Original Research Article

Population dynamics of gram pod borer (*Helicoverpaarmigera*Hubner, 1805) and its larval parasitoid (*Campoletischloride* Uchida, 1957) on chickpea

Abstract

The present investigation was carried out to study the population dynamics of gram pod borer (*Helicoverpaarmigera*Hubner) and its larval parasitoid (*Campoletischlorideae*) on chickpea during the *Rabi* season 2020-21 at College of Agriculture, JNKVV, Tikamgarh (M.P.). The egg and larval population of gram pod borer (*Helicoverpaarmigera*) were first observed on vegetative stages at 49th SW (i.e. 3rd to 9th December) and 50th SW (i.e. 10th to 16th December), respectively and were available till the maturity of crop with two peaksi.e. first and second peak at 3rd SW and at 9th SW, respectively. The result of correlation studies revealed that both number of eggs and larval populations were found significant positive correlation with maximum temperature and evaporation. While, both of these egg numbers and larval populations were found to be significant negative correlation with morning RH. The larval parasitoid population (*C. chlorideae*) first appeared at vegetative stage of the crop at 51st SW (i.e. 17th to 23rd December) (0.20 parasitoid/*mrl*) with two peak points first at 3rd SW and second at 6th SW. The result of correlation studies revealed that the larval parasitoid population found significant positive correlation with morning RH, whereas it was exhibited significant negative correlation with maximum and minimum temperature and evaporation, respectively.

Keywords:*Helicoverpaarmigera*,*Campoletischlorideae*,population dynamics,chickpea.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is a most popular legume crop of Fabaceae family which is grown across the world. It is also known as gram, Bengal gram, Chhana, Chana,Garbanzo bean, Egyptian pea etc. in various region of theworld. It is one of the most important pulse cropof India hence it is considered as ‘King ofpulses’and also ‘the poor man's meat’ (Bhatt and Patel, 2001). Chickpea containhighest nutritional composition among any dry edible legume having 23% protein, 47% starch, 56% fat, 6% crude fiber, 6% soluble sugar, 3% ash and oil contains many medicinal and nutritionally important tocopherols, sterols and tocotrienols which are helpful for lowering blood cholesterol (Haq *et al*., 2007 and Pittaway *et al*., 2008).

Indiais the largest producer of chickpea in the world with contributing71 and 70 percent global area production, respectively, and ranks first in area and production of chickpea. Though, it is stay behind from several countries in terms of productivity because of poor adoption of plant protection measures by the chickpea growers (Samriti *et al.,* 2020).In India, the cultivation of chickpea was occupied during 2020-21 in 10 million ha area with production and productivity of 11.91 million tones and 1192 kg/ha, respectively (Anonymous, 2022).Theforemost chickpea producing states in India are Madhya Pradesh (26.99%), Maharashtra (20.12%), Rajasthan (19.02%), Gujarat (10.74%) and Uttar Pradesh (6.38%) which aresolely contributed about 50% of the Indian pulse production. In Madhya Pradesh,chickpea was cultivatedin 2.16 million ha area with the production and productivity of 3.21 million tones and 1488 kg/ha, respectively during 2020-21 (Anonymous, 2022).

The productivity of chickpea crop has not witnessed any significant jump as compared to the cereal crops, because of several biotic and abiotic constraints. Among the biotic constraints the infestation of insect pests is one of the major limiting factors of chickpea production (Bhagwat *et al.,* 1995). Chickpea is infested by nearly 60 different types insect pestsamong which gram pod borer (*Helicoverpaarmigera*), cutworm(*Agrotisipsilon*Hufnagel, 1766), termite (*Odontotermesobesus* Rambur, 1842) and black bean aphid (*Aphis fabae*Scopoli, 1763) are the major pests (Acharjee and Sharma, 2013 and Chandrashekar *et al*.,2014). Of them, *H. armigera* is one of the most devastating pests causing severe yield loss and infesting several crops such as cereals, pulses, cotton, vegetables and fruit crops as well as wild hosts. *H. armigera* is distributed throughout India and account for 50 to 60% losses in grain yield (Balikai*et al*., 2001). Thebuild-up of larval population of *H. armigera*is dynamically influenced by different weather factors. Moreover, their populations are also significantlyregulated by their natural enemies particularly larval parasitoid (*Campoletischlorideae*). Hence, keeping the above facts in mindthe present study was planned to know the effect of biotic and abiotic factors of gram pod borer in chickpea to find out suitable and feasible tactics by understanding its biology and build up of this pest.

MATERIALS AND METHODS

A field experiment was conducted to study the population dynamics of gram pod borer (*Helicoverpaarmigera*) and its parasitoid (*Campoletischlorideae*) on chickpea during the *Rabi* season 2020-21 at Experimental Field of College of Agriculture, JNKVV, Tikamgarh (M.P.), India. The crop variety JG-12 was shown with30cm x 10cm spacing in total 270 square meter area. All the recommended agronomical practices were followed and the crop was kept free from insecticidal spray.

Observations onthe number of eggs and the larval population of *H. armigera*were recordedweekly from one meter row length (*mrl*) at randomly selected ten different sites ofthe experimental field. Similarly,larval parasitoid (*Campoletischlorideae*) of *H. armigera* was also recorded from one per *mrl* at randomly selected ten different sites in the field.All these observations was started from the first appearance of the insects and continued till their availability or maturity of the crop.The obtained data was statistically analyzed through simple correlationcoefficient and regression equation among the gram pod borer and its parasitoid with weather parameters by using the formula as described by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

Egg population of H. armigera

The data presented in Table 1 and Fig. 1 revealed that the egg population of gram pod borer was ranged between 0.30-4.80 eggs/*mrl*during *Rabi*season. The incidence of the number of eggs (0.30eggs/*mrl*) was first appeared on vegetative stage of chickpea crop at 49th SW (i.e. 3rd to 9thDecember). The number of eggs increased in the following weeks and reached its first peak (2.50 eggs/*mrl*) at 3rd SW (i.e. 15thto 21stJanuary). After that, eggsnumber slightly declined (1.30 eggs/*mrl*) at 4thSW (i.e. 22nd to 28thJanuary)and (1.10 egg/*mrl*) at 5thSW (i.e. 29thJanuary to 4thFebruary). Then the number of eggs slightly increased again and reached its second peak (4.80 eggs/*mrl*) at 9th SW (i.e. 26thFebruary to 4thMarch). Later on, the number of eggsgradually declinedas the crop reached the maturity stage.The present findings are corroborated with the findings of Dindor*et al.* (2020) as they reported that the egg population of gram pod borer first appeared from 49th SW. The two peaks incidence were observed in the finding of Tekam*et al*. (2018) indicating a close conformity to present findings.

