Journal of Entomology and Zoology Studies
Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 909-913

Received: 04-05-2020
Accepted: 06-06-2020

S Pal
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

A Banerjee
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

S Samanta
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Corresponding Author:
S Pal
Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, India

Impact of abiotic factors on the occurrence of gram pod borer (*Helicoverpa armigera* Hubn.) on some varieties of field pea (*Pisum sativum* L.) in lower Gangetic plains of West Bengal

S Pal, A Banerjee and S Samanta

Abstract
Field pea (*Pisum sativum* L.) is an important rabi pulse crop world wide. There are many constraints in the production of this crop, among which attack of insect pests is the important ones. Climate also have a significant role in changing the pest scenario of the crop. Among the various pests of field pea gram pod borer is the notorious one. Therefore, an experiment was carried out in kalyani A-B block farm of BCKV during rabi seasons of 2017-18 and 2018-19. The larval population of pod borer was recorded at weekly interval. 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.

Keywords: Seasonal incidence, field pea, gram pod borer, abiotic factors

Introduction
India is the third largest producer of pea in the world and accounts for 21 percent of the world production (FAO STAT, 2015) [5]. Pea contributes 3% of total pulse area and about 5% of total pulse production in India (Vaibhav *et al.*, 2018) [21]. In India field pea is grown over an area of 0.7 million hectares with a production of about 0.6 million tonnes and an average productivity of 906Kg/ha (Annual Vegetable Research Report, Ministry of Agriculture, Govt. of India. 2007) [1]. It is grown in most of the states in India during *rabi* season and because of its taste, nutritive value, faster growth and high yielding capacity (Bhati and Patel, 2001) [2]. Regardless a large number of cultivars of field pea the yield per unit in India is still lower as compared to international standard due to several biotic and abiotic constraints. Among the biotic constraints gram pod borer, *Helicoverpa armigera* hubn. attack is the important ones which cause both qualitative and quantitative loss (Kumar *et al.*, 2018) [10]. On an average, 30 – 40% pod damage is caused by this pest but in optimum weather condition it goes up to 90-95 percent (Shengal and Ujagir, 1990) [17]. It is a polyphagous pest which is reported from 67 host plant family (Krinski and Godoy, 2015) [8]. Nature of this pest is voracious feeding on fruiting structures, high mobility, fecundity and overlapping generations (Sarode, 1999) [16]. For controlling the pest population excessive and indiscriminate use of pesticides lead to the development of insecticidal resistance (Phokela *et al.*, 1990) [13]. So we have to concern about integrated pest management technique to maintain the pest population below ETL for which adequate ecological data is required to determine the seasonal abundance (Mathur *et al.*, 2003) [11]. To fulfill this aim the current experiment was conducted to study the abundance of *H. armigera* on four varieties field pea and find out their correlation and regression with some meteorological parameters in Gangetic plains of West Bengal.

Materials and Methods
The present study was carried out at 'A-B' Block Farm of Bidhan Chandra Krishi Viswavidyalaya, Kalyani, West Bengal during the rabi seasons of two consecutive years (2017–18 and 2018-19). The healthy seeds of four field pea varieties were sown @ 60 kg/ha in rows at a depth of 5-6 cm and covered with soil maintaining row to row and plant to plant spacing of 30 cm and 10 cm respectively on 28th November (2017-18) and 14th November (2018-19).

The experiments were laid out in Randomized Block Design (RBD) with three plots for each variety. For taking observations randomly four plants were selected as sample plants from each plot and tagged with the help of paper card and weekly observations were recorded. Larval population of *H. armigera* present on the tagged plant was counted in the morning hours at weekly intervals and started from three weeks after sowing (WAS) to harvest. The data of weather parameters, maximum and minimum temperature, maximum and minimum relative humidity, rainfall, wind speed and bright sunshine hour were recorded during the course of the experiment from AICRP on Agro meteorology (Kalyani Centre), Directorate of Research, BCKV, Kalyani, Nadia, West Bengal.

Statistical analysis: Correlation and multiple step wise linear regression were worked out between the mean larval population of gram pod borer with weekly mean of above mentioned meteorological parameters except rainfall for which sum of previous seven days were used. All the data were analyzed by using the software IBM SPSS20.0.

