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Population fluctuations of *Helicoverpa armigera* (Hubner) on chickpea in relation with weather parameters

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Abstract

The Population Fluctuation of *H. armigera* on chickpea conducted on experimental field of G.H. Raisonni School of Agriculture Sciences, Saikheda (M.P.) during Rabi 2022-23 on variety JG-36. The actual results reveals that the population fluctuation of gram pod borer is starts from vegetative stage and last to maturity of crop. The first occurrence of *H. armigera* was observed in 49th MW with 0.60 larva /meter row length Afterword larvae first time attained its greatest level 1.86 larvae/mrl in 2nd SMW and then slightly declined and as per investigation the maximum population of *Helicoverpa amigera* recorded in 6th MW having 2.20 larvae/mrl respectively. Confirms as peak incidence and identified stage is podding stage (grain development stage). The incidence of *H armigera* gradually declined after 2nd peak incidence. The varietal characteristics also help in controlling the population of *H. armigera*. The correlation studies reveal that the signify negative correlation in between gram pod borer and max temperature and correlation calculated -0.648. Likewise the significant positive correlation found in between larval population and RH morning i.e. 0.531 and RH evening i.e. 0.692 as well as rainfall.

Keywords: Population dynamics, *Helicoverpa armigera*, gram pod borer, abiotic factors or weather parameters

Introduction

Chickpea (*Cicer arietinum*) is a leguminous crop that is widely cultivated and consumed around the world. It belongs to the Fabaceae family and is known by various names, including Bengal gram, Egyptian pea. Chickpeas are one of the earliest domesticated crops and have been an essential part of human diets for thousands of years. (Purseglove, J. W 1972) [8]. Chickpea has high nutritional value and plays vital role in human diet but as per investigation per capita availability of chickpea declines from 24g/day to 16 g/day due to decrease in productivity of chickpea. The productivity of chickpea decreases due to abiotic factors, weeds and most important insects and pest. Total 8 to 11 insect pests recorded on chickpea crop like cutworms, semiloopers and termites but most destructive major pest is *Helicoverpa armigera* (Rahman *et al.* 1982; Anwar and Shafique 1993) [9, 3]. Gram pod borer is a serious polyphagous pest also known as cotton bollworm feed on near about 200 cultivated species including gram, okra, chili, tomato, cotton, tobacco and sunflower also. (Singhs and Yadav, 2009) [11] (Ahmad *et al.* 2015) [2]. It presents on crop throughout its maturity by feeding voraciously can cause damage up to 80% in favorable environment. (Ahmad *et al.* 2014) [1]. So relay on chemical spraying over crop again and again to manage pest had an hazardous effect to environment and human being and leads to biomagnifications and that's why we were approaching to investigates the population fluctuation of pest to knowing the actual incidence of gram pod borer that helps to managing the pest at early stage by using less inputs and avoid the hard situations.

Material and Methods

The investigation survey on the relationship between weather parameters and population dynamics of *Helicoverpa armigera* on chickpea is investigated to identify the most significant

factors impacting their numbers i.e. Temperature, RH, evaporation and rainfall conducted on research fields of G.H. Raiosni School of Agriculture Sciences, Saikheda (M.P.) during rabi 2022-23. The larval incidence or population recorded by visual counting from randomly selected five plants. All cultural practices like weeding, hoeing, gap filling, thinning, inter culturing was carried out except plant protection. The observation of larval incidence on chickpea taken on weekly basis as per metrological week and given data computed to statistical analysis. The relationship or correlation between gram pod borer population and weather parameters likes temperature, RH, rainfall, evaporation was calculated with the help of MS office Excel by simple correlation. The cumulative data of weather parameters provided by dept of Agro-Metrology School of Agriculture Sciences, Saikheda.

Results and Discussion

The present investigation on population fluctuation of *Helicoverpa* on chickpea results that, the population of gram pod borer is observed in between 49 to 10 SMW (Seasonal Metrological Week) ranged near about 0.40 larvae/mrl to 2.20 larvae/mrl. The debut and first introduction of *Helicoverpa armigera* on chickpea in 49th SMW larvae ranged 0.60 larvae/mrl. While max and mini temperature 27 °C and 8.36 °C and the RH ranged between 84.57% and 39% respectively. After 1st introduction of larvae in environment it continuously expanded in further metrological weeks, in 50th MW (0.86 larvae/mrl), 51thMW (1.20 larvae/mrl), 52 thMW (1.35n larvae/mrl), and 1st MW (1.60 larvae/mrl) resp. In 2nd SMW larval population goes up to 1.86 larvae/mrl in between 8 Jan to 14 Jan. While max and mini temperature 23.5 °C and 10.25 °C and the RH 95.8% recorded respectively. The period of