Correlation between the number of eggs of the gram pod borer and weather factors

Correlation studies revealed that the number of eggs showed significantly positive correlation with maximum temperature and evaporation (r= 0.56 and r= 0.56, respectively)(Table 2).The regression equations being as$\bar{Y}$ =-2.61 + 0.17x (R^2 = 0.32)and$\bar{Y}$= -0.26 + 0.59x (R^2= 0.31). From theseequations it may be expressed that with every unit increase in maximum temperature and evaporation there was an increase of 0.17 and 0.59 eggs number/*mrl*(Fig. 2 and 3, respectively). While, minimum temperature and sunshine exhibited positive correlation (r= 0.21 and r= 0.45, respectively) with the influence on the number of eggs but statistically found to be non-significant. Further, morning RH exhibited significantly negative correlation (r= -0.53) with egg population. The regression equations being as$\bar{Y}$=12.65 - 0.12x (R^2 = 0.28).From this equation it may be expressed that with every unit increase in morning RH there was a decrease of 0.12 egg number/*mrl*(Fig.4).

Our result fully agreed with findings of Shah and Shahzad (2005)as reported that maximum temperature exhibited significantly positive correlation, morning RH showed significantly negative correlation and evening RH exhibited negatively non-significant correlation with eggs number.Jagdish and Agnihotri (2015) reported that maximum temperature exhibited significantly positive correlation, minimum temperature had exhibited positively correlated with eggs number but statistically found to be non-significant, evening RH exhibited negatively non-significant correlation, rainfall exhibited negatively non-significant correlation and sunshine had exhibited non-significant positive correlation with egg population. Tekam*et al.* (2018) also reported that maximum temperature and evaporation had exhibited significantly positive while,minimum temperature exhibited positive correlation with eggsnumber but statistically found to be non-significant. Further, evening RH and rainfall exhibited negatively non-significant correlation while,sunshine had exhibited positive non-significant correlationwith the number of eggs.

Larval population of H. armigera

The population of gram pod borer larvae were ranged between 0.00 - 4.60 larvae/*mrl*during *Rabi* season presented in Table 1 and Fig. 1. The incidence of larval population with 0.20 larvae/*mrl*first appeared on vegetative stage of chickpea crop at 50th SW (i.e. 10th to16th December). The population of larvae slightly increased uptonext four weeks and reached its first peak(2.30 larvae/*mrl*) at 3rd SW (i.e. 15thto 21st January). After that, the larval population slightly declined with 1.10 and 0.90 larvae/*mrl*) during 4th SW (i.e. 22nd to 28th January) and 5th SW (i.e. 29thJanuary to 4th February), respectively. Later on larval population slightly increased and resumed its second peak(4.60 larvae/*mrl*) at 9th SW (i.e. 26thFebruary to 4thMarch). Then larval population slightly declined with the maturity of crop.

The first incidence of larval population of gram pod borer on chickpea was also evident from the reports of Yadav *et al.* (2016) and Kaneria *et al*. (2018) as they also reported that incidence of larval population of gram pod borer on chickpea was started 2nd week of

December (50th SW). Similarly, Patel *et al.* (2015) partially supported and reported that the incidence of gram pod borer was started from the 2nd week of November which remained till 4th week of February with its peak activity was recorded during 1st and 2nd week of December. Contrarily, Gautam *et al*. (2018) and Kumar *et al*. (2019) recorded the incidence of gram pod borer population first time during 46th SW while, Sardar *et al.* (2018) recorded its incidence first time during 47th SW on chickpea crop. Munni *et al.* (2013), Kumar and Srivastava (2017) also recorded two peaks of larval population of gram pod borer on chickpea.

Correlation between larval population of H. armigera and weather factors

The result of correlation studies in Table 2 revealed that larval population exhibited significantly positive correlation with maximum temperature and evaporation (r= 0.57 and r= 0.57, respectively).The regression equations being as$\bar{Y}$= -2.93 + 0.17x (R^2 = 0.32)and $\bar{Y}$= -0.55 + 0.61x (R^2= 0.32).From the above equations it may be expressed that with every unit increase in maximum temperature and evaporation there were an increase of 0.17 and 0.61 larval population/*mrl*(Fig. 5 and 6, respectively). Minimum temperature and sunshine wasexhibited non-significant positive correlation with influence of larval population.Further, morning RH exhibited significant and negative correlation (r= -0.55) with larval population. The regression equations being as$\bar{Y}$=13.10 - 0.13x (R^2 = 0.30).From this equation it may be expressed that with every unit increase in morning RH there was a decrease of0.13 larval population/*mrl*(Fig.7).While, evening RH and rainfall expressed negative correlationwith larval population but statistically it was found to be non-significant.

The present findings are the full agreement with those of Yadav *et al.* (2016), Kumar and Srivastava (2017), Spoorthi *et al.* (2017), Bahadur *et al.* (2018), Singh *et al.* (2018), Kumar *et al*. (2019) and Waseem and Thakur (2019) as they reported that maximum temperature exhibited significantly positive and minimum temperature expressed non-significant positive correlation with the influence of larval population of gram pod borer. Similarly, Meena and Bhatia (2014), Sagar *et al.* (2017), Bala (2020) and Sharma *et al.* (2020) also reported that maximum temperature exhibited significantly positive correlation with the influence of larval population of gram pod borer.Further, Meena and Bhatia (2014), Bahadur *et al.* (2018) and Waseem and Thakur (2019) also reported that morning RH had exhibited significant negative correlation with larval population of gram pod borer.