Results and Discussion

Seasonal incidence of *H. armigera*: The incidence pattern of *Helicoverpa armigera* on four different varieties of field pea during the season 2017-18 is presented in Table 1 and Fig.1. Pest population was observed in field for the first time on 15.01.18 i.e. 7 weeks after sowing (WAS) at flower bud initiation stage of crop. But the peak larval population was recoded on 19.02.18 (8^{th} SMW) i.e. 12 WAS at fifty percent pod maturity stage of the crop

The incidence pattern of *H. armigera* on four different varieties of field pea during the season 2018-19 is presented in Table 2 and Fig. 2. The activity of pest population was commenced from 2^{nd} SMW (second week of January) i.e. 9 WAS at flowering stage of crop and gradually increased up to 6^{th} standard week (second week of February). Pest population was observed in field for the first time in the variety HFP 9907B. But in rest of the varieties the larval population was recorded for the first time on 18.01.19 (3^{rd} SMW). The peak larval population was recorded at fifty percent pod maturity stage of the crop when temperature (maximum and minimum), relative humidity (maximum and minimum), wind velocity and sunshine hours and rainfall were 29.8 ^{0}C, 12.1 ^{0}C, 91.6%, 40.7%, 0.4 km/ h, 7.2 h and 0.6 mm respectively. Thereafter, the pest population gradually declined and reached to its minimum level of 0.02 larvae per plants in variety HFP 1428 on 22^{nd} February (8^{th} SMW) when the crop was fully matured. Among the screened varieties highest larval population was observed in variety HFP 9907B followed by NDPT 2017 06, IFP 1718 and HFP 1428 at fifty percent pod maturity stage of the crop during both of the seasons.

The present findings showed the peak activity of gram pod borer during second and third week of February in both years of experimentation. Singh *et al.* (2015) [20] reported that maximum prevalence of gram pod borer larvae was found at podding stage of chickpea with abrupt temperature rise by 5^{0} C in February. Dubey *et al.* (1993) [4] also observed the peak activity of *H. armigera* in February to March on the same crop. Reddy *et al*. (2009) [15] found that the incidence of gram pod borer, *Helicoverpa armigera* in chickpea commenced from second week of February however, Prasad *et al.* (1997) [14] obtained maximum adult catches of *H. armigera* in late March. According to Kumar *et al.* (2018) [10], gram pod borer population occurred on pea throughout its growth phase, being low at vegetative stage and high at pod formation stage. The present results are also in partial accordance with the findings of Gautam *et al*. (2018) [6], Singh and Ali (2006) [18]. They reported the incidence of *Helicoverpa armigera* from December to March, though all of them worked on chickpea.

Correlation between gram pod borer population with weather parameters

The data of larval population of gram pod borer was correlated with prevailing weather parameters to signify the impact of abiotic factors. Correlation studies revealed that the pest population exhibited a highly significant positive correlation with maximum, minimum temperature and a non-significant positive correlation with sun shine hour in all varieties during both of the seasons. Maximum relative humidity had non-significant negative correlation with larval population. Minimum relative humidity also had non-significant negative correlation in all varieties during second year however, during first year the variety NDPT 2017 06 and HFP 9907B showed a significant negative relation (r = -0.619 and r = -0.628) but rest two varieties (IFP 17 18 and HFP 14 28) showed non- significant negative (r = -0.583 and r = -0.520) relation. Similarly, the pest populations exhibited a non-significant negative correlation with rainfall in all varieties during second year but in first year the variety NDPT 2017 06 showed only non-significant negative correlation (r = -0.046) with rainfall and rest three varieties (IFP 17 18, HFP 14 28 and HFP 990 7B) showed non-significant positive correlation (r = 0.004, r = 0.036 and r = 0.034 respectively) with rainfall. In case of wind speed a non-significant and positive correlation was obtained in all varieties during second season but in first season a non-significant negative correlation (r = -0.072) was found in the variety HFP 990 7B and rest of the varieties (IFP 17 18, HFP 14 28 and NDPT 2017 06) showed non-significant positive correlation (r = 0.020, r = 0.105 and r = 0.017 respectively).