this peak larval incidence concluded as a flowering stage. Moreover after 2nd MW the larval population decreased slightly 1.42 larvae/mrl and 1.06 larvae/mrl in 3rd and 4th MW and again the larval incidence accelerate or increased up to 2.20 larvae/mrl in 6th SMW in between 5 Feb to 11 Feb. As per investigation the stage identified was grain development stage. While max and mini temperature 22.08 °C and 10.71 °C and RH 92.56% and 51.28% recorded respectively. This stage of incidence concluded as 2nd peak incidence of *H. armigera* over gram crop. Afterword a incidence of gram pod borer decreased gradually and reached at lowest up to maturity of crop i.e. 1.72, 0.98, 0.78, 0.40 larvae/meter row length respectively. Present investigation and findings were resembles to previous findings as follows:

Sunganthy *et al.* (2023) ^[12] carried out research on population and incidence of *Helicoverpa armigera* and they concluded the peak's of gram pod borer is observed during second and third week of Jan and Feb underlying with the crop peak pod development stage.

Chatar *et al.* (2010) ^[5] resulted that the gram pod borer first appeared in first fortnight of December and reached its top population 3.12 larvae/mrl in first fortnight of January and pests observed throughout crop maturity by declining towards maturity of crop.

Shinde *et al.* (2013) ^[10] also noticed two peak periods in larval population of *Helicoverpa armigera*. The first peak observed during 47th to 50th MW and second peak observed during 10th to 14th MW in both years of their study. Bajya *et al.* (2010) ^[4] found that the gram pod borer active on chickpea from November to March and investigates the larval incidence of *H. armigera* on chickpea and they observed two peaks in that first peak was recorded in between 46th to 49th MW and second peak recorded in between 5 to 13th MW.

Table 1: Average larval incidence of *H. armigera* relation with weather factors during Rabi 2022-23.

SMW	Date of observations	Larvae/MRL	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)	Evapor ⁿ
			Max	Min	Morning	Evening		
47	24/11/2022	0	27.16	9.48	91.71	35.63	0	2.96
48	01/12/2022	0	26.23	9.52	86.86	39.65	0	2.5
49	02/12/2022	0.6	27	8.36	84.57	39	0	2.84
50	15/12/2022	0.86	27.69	9.81	85.83	48.26	0	2.7
51	22/12/2022	1.2	26.81	10.28	86.3	39.06	0	2.23
52	30/12/2022	1.35	22.21	12.56	92.86	49.51	0	2.1
1	06/01/2023	1.6	19.23	14.86	94.52	46.26	0	1.96
2	13/01/2023	1.86	23.05	10.25	95.8	44.97	0	2.6
3	20/01/2023	1.42	24.03	15	91.2	51.12	3.85	2.53
4	27/01/2023	1.06	21.05	11.82	85	45.23	1.25	2.43
5	03/02/2023	1.75	23.91	13.65	85.26	43.71	0	2.29
6	10/02/2023	2.2	22.8	10.71	92.56	51.28	0	2.34
7	17/02/2023	1.72	22.27	16.32	90.83	55	0	3.19
8	24/02/2023	0.98	26.58	12.56	84.46	50.43	0	2.67
9	03/03/2023	0.78	30.05	16.3	82.21	35.63	0	3.43
10	10/03/2023	0.4	34.28	17.45	77.59	31.58	0	3.96

Table 2: Correlation coefficient of gram pod borer with weather parameters.

Weather parameters	Temperature (°C)		Relative Humidity (%)		Rain fall	Evaporation
	Max	Mini	RH _M	RH _E		
Correlation <i>H. armigera</i>	-0.648*	-0.211	0.531*	0.692*	0.116	-0.453

* indicates significant value at 0.05 (two tailed); RH_M-Morning Relative humidity; RH_E-Evening relative humidity.