Population of larval parasitoid (Campoletischlorideae)

The data presented in Table 1and Fig. 1 revealed that the population of larval parasitoid (*C. chlorideae*)was ranged between 0.00-1.90 parasitoid/*mrl*during *Rabi* season. The incidence of parasitoid population first started to appear on vegetative stage of chickpea crop at 51stSW (i.e. 17thto 23rd December) (0.20 parasitoid/*mrl*). The population of parasitoid increased in the following weeks and reached its first peak (1.90 parasitoid/*mrl*) at 3rd SW (i.e. 15thto 21st January).After that the parasitoid population gradually declined 0.90 parasitoid/*mrl*and 0.80 parasitoid/*mrl* at 4th SW (i.e. 22nd to 28th January) and 5th SW (i.e. 29thJanuary to 4thFebruary), respectively and again resumed itssecond peak (1.1 parasitoid/*mrl*)during 6th SW (i.e. 5th to 11thFebruary). Later onthis trend slightly declined toward the maturity of crop.The present findings are in full conformity with those of Devi *et al.* (2002) and Kaur *et al*. (2004) as they found the percentage of parasitism ranged from 0.18 to 23.81% and 0.02 to 1.50 cocoons/*mrl,* respectively. Similarly, Bisane*et al*. (2008) also observed that the occurrence of *C. chlorideae*firstly observed at 51st SW until 3rd SW and caused 8.11 to 11.54% parasitisation in chickpea. Further, Singh *et al.* (2018) indicated that larval parasitization by *C. chlorideae* was first observed in 3rd week of December (*i.e*., 51st SW) this result is in close conformity with the present finding.

Correlation between larval parasitoid (C. chlorideae) and weather factors

The result of correlation studies revealed that larval parasitoid population showed significantly positive correlation with morning RH (r= 0.53) (Table 2).The regression equations being as$\bar{Y}$= -3.92+0.05x (R^2 = 0.28).From this equation it may be expressed that with every unit increase in morning RH there was an increase of 0.05 parasitoid population/*mrl*(Fig.8).While, evening RH exhibited positive correlation (r= 0.31 respectively) with the influence of larval parasitoid population but statistically found to be non-significant.Further, maximum temperature, minimum temperature and evaporation exhibited significant and negative correlation (r= -0.53, r= -0.56 and r = -0.59, respectively) with larval parasitoid population.The regression equations being as$\bar{Y}$= 2.31-0.06x (R^2 = 0.28),$\bar{Y}$= 1.43 - 0.09x (R^2= 0.31) and$\bar{Y}$=1.51- 0.26x (R^2 = 0.35).From this equation it may be expressed that with every unit increase in maximum temperature, minimum temperature and evaporation there was a decrease of 0.06, 0.09 and 0.26 larval parasitoid population/*mrl*(Fig.9, 10 and 11, respectively).While, sunshine and rainfall exhibitednon-significant negative correlation (r= -0.05 and r= -0.31, respectively) with parasitoid population.

Similar findings was also reported by Bhagat *et al*. (2020) and Divija and Agnihotri (2021) as they computed that maximum temperature and minimum temperature exhibited significantly negative correlation with the influence of parasitoid population (*C. chlorideae*) and morning relative humidity had exhibited significantly positive correlation with parasitoid population. Similarly, Munni *et al.* (2013) reported that *C. chlorideae* exhibited reciprocal relationship with weather parameters and suppressed the larval population of gram pod borer in chickpea crop.

CONCLUSION

It was concluded that the number of eggs and the larval population of gram pod borer was first observed on vegetative stages and was available till the maturity of crop with two peak points first peak at 3^{rd} SW and second peak at 9^{th} SW, respectively. The result of correlation studies revealed that both eggs number and larval populations was found significant positive correlation with maximum temperature and evaporation. While, both the number of eggs and the larval populations were found significantly negative correlation with morning RH. The parasitoid population first appeared at vegetative stage of the crop with two peak points i.e., first at 3^{rd} SW and second at 6^{th} SW. The result of correlation studies revealed that the parasitoid population found significant positive correlation with morning RH, whereas it was exhibited significant negative correlation with maximum and minimum temperature and evaporation, respectively.

REFERENCES

Acharjee S, Sharma BK. Transgenic *Bacillus thuringiensis* (*Bt*) chickpea India's most wanted genetically modified (GM) pulse crop. Afr J Biotechnol.2013;12:5709-5713.

Anonymous, Agriculture Statistics At A Glance. Directorate of Economics and Statistics, Department of Agriculture, Cooperation and Farmer Welfare Ministry of Agriculture and Farmer Welfare, Government of India. 2022 pp. 42-43.

Bahadur DGM, Keval R, Verma S, Bisht K. Seasonal occurrence of gram pod borer [*Helicoverpaarmigera* (Hubner)] on chickpea in Varanasi. J EntomolZool Stud. 2018; 6:786-790.

Bala SCH. Population fluctuation and management of gram pod borer, *Helicoverpaarmigera* (Hubner) infesting chickpea in new alluvial zone of West Bengal, India. J EntomZool Stud.2020; 8:262-266.

Balikai RA, Biradar AP, Yelshetty S,TeggelliRG. Relative efficacy of some selected insecticides against chickpea pod borer, *Helicoverpaarmigera* (Hub.). KarnatakaJ Agric Sci.2001; 14:346.

Bhagat JK, Soni VK,Chandraker HK.Surveillance of pod borer, *Helicoverpaarmigera* (Hubner) and its natural enemies on chickpea at Sahaspur Lohara blocks. J PharmacogPhytochem. 2020;9:1995-2000.

Bhagwat VR, Aherkar SK, Satpute US, Thakare HS. Screening of chickpea (*Cicer arietinum* L.) genotypes for resistance to gram pod borer, *Helicoverpaarmigera* (Hubner) and its relationship with malic acid in leaf exudates. J Entomol Res.1995; 19:249-253.

Bhatt NJ,Patel RK. Screening of chickpea cultivars for their resistance to gram pod borer *Helicoverpaarmigera*. Indian J Entomol.2001; 63:277-280.

Bisane KD, Nehare SK, Khande DM. Extent of parasitisation of *Helicoverpaarmigera* (Hubner) by larval and pupal parasitoid on chickpea. J Entomol Res.2008; 32:295-301.

Chandrashekar K, Gupta O, Yelshetty S, Sharma OP, Bhagat S, ChattopadhyayC, Sehgal M, Kumari A, Amaresan N, Sushil SN, Sinha AK, Asre R, Kapoor KS, Satyagopal K,Jeyakumar P. Integrated Pest Management for Chickpea. 2014; pp. 43.

Devi NS, Singh OH, Devjani P,Singh TK. Natural enemies of *Helicoverpaarmigera*Hubner on chickpea. Ann Plant Protec Sci.2002; 10:179-183.