Multiple stepwise linear regressions during both of the seasons for all varieties were worked out and presented in table 4. The regression equations revealed that among the various weather parameters maximum temperature was found to be the most influencing factor for significant variation in the incidence of pod borer population in pea.

The present investigations are in close accordance with the findings of Singh *et al.* (2015) [20], Reddy *et al*. (2009) [15], Devi *et al*. (2002) [3] and Yadav *et al*. (1998) [23] who reported that reported that temperature had a positive correlation with larval population while relative humidity showed negative correlation. The present findings are partial accordance with Vaishampayan and Veda (1980) [22] reported a positive correlation between pod borer population dynamics and temperature while a negative correlation with relative humidity and sunshine. The present findings are also partial accordance with Kumar *et al.* (2015) [9] they found that the larval population of pod borer have significant positive correlation with maximum temperature (r = 0.886), minimum (r = 0.858) temperature and non-significant positive relation with rainfall (r = 0.158) while, negative non-significant relation with relative humidity (r = -0.569). The results are also in agreement with the findings of Singh *et al*. (2014) [19] and Pandey *et al*. (2012) [12] reported that the negative correlation of rainfall and relative humidity with the pest activity, whereas maximum and minimum temperature, were positively correlated with pest activity. The present findings are in partial agreement with the findings of Gupta and Desh (2002) [7] who reported positive correlation between *H. armigera* population with maximum temperature, relative humidity and rainfall in chickpea.

Conclusion

Based on the results, it can be concluded that gram pod borers (*Helicoverpa armigera* Hubn.) on field pea in lower Gangetic plains of West Bengal commenced from 2nd week of January at flowering stage of the crop and remained up to harvesting stage of the crop i.e. 1st week of March. The pest population reached its peak activity during 2nd or 3rd week of February at fifty percent pod maturity stage of the crop. Variation in peak period of the gram pod borer population may be due to differed climatic condition, sowing time and biotic component of the environment. Correlation between weather parameters and larval pod borer population revealed that the pest population exhibited positive correlation with temperature (maximum and minimum) but negative correlation with relative humidity (maximum and minimum). From the multiple stepwise regression studies it can be inferred that among the various abiotic factors maximum temperature becomes the prime influencing factor over population dynamics of gram pod borer in field pea.

Acknowledgements

We are grateful to the Chairman, Dr. Amitava Banerjee, Department of Agricultural Entomology, Bidhan Chandra Krishi Viswavidyalaya for providing assistance to carry out the research work.

Table 1: Seasonal incidence of Gram pod borer population on different field pea varieties during 2017-18

SMW	Date	Pod borer population (larvae/plant) recorded in different varieties *				Weather parameters						
		IFP 17 18	HFP 14 28	NDPT 2017 06	HFP 990 7B	Tmax (⁰C)	Tmin (⁰C)	Rhmax (%)	Rhmin (%)	WS (Km/h)	SSH (h)	RF (mm)
51	18.12.17	0.0	0.0	0.0	0.0	24.10	13.60	93.90	64.60	0.2	4.8	0.0
52	25.12.17	0.0	0.0	0.0	0.0	25.50	11.70	94.05	56.85	0.4	6.5	0.0
1	01.01.18	0.0	0.0	0.0	0.0	22.51	8.60	93.00	50.57	0.3	7.2	0.0
2	08.01.18	0.0	0.0	0.0	0.0	21.97	7.80	91.40	54.10	0.3	4.0	0.0
3	15.01.18	0.25	0.16	0.25	0.50	25.14	8.40	91.30	45.00	0.3	7.4	0.0
4	22.01.18	0.50	0.25	0.83	0.91	26.80	9.84	88.14	41.28	0.31	8.0	0.0
5	29.01.18	1.16	0.66	1.08	1.75	28.34	12.42	91.85	49.57	0.22	6.1	0.01
6	05.02.18	1.83	1.08	2.00	2.00	29.60	15.80	87.30	40.10	0.2	5.9	0.0
7	12.02.18	2.83	1.50	3.16	3.33	29.80	14.30	88.90	43.90	0.4	8.1	0.0
8	19.02.18	4.16	2.41	4.50	5.16	33.70	18.30	90.70	42.90	0.3	5.7	0.0
9	26.02.18	1.91	0.50	2.08	2.91	33.20	19.80	95.01	43.02	0.2	6.3	0.0
10	05.03.18	1.08	0.33	1.58	2.33	33.41	20.01	95.42	43.54	0.2	6.2	0.0

