58.90	28.40	0.00
14	04 Apr. - 10 Apr.	0.26	40.10	22.80	52.60	23.20	0.00

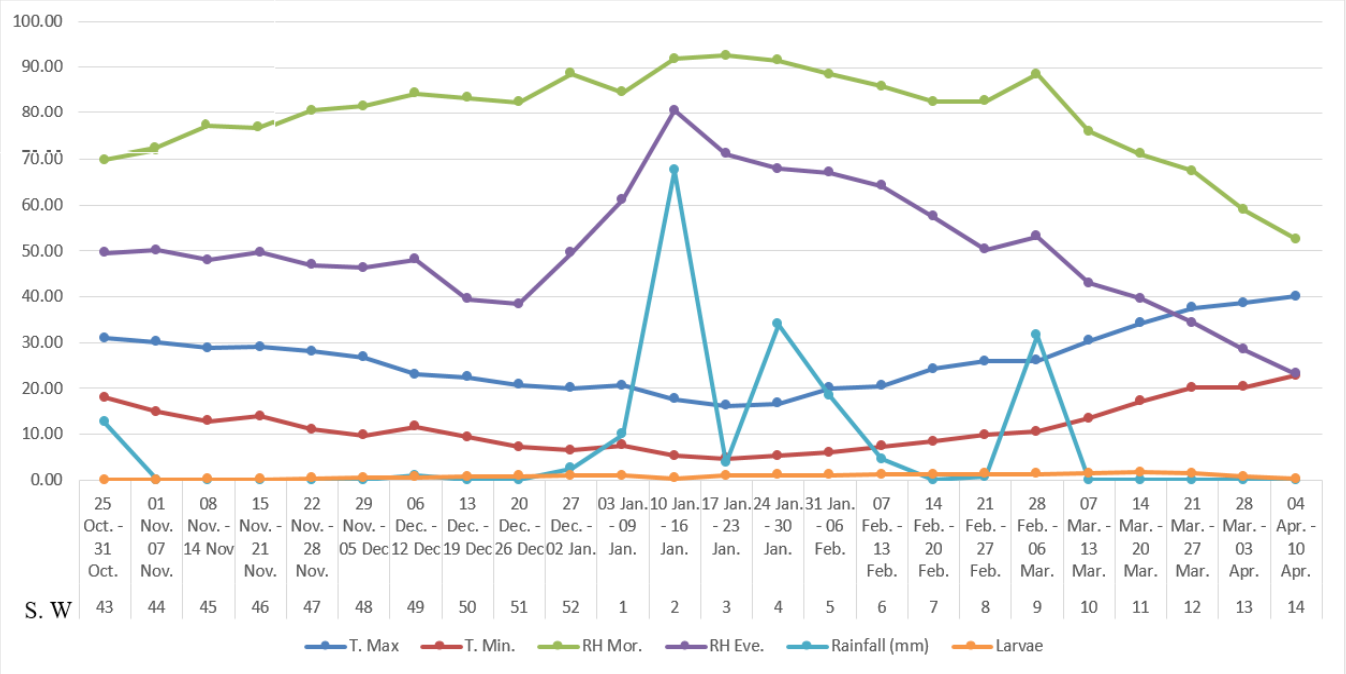

Fig 2: Population fluctuation of pod borer, *H. armigera* (Hubner) in relation with abiotic factors in chickpea during *Rabi*, 2021-22

Conclusion

In present investigation, we observed that the population of pod borer, *Helicoverpa armigera* was recorded on chickpea from 46th to 14th standard week during the crop season with mean population ranged from 0.20 to 1.33 per plant during *Rabi*, 2020-21 and during *Rabi*, 2021-22 the incidence of pod borer, *Helicoverpa armigera* was observd on chickpea from 45th to 14th standard week during the crop season with mean larval population ranged from 0.06 to 1.73 per plant.

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