Dindor MA, Panikar B, Chaudhari SJ. Population dynamics of pod borer *Helicoverpaarmigera* on chickpea. Indian J Entomol.2020; 82:330-332.

Divija SD,Agnihotri M.Impact of abiotic factors and dates of sowing on *Helicoverpaarmigera* (Hubner) parasitoid *Campoletischlorideae* (Uchida) under chickpea cropping system in Tarai region of Uttarakhand. Legume Res - An Int J. 2021:1-4.

Gautam MP, Chandra U, Yadav SK, Jaiswal R, Giri SK, Singh SN. Studies on population dynamics of gram pod borer *Helicoverpaarmigera* (Hubner) on chickpea (*Cicer ceritinum* L.). J EntomolZool Stud.2018; 6:904-906.

Haq ZU, Ahmad M, Iqbal S. Characterization and compositional study of oil from seeds of Desi chickpea (*Cicer arietinum* L.) cultivars grown in Pakistan. J Am Oil Chem Soc.2007; 84:1143-1148.

Jagdish J, Agnihotri M. Relationship of certain abiotic factors and the incidence of gram pod borer, *Helicoverpaarmigera* (Hubner) in chickpea at Pantnagar.Int J Basic Appl Agric Res.2015;13:250-253.

Kaneria PB, Kabaria BB, Chudasama KA, Patel TM, Bharadiya AM. Effect of weather parameters on the seasonal incidence of *Helicoverpaarmigera* (Hubner) infesting chickpea in Saurashtra conditions, Gujarat, India.Int J Curr Microbiol Appl Sci. 2018;7:548-552.

Kaur S, Brar KS, Shehnmar M. Effect of different chickpea cultivars on parasitization of *Helicoverpaarmigera* (Hubner) by *Campoletischlorideae* Uchida. Biol Control. 2004;18:69-72.

Kumar A, Tripathi MK, Chandra U, Veer R. Studies on correlation co-efficient of larval population of *Helicoverpaarmigera* in reference to weather parameters. J EntomolZool Stud. 2019;7:06-08.

Kumar V, Srivastava AK. Seasonal incidence of *Heliothisarmigera* (Hubner) in gram. Plant Arch. 2017; 17:216-218.

Meena BS, Bhatia KN. Effect of weather parameters on population dynamics of gram pod borer (*Helicoverpaarmigera*) in North West Plain Zone of Rajasthan. J Agrometeorol.2014;16:233-235.

Munni L, Singh SV, Singh D, Pal BN. Population fluctuation of *Helicoverpaarmigera* and *Campoletischlorideae* and their relationship on chickpea. Agric Sci Di - A Res J. 2013; 33:77-79.

Patel SR, Patel KG, Ghetiya LV. Population dynamics of pod borer (*Helicoverpaarmigera*HUBNER) infesting chickpea in relation to abiotic factors. AGRES -An Int e-J. 2015; 4:163-170.

Pittaway JK, Robertson IK, Ball MJ. Chickpeas may influence fatty acid and fiber intake in an ad libitum diet, leading to small improvements in serum lipid profile and glycemic control. J Am Diet Assoc. 2008;108:1009-1013.

Sagar D, Nebapure Suresh M, Chander S. Development and validation of weather based prediction model for *Helicoverpaarmigera* in chickpea. J Agrometeorol.2017;19:328-333.

Samriti, Sharma S, Sharma R, Pathania A. Trends in area, production, productivity and trade of chick pea in India. Economic Affairs. 2020, 65:261-265.

Sardar SR, Bantewad SD, Jayewar NE. Seasonal incidence of *Helicoverpaarmigera* influenced by Desi and Kabuli genotype of chickpea. Int J Curr Microbiol Appl Sci. 2018; 6:536-541.

Shah ZA, Shahzad MK. Population fluctuations with reference to different developmental stages of *Helicoverpaarmigera* (Lepidoptera: Noctuidae) on chickpea and their relationship with the environment. Int J Agri Biol. 2005; 7(1):90-93.

Sharma S, Chandra U, Veer R, Kumar S, Yadav SK, Kumar A. Study on population dynamics of *Helicoverpaarmigera* (Hübner) in chickpea. J EntomolZool Stud. 2020;8:629-632.

Singh VV, Agarwal N, Sathish BN, Kumar S, Kumar S, Pal K. Studies on insect diversity in chickpea (*Cicer arietinum* Linnaeus) ecosystem. J EntomolZool Stud. 2018; 6:693-697.

Snedecor GW & Cochran WG, Statistical Methods. Oxford and IBH Publishing Company, New Delhi. 1967 pp 381-418.

Spoorthi GS, Singh R, Sachan SK, Singh DV, Sharma R, Kumar S. Monitoring and seasonal incidence of gram pod borer (*Helicoverpaarmigera*Hubner) in relation to abiotic factor in chick pea. J PharmacognPhytochem.2017;1:490-494.

Tekam KD, Kelwatkar NM, Das SB. Population dynamics of gram pod borer on late sown chickpea. J EntomolZool Stud. 2018; 6:620-623.

Waseem MA, Thakur S. To study the population dynamics of gram pod borer (*Helicoverpaarmigera*Hubner) in chickpea and to evaluate the benefit-cost ratio of different intercrop patterns. J PharmacognPhytochem.2019; 8:2840-2844.

Yadav PC, Ameta OP, Yadav SK. Seasonal of gram pod borer *Helicoverpaarmigera* (Hubner) in chickpea. J Exp Zool. 2016; 19:587-589.