*Mean values of three replications

Table 2: Seasonal incidence of Gram pod borer population on different field pea varieties during 2018-19

SMW	Date	Pod borer population (larvae/plant) recorded in different varieties*				Weather parameters						
		IFP 17 18	HFP 14 28	NDPT 2017 06	HFP 990 7B	Tmax (⁰C)	Tmin (⁰C)	Rhmax (%)	Rhmin (%)	WS (Km /h)	SSH (h)	RF (mm)
49	06.12.18	0.0	0.0	0.0	0.0	26.1	12.1	92.1	43.3	0.2	5.5	0.0
50	13.12.18	0.0	0.0	0.0	0.0	25.6	13.9	87.7	49.4	0.3	4.4	18.8
51	20.12.18	0.0	0.0	0.0	0.0	22.2	11.5	96.6	60.3	0.3	5.9	0.4
52	27.12.18	0.0	0.0	0.0	0.0	22.9	8.0	93.3	39.0	0.2	7.8	0.0
1	04.01.19	0.0	0.0	0.0	0.0	25.0	8.6	91.1	41.1	0.2	7.7	0.0
2	11.01.19	0.0	0.0	0.0	0.08	24.7	9.9	90.9	44.7	0.2	6.1	0.0
3	18.01.19	0.33	0.01	0.41	0.63	24.9	9.4	89.3	42.1	0.2	7.3	0.0
4	25.01.19	0.50	0.16	1.16	1.18	27.9	13.1	89.3	46.6	0.2	5.2	0.0
5	01.02.19	0.66	0.09	0.58	0.82	28.1	10.5	89.3	34.1	0.2	8.3	0.0
6	08.02.19	0.91	0.33	1.41	1.62	29.8	12.1	91.6	40.7	0.4	7.2	0.6
7	15.02.19	0.41	0.24	0.38	0.45	28.6	15.4	89.3	39.4	0.3	7.8	0.0
8	22.02.19	0.25	0.02	0.21	0.32	27.2	13.2	89.2	39.2	0.2	7.6	0.0

*Mean values of three replications

Table 3: Correlation between Gram pod borer population on four different varieties of pea with meteorological parameters during two years of experimentation

Year	Variety	Tmax	Tmin	Rhmax	Rhmin	WS	SSH	RF
2017-18	IFP 17 18	0.799**	0.668*	-0.312	-0.583*	0.020	0.110	0.004
	HFP 14 28	0.783**	0.685**	-0.441	-0.520	0.105	0.091	0.036
	NDPT 2017 06	0.828**	0.676**	-0.307	-0.619*	0.017	0.141	-0.046
	HFP 9907B	0.889**	0.654*	-0.187	-0.628*	-0.072	0.121	0.034
2018-19	IFP 17 18	0.824**	0.605*	-0.309	-0.432	0.206	0.355	-0.243
	HFP 14 28	0.806**	0.662*	-0.176	-0.267	0.344	0.210	-0.179
	NDPT 2017 06	0.748**	0.621*	-0.237	-0.228	0.298	0.091	-0.208
	HFP 9907B	0.759**	0.649*	-0.270	-0.295	0.252	0.173	-0.231

** Significance at 1% level in two tail * Significance at 5% level in two tail

Table 4. Multiple step-wise linear regression between *Helicoverpa* population and meteorological parameters during two years of experimentation