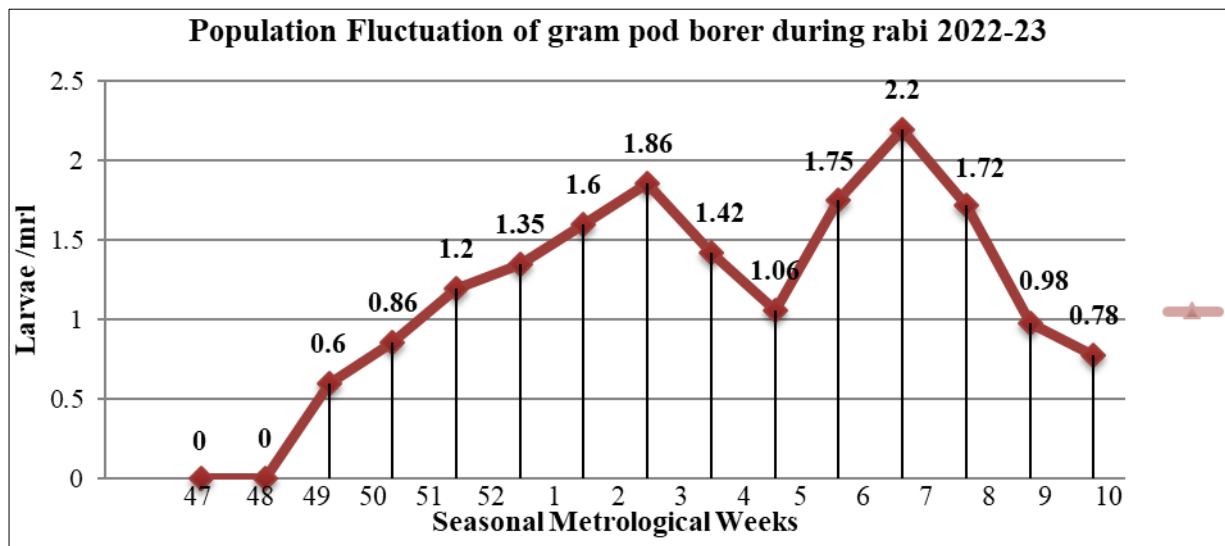


Fig 1: Incidence of *H. armigera* (Hub.) during Rabi 2022-23.

Examining the Correlation between Weather Parameters and the *Helicoverpa armigera* (Hubner) Gram Pod Borer

The results of the correlation study revealed noteworthy positive relationships between the larval population of gram pod borer and both morning and evening relative humidity (RH), exhibiting correlation coefficients of 0.531 and 0.692, respectively. Conversely, significant negative correlations were established between the larval population and maximum temperature (correlation coefficient: -0.648). Furthermore, there were non-significant negative correlations observed with minimum temperature and evaporation, denoted by correlation of -0.211 and -0.453, respectively. Notably, a non-significant yet positive correlation surfaced between the larval incidence and rainfall, with a correlation coefficient of 0.116. These findings align with earlier studies. For instance, Kulwinder Singh *et al.* (2020) [7] reported similar results, showing negative correlations between the larval population and maximum and minimum temperatures, and positive correlations with maximum and minimum RH, along with a positive correlation with rainfall. Similarly, Jakar *et al.* (2016) [6] found negative correlations between maximum temperature and gram pod borer incidence over four years, with no significant correlations observed with minimum temperature, RH, or rainfall at a 5% level of significance.

Suggestion for further study

The study of population fluctuation of gram pod borer needs to be implemented that should be determines the actual incidence as well as larval instars that would be helpful for managing and controlling pest in early instar or before crossing ETL level. As well as crop varietal characteristics of chickpea like trichomes, pod thickness etc. are take to be serious because varietal characteristics plays vital role to avoid the damage cause by gram pod borer. So, choose better variety which resists the damage cause by pod borer. In contrast, take note of the most vulnerable phase of larvae, which occurs between two molts when the larvae shed their outer layer. During this period, they become more susceptible to spray applications.

Conclusion

The research investigation has been presented in Table 1, Table 2 and Fig 1 during Rabi 2022-23 at field oh School of Agriculture Sciences, Saikheda.As result *Helicoverpa armigera* first appeared in 49th SMW and the population

continuously expanded at the peak i.e. 1.86 larvar/mrl in 2nd SMW with 23.08 °C max temperature and 95.08% relative humidity. Afterword the population of gram pod borer slightly declined and again it goes for attaining its peak. And the second larval peak recorded 2.20 larvae/mrl in 6th SMW with 22.8 °C temperature and 92.56% relative humidity. Then the incidence has been gradually decreased to the maturity of crop. From above the result confirms that or conclude that gram pod borer attained two peak's in its life period and the first peak incidence was at flowering stage and second at grain development stage or podding stage. And larvae present on crop from vegetative stage to the maturity of crop and some particular varietal characteristics play important role to avoid the damage cause by gram pod borer it is also called varietal resistance.

Also, the correlation between gram pod borer and morning and evening RH shows significant correlation while the significant negative correlation found in between gram pod borer and max temperature as well as the non-significant negative correlation recorded in between gram pod borer and minimum temperature and evaporation.

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