Table 1: Population dynamics of egg and larval population of *Helicoverpaarmigera*and their larval parasitoid on chickpea crop during *Rabi* 2020-2021

Standard weeks	**Number of eggs /*mrl* *(H.armigera)***	**Larval population/*mrl* *(H.armigera)***	**Population of larval parasitoid (*C. chlorideae*/mrl)**
49	0.30 #	0.00#	0.00#
50	0.40	0.20	0.00
51	0.40	0.30	0.20
52	1.10	0.80	0.70
1	1.30	1.10	0.80
2	1.50	1.20	1.10
3	2.50	2.30	1.90
4	1.30	1.10	0.90
5	1.10	0.90	0.80
6	1.60	1.20	1.10
7	2.20	1.90	0.70
8	3.10	2.90	0.60
9	4.80	4.60	0.40
10	3.80	3.70	0.00
11	1.20	1.00	0.00

Mean of ten observations

Table 2: Correlation (r) and regression coefficient (byx) of egg and larval population of *H. armigera* and their larval parasitoid on chickpea with weather parameters

Weather parameter	Eggs population (*H. armigera*)		Larval population (*H. armigera*)		Larval parasitoids (*C. chlorideae*)	
	r	***byx***	***r***	***byx***	***r***	***Byx***
Maximum temperature (ºC)	0.56*	0.17	0.57*	0.17	-0.53*	-0.06
Minimum temperature (ºC)	0.21^{NS}	-	0.21^{NS}	-	-0.56*	-0.09
Morning RH (%)	-0.53*	-0.12	-0.55*	-0.13	0.53*	0.05
Evening RH (%)	-0.51^{NS}	-	-0.51^{NS}	-	0.31^{NS}	-
Sunshine (hrs)	0.45^{NS}	-	0.45^{NS}	-	-0.05^{NS}	-
Rainfall (mm)	-0.35^{NS}	-	-0.34^{NS}	-	-0.31^{NS}	-
Evaporation (mm)	0.56*	0.59	0.57*	0.61	-0.59*	-0.26

* = Significant at 5% level, ** = Significant at 1% level, NS = Non-significant

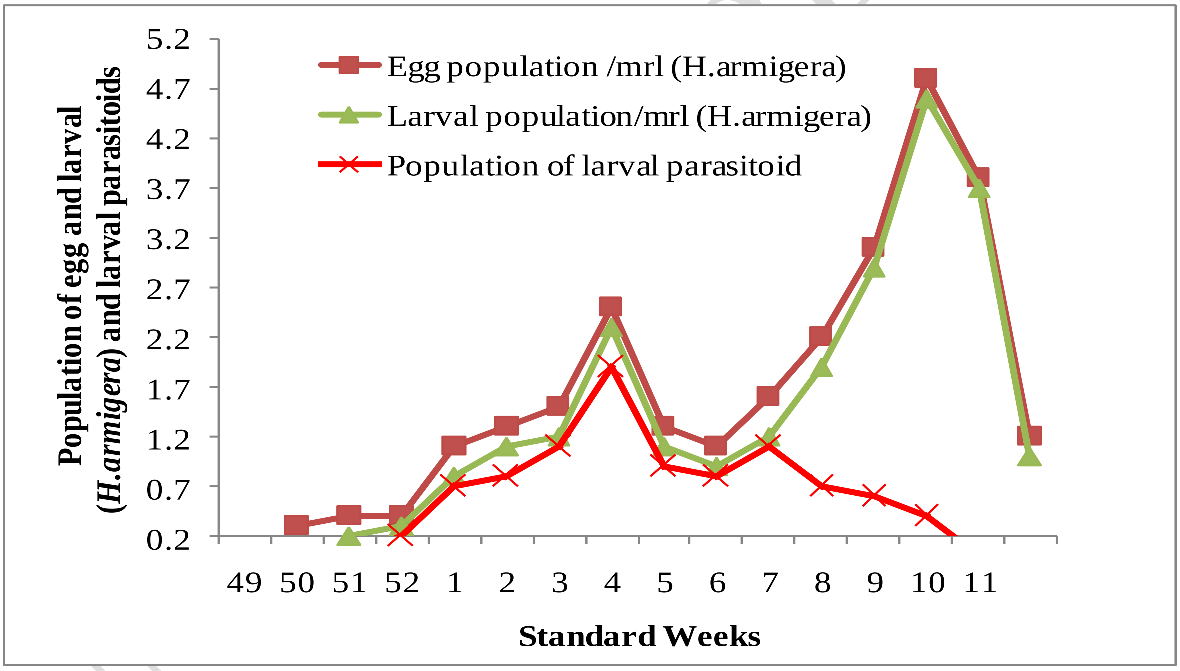

Fig. 1: Occurrence of egg and larval population of *H. armigera*, and larval parasitoid population of *C. chlorideae*in chickpea during *Rabi* 2020-21

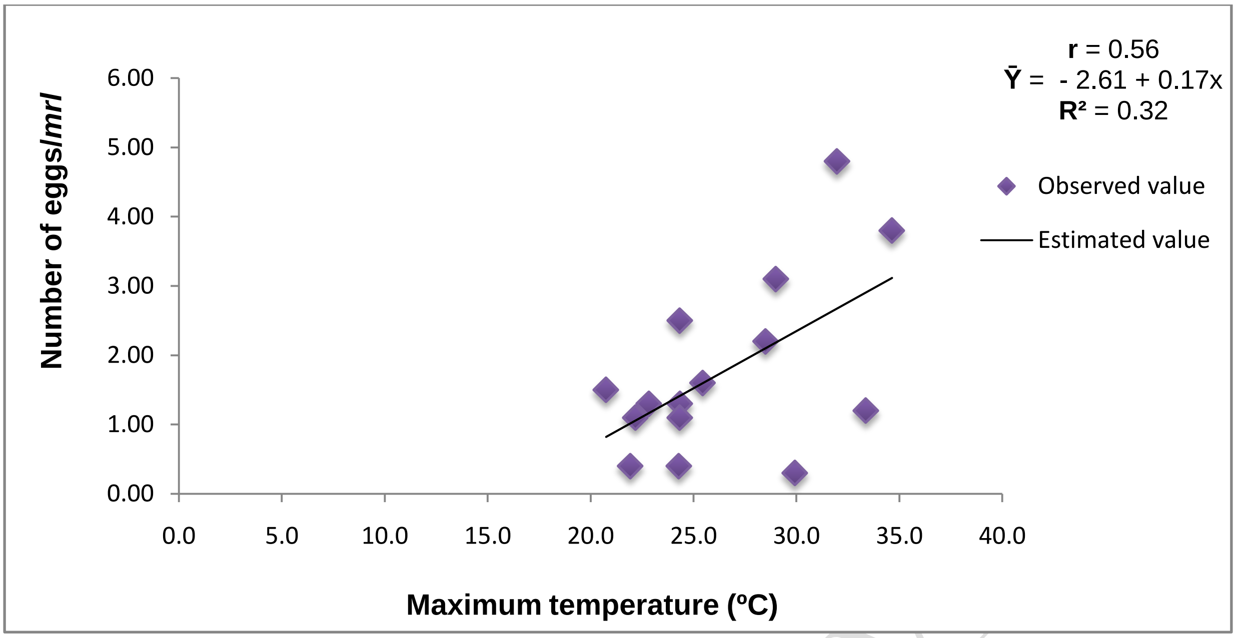

Fig. 2: Regression of maximum temperature (ºC) on number of eggs of gram pod borer in chickpea