Year	Variety	Regression equation	R^2 value	Parameters	Remarks
2017-18	IFP 17 18	$Y_1 = -5.932 + 0.254 X_1^*$	$R^2 = 0.638$	X_1= Max Temp Y_1= pod borer population	Maximum temperature becomes the sole influencing factor over larval population of pod borer for varieties IFP 17 18, NDPT 2017 06, HFP 990 7B but in case of variety HFP 14 28 both maximum and minimum temperature play significant role over population fluctuation of pod borer.
	HFP 14 28	$Y_2 = -4.267 + 0.124 X_1^{**} + 0.132 X_2^*$ $Y_2 = -2.779 + 0.120 X_1^*$	$R^2 = 0.583$ $R^2 = 0.672$	X_1= Max Temp X_2= Min Temp Y_2= pod borer population	
	NDPT 2017 06	$Y_3 = -6.692 + 0.287 X_1^{**}$	$R^2 = 0.686$	X_1= Max Temp Y_3= pod borer population	
	HFP 9907B	$Y_4 = -8.207 + 0.351 X_1^{**}$	$R^2 = 0.790$	X_1= Max Temp Y_4= pod borer population	
2018-19	IFP 17 18	$Y_1 = -2.652 + 0.112 X_1^{**}$	$R^2 = 0.680$	X_1= Max Temp Y_1= pod borer population	During second season also maximum temperature becomes the prime influencing factor over population dynamics of pod borer for varieties IFP 17 18, NDPT 2017 06 and HFP 990 7B however, in variety HFP 14 28 both maximum and minimum temperature have significant role over the incidence and activity of pod borer population.
	HFP 14 28	$Y_2 = -1.002 + 0.036 X_1^{**} + 0.599 X_2^*$ $Y_2 = -0.957 + 0.039 X_1^*$	$R^2 = 0.772$ $R^2 = 0.614$	X_1= Max Temp X_2= Min Temp Y_2= pod borer population	
	NDPT 2017 06	$Y_3 = -3.753 + 0.157 X_1^*$	$R^2 = 0.515$	X_1= Max Temp Y_3= pod borer population	
	HFP 9907B	$Y_4 = -4.220 + 0.178 X_1^*$	$R^2 = 0.576$	X_1= Max Temp Y_4= pod borer population	

