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INFLUENCE OF WEATHER PARAMETERS ON *HELICOVERPA ARMIGERA* (HUBNER) LARVAL PARASITISATION BY *CAMPOLETIS CHLORIDEAE* (UCHIDA) IN CHICKPEA ECOSYSTEM

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Abstract- In the present study, the influence of weather parameters on larval parasitoid of *H. armigera* investigated in chickpea ecosystem. Results revealed that, maximum and minimum temperature (°C) are playing had a highly negative significant role (r = -0.756) and (r = - 0.760) with larval parasitization of pest. Whereas, Relative humidity (%) have had a significant positive correlation, on the contrary rainfall was negatively correlated with larval parasitization of pest. Considering the effects of weather parameters on the larval parasitisation by *C. chlorideae* can suitably be exploited by means of mass multiplication and mass release under favorable set of agro-climatic conditions for pest management.

Keywords-*Campoletis chlorideae,* Relative humidity, chickpea ecosystem, agro-climatic conditions

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Introduction

Gram pod borer *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae), a highly polyphagous and major insect pest in chickpea ecosystem. Its larvae appeared on chickpea crop after 15 days of germination at Dharwad, Karnataka. Singh and Ali [1] reported *H. armigera* larvae found active throughout the chickpea crop period at Faizabad, Uttar Pradesh. The single larva of pest has ability to destroy 30-40 pods in its lifetime. In other parts of India, the extent of losses due to *H. armigera,* in chickpea, is up to 27.9% in North West Plain Zone, 13.2% in North East Plain Zone, 24.3% in Central Zone and 36.4% in South Zone [2]. The crop has been noted to suffer an avoidable loss of 9 to 60% [3]. In U.P. alone 15.3% of the chickpea crop, worth Rs. 462.5 million, is lost annually due to *H. armigera* attack[4]. 17.2% in Karnataka and 28.5% in Delhi [5]. Of late *H. armigera* has assumed serious proportions leading to an array of economical, political and social upheavals. 1987 and 1997 witnessed several farmer suicides in Andhra-Pradesh due to *H. armigera* attack on cotton, so much so that 1997-98 came to be known as '*Helicoverpa year*' [6].

Development of resistance in *H. armigera* against conventional insecticides is quite common and has developed resistance against all major groups of insecticides [7]. The combined effect of decreased sensitivity to acetyl cholinesterase, higher levels of esterase, phosphates and the expression of P-glycoprotein in resistance larvae are the main causes of resistance [8]. Other than the above mentioned causes certain biological and behavioural characteristics are also responsible for its outbreaks such as; high fecundity, migratory behavior and high adaptation to various climatic conditions. To combat this pest till now the thrust was given mainly on chemicals, however their indiscriminate use resulted in the development of resistance, resurgence and environmental pollution [9]. Though, there is a need to search for pest management tactics which are eco-friendly and able to control resistant strains of *Helicoverpa armigera* effectively.

It well known that, biological control is one of the major components of IPM. In a ecosystem the population of individual species is regulated by both abiotic and biotic factors at a certain levels. Among the biotic factors Predators, parasites and disease causing micro-organisms of pests available in abundance, maintain natural balance and reduce pest incidence. Use of these naturally occurring living organisms to check pest population is one of the safest methods of pest management. The ability of biotic factors to control pest population also affected by prevailing abiotic factors. The ichneumonid *Campoletis chlorideae* is arrhenotokous, idiobiont parasitoid species and reported to be most effective bioagent of *H armigera* on chickpea in India. The early stage larvae of pest are found to be parasitized by *Campoletis chlorideae* (Uchida) [10 & 11]. *Campoletis chlorideae* (Uchida) has been observed to cause 80.5 per cent parasitization of *H. armigera* larvae in chickpea ecosystem [12]. The parasitic activity was noticed higher at minimum temperature 9.7°C and was also ceased at maximum temperature more than 40°C in chickpea ecosystem in Himachal Pradesh [6]. The monitoring the extent of larval parasitization of *H. armigera* in the field is a prerequisite for successful pod borer management. Considering the impact of weather factors on the larval parasitisation of *H. armigera* by its parasitoid *C. chlorideae* in chickpea ecosystem investigations were carried out, in Meerut region during *rabi* season of 2014-15.

Materials and Methods

The field experiment was conducted during *Rabi* season of 2014-15 at Bio-control Laboratory, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110 (U.P.) India, to study weather parameters relationship with the extent of parasitization by potential early stage larval parasitoids *Compoletis chlorideae* of *Helicoverpa armigera* in chickpea ecosystem.

Larvae of *H. armigera* were collected at weekly interval starting from first week of December 2014 (48th SW) to third week of April, 2015 (16th SW) from chickpea fields.

Larvae collected in each week were kept at room temperature individually in plastic vials measuring 45 x 25 mm^2 in the bio-control laboratory for rearing them up to adult stage. Records on number of larvae collected in each week were maintained. These larvae were provided fresh twigs of chickpea pods as food daily. Observations on death of larvae, date and number of emergence of

immature/adult parasitoid (s), pupation, death in pupal stage and adult moths' emergence were also recorded daily. Natural enemies emerged from these larvae were identified and recorded.

The data, thus recorded on larvae were tabulated and per cent parasitization was worked out by using following formula.

$$\text{Parasitization\%} = \frac{\text{No. of parasitoids emerged}}{\text{No. of larvae reared}} \text{ X } 100$$

Weekly meteorological data on temperature (minimum and maximum in degree centigrade), relative humidity (%) and rainfall (mm) were collected from Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut-250110 (U.P.). Simple correlation coefficient analysis was done using OPSTAT software.

Results and discussion

Parasitization of early stage larvae of H. Armigera in chickpea

The *C. chlorideae* was noticed as major parasitoid/ parasite of early stage larvae (I and II instar) of *H. armigera*. Data presented in [Table-1] revealed that number of *H. armigera* larvae population between 48th SW, 2014 to 14th SW, 2015 varied from 23-55 with a mean of 44.47±2.22 percent and total of 845 larvae were reared up to adult stage. Devi *et al.* [13] also observed 5 parasitoids associated with this pest and among them *C. chlorideae* was most important causing 0.18-23.81 per cent parasitization from March –May. Whereas, in present study data revealed that only one endo-solitary parasitoid *viz*., *Campoletis chlorideae