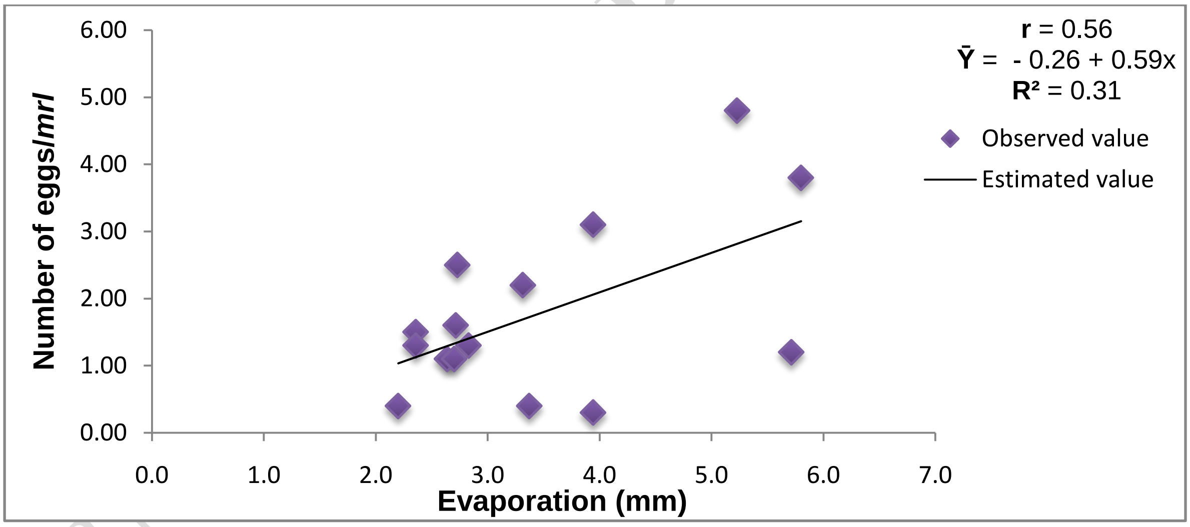

Fig. 3: Regression of evaporation (mm) on number of eggs of gram pod borer in chickpea

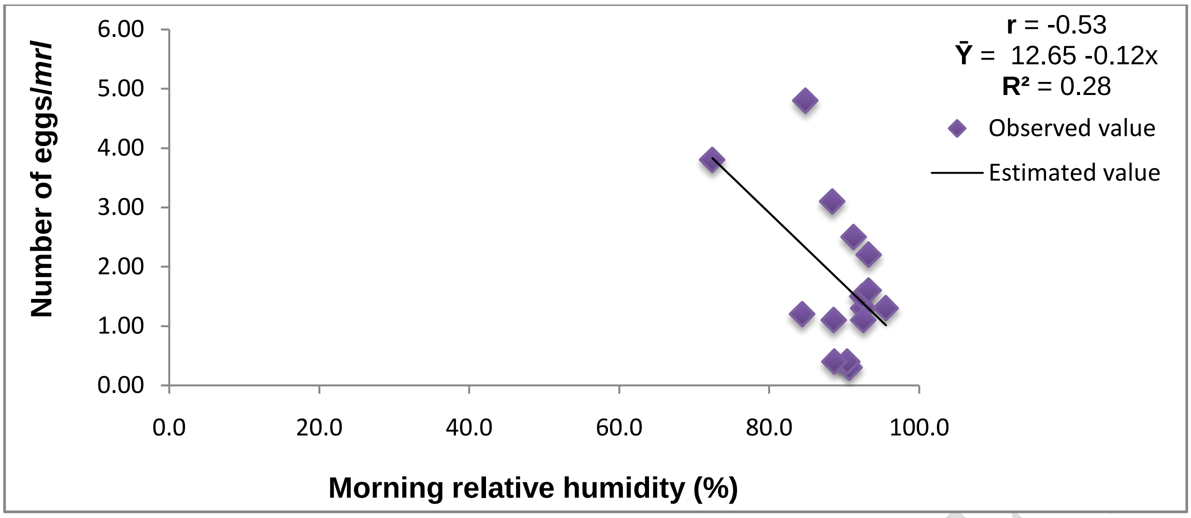

Fig. 4: Regression of morning relative humidity (%) on number of eggs of gram pod borer in chickpea

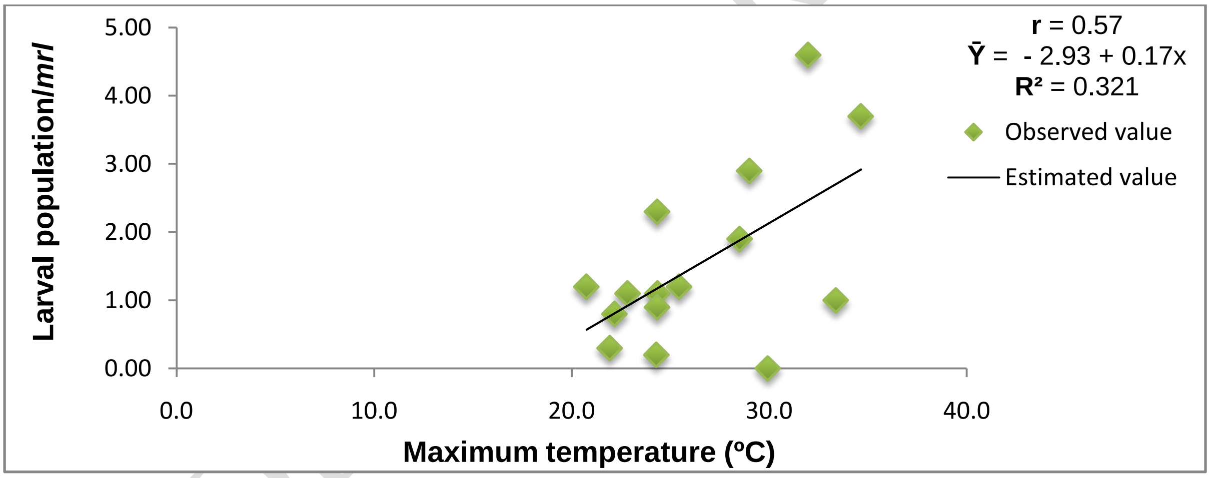

Fig. 5: Regression of maximum temperature (ºC) on larval population of gram pod borer infesting chickpea