** Significance at 1% level (two tail) * Significance at 5% level (two tail)

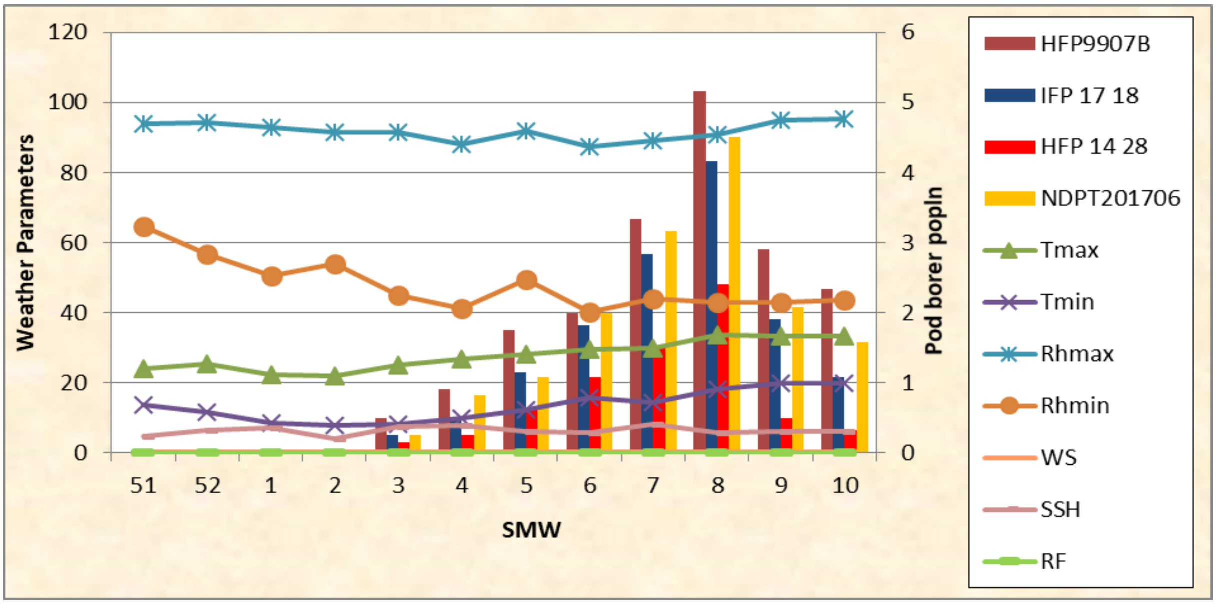

Fig 1: Interaction of weather parameters with pod borer population in 2017-18

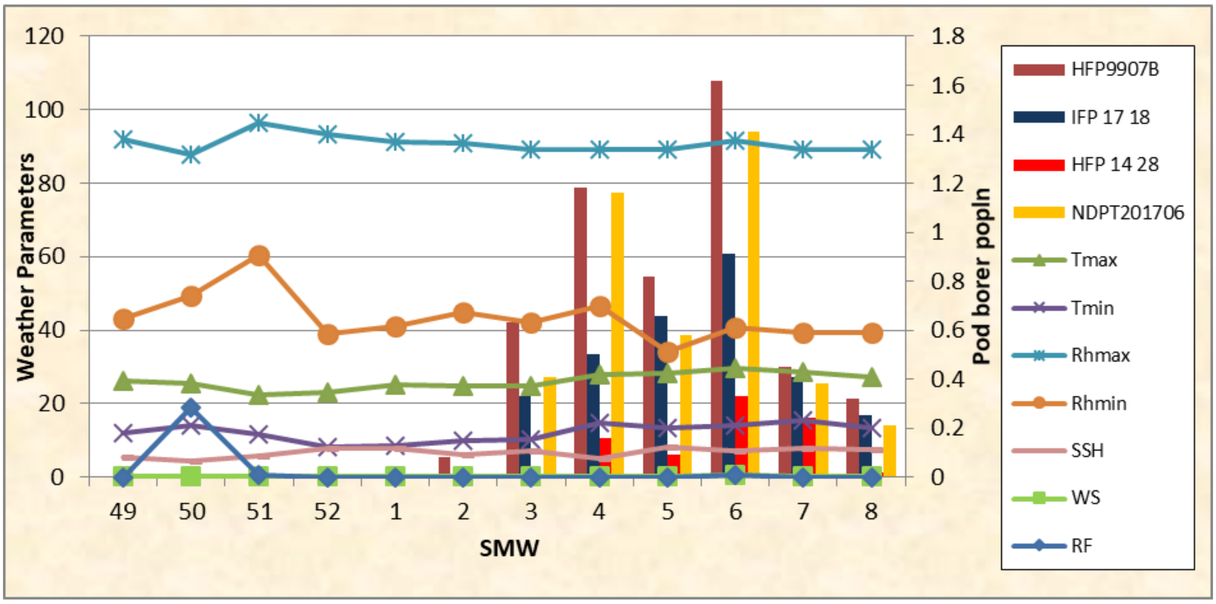

Fig 2: Interaction of weather parameters with pod borer population in 2018-19

References

1. Anon. Annual Vegetable Research Report: 2005-06 presented in 3rd meeting of Crop Improvement Sub-committee held on 5-6 April, at Anand. 2007, 103.
2. Bhati NJ, Patel KK. Biology and management of chickpea pod borer. *H. armigera* (Hub.) Hardwick. Abstract published in National Conference on Plant protection-New Horizons in the millennium at RCA from Feb. 23-25, Abstract No. 2001; 231:70.
3. Devi NS, Singh OH, Devjani P, Singh TK. Natural enemies of *Helicoverpa armigera* Hubner on chickpea. Annales of Plant Protection Sciences. 2002; 2(10):179-183.
4. Dubey OP, Odak SC, Gargav VP. Population dynamics of gram pod borer. JNKVV Research Journal. 1993; 27(1):59-63.
5. FAO STAT. Food and Agriculture Organization of the United Nations [Online], Available at: http://www.faostat.fao.org. 2015.
6. Gautam MP, Chandra C, Yadav SK, Jaiswal R, Giri SK, Singh SN. Studies on population dynamics of garm pod borer *Helicoverpa armigera* (Hubner) on chickpea (*Cicer arietinum* L.). Journal of Entomology and Zoology Studies. 2018; 6(1):904-906.
7. Gupta RK, Desh R. Monitoring of *Helicoverpa armigera* (Hubner) through light trap and pheromone traps and relationship of catch data with abiotic factors and larval infestation on chickpea in Himachal Pradesh. Pest Management and Economic Zoology. 2002; 10(2):103-110.
8. Krinski D, Godoy AF. First record of *Helicoverpa armigera* (Lepidoptera: Noctuidae) feeding on *Plectranthus neochilus* (Lamiales; Lamiaceae) in Brazil. Florida Entomologist. 2015; 98(4):1238-1240.
9. Kumar S, Singh G, Singh DV, Sidhartha NR. Seasonal incidence of larval population of gram pod borer *Helicoverpa armigera* (Hubner.) on chickpea in Meerut. Progressive Agriculture. 2015; 15(2):259-262.
10. Kumar N, Kumar L, Visvash V, Singh R, Kumar A, Kumar A. Seasonal abundance and effect on insect pest associate with vegetable pea crop under abiotic factors of U.P. Journal of Pharmacognosy and Phytochemistry. 2018; 7(1):1689-1693.
11. Mathur *et al*. In: Proc. National Symp. Frontier Area on Entomological Research, New Delhi Nov-5-7, 2003.