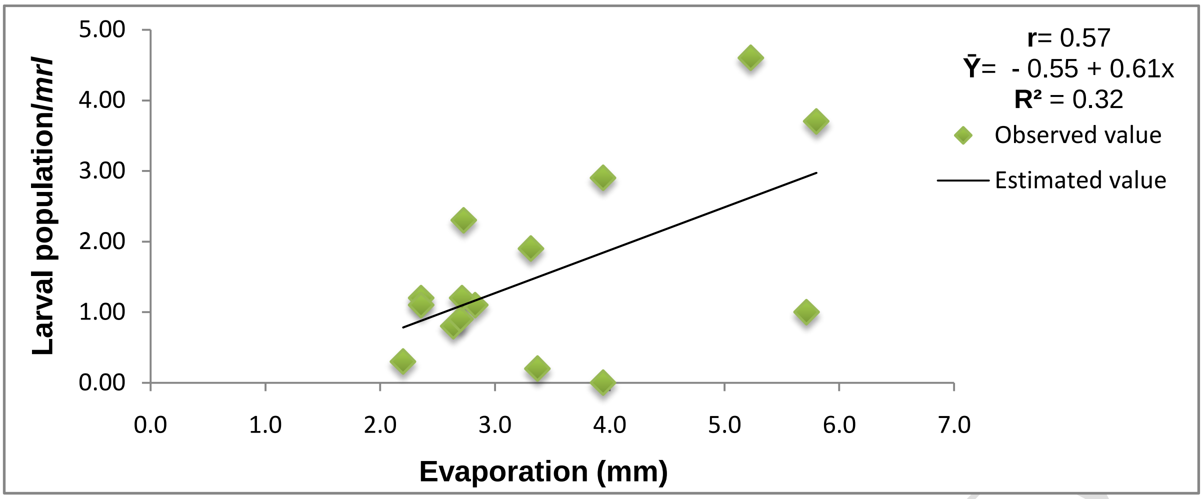

Fig. 6: Regression of evaporation (mm) on larval population of gram pod borer infesting chickpea

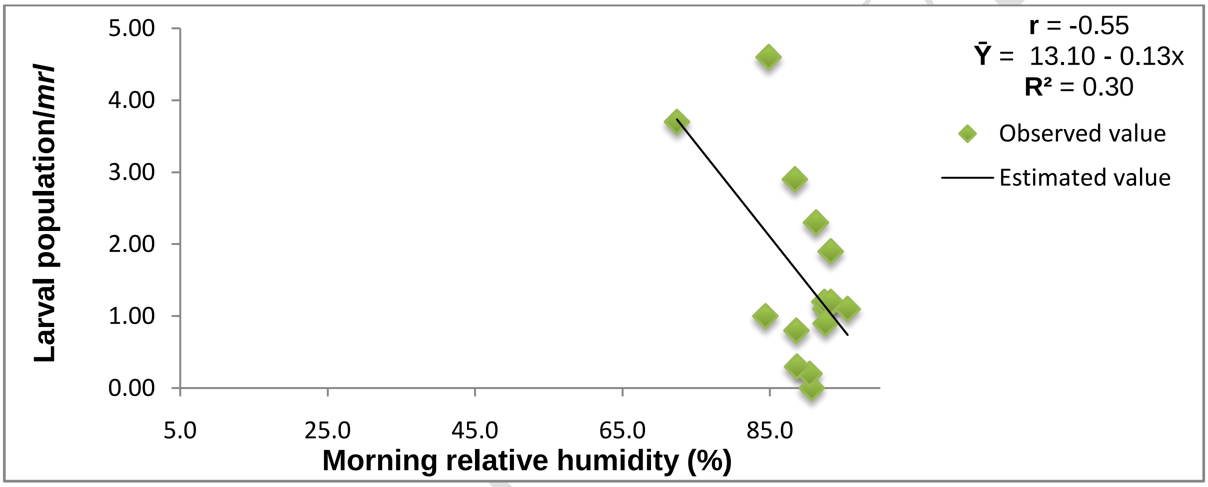

Fig. 7: Regression of morning relative humidity (%) on larval population of gram pod borer infesting chickpea

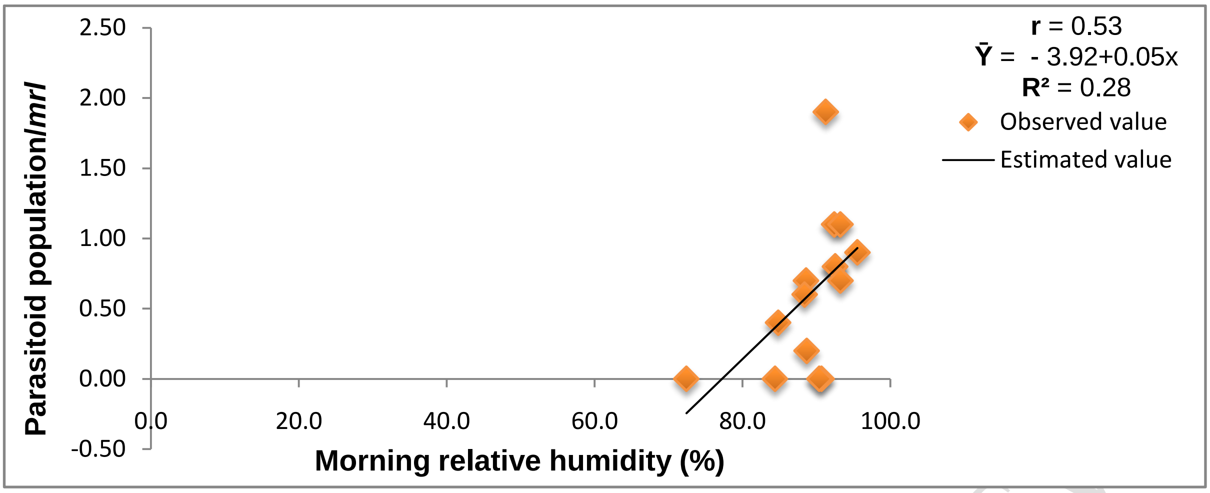

Fig. 8: Regression of morning relative humidity (%) on larval parasitoid population of gram pod borer in chickpea