12. Pandey BM, Tripati MK, Lakshmi V. Seasonal incidence of gram pod borer *Helicoverpa armigera* (hub.) on chickpea in Varanasi area. Journal of Exerimental Zoology. 2012; 15(2):667-669.
13. Phokela A, Dhingra S, Sinha SN, Mehrotra KN. Pyrethroid resistance in *Heliothis armigera* Hub. III Development of resistance in field. Pesticide Research Journal. 1990; 2(l):28-30.
14. Prasad CS. Host range and seasonal incidence of *Helicoverpa armigera* Hubner in the lower Kumaon Hills of Uttar Pradesh. Indian Insect Environment. 1997; 3(2):33-34.
15. Reddy AV, Anandhi P, Elamathi S, Verma S. Seasonal occurrence of pulse pod borer *Helicoverpa armigera* (L.) on chick pea at eastern U.P. region. Agricultural Science Digest. 2009; 29(2):60-62.
16. Sarode SV. Sustainable management of *Helicoverpa armigra* (Hubner). Pestology Special issue. 1999; 13(2):279-284.
17. Shengal VK, Ujagir R. Effect of synthetic pyrethroids, neem extracts and other insecticides for the control of pod damage by *Helicoverpa armigera* on chickpea and pod damage-yield relationship at Patancheru in Northern India. Crop Protection. 1990; 9:29-32.
18. Singh R, Ali S. Seasonal incidence of Helicoverpa armigera and Campoletis chloridae on chick pea. Annales of Plant Protection Sciences. 2006; 14(1):234-235.
19. Singh S, Singh RS, Shanker K, Verma SK. Seasonal profusion of gram pod borer, *Helicoverpa armigera* hubner In chick pea in relation to meteorological surroundings. Society for Sci. Dev. in Agric. and Tech. Progressive Research. 2014; 9(1):268-271.
20. Singh D, Singh SK, Vennila S. Weather parameters influence population and larval parasitization of *Helicoverpa armigera* (Hübner) in chickpea ecosystem. Legume Research. 2015; 38(3):402-406.
21. Vaibhav V, Singh G, Maurya NK, Vishvendra. Seasonal incidence of major pod borers *Etiella zinckenella* (Treitschke) and *Helicoverpa armigera* (Hubner) of vegetable pea in relation with abiotic factors. Journal of Entomology and Zoology Studies. 2018; 6(3):1642-1644.
22. Vaishampayan SM, Veda OP. Population dynamics of gram pod borer *Helicoverpa armigera* (Hub.) and its outbreak situation on gram (*Cicer arietinum* L.). Indian Journal of Entomology. 1980; 42(3):453-459.
23. Yadav CP, Lal SS. Relationship between certain abiotic and biotic factors and the occurrence of gram pod borer, *Helicoverpa armigera* (Hb.) on chickpea. Entomon. 1998; 13(3-4):269-273.