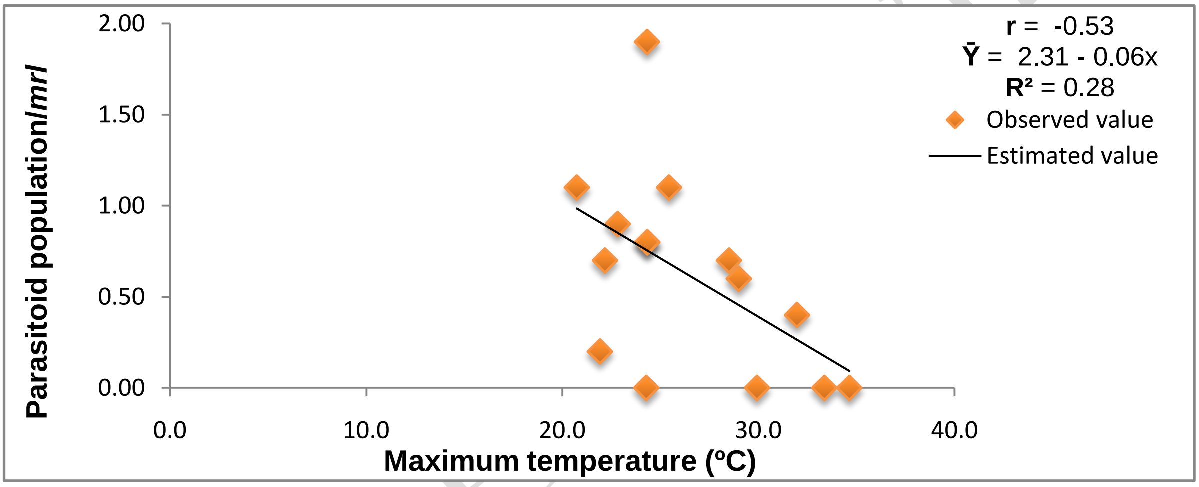

Fig. 9: Regression of maximum temperature (ºC) on larval parasitoid population of gram pod borer in chickpea

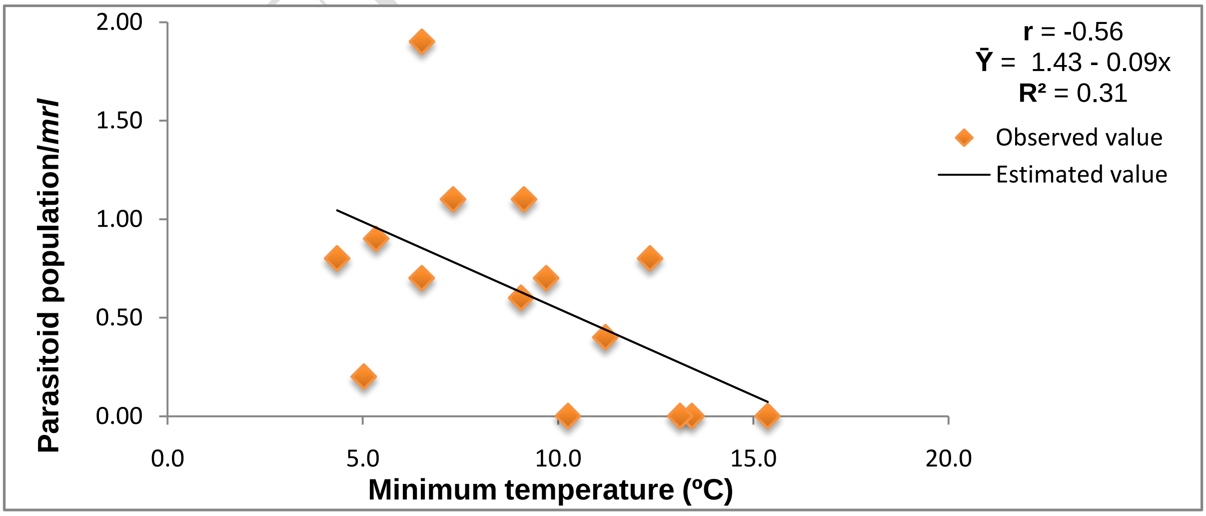

Fig. 10: Regression of minimum temperature (ºC) on larval parasitoid population of gram pod borer in chickpea

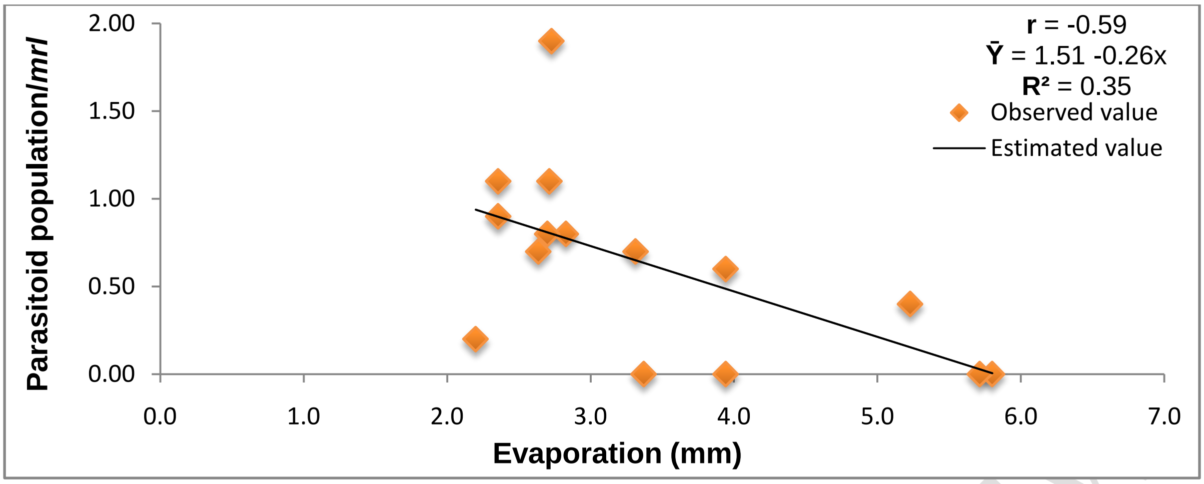

Fig. 11: Regression of evaporation (mm) on larval parasitoid populationof gram pod borer in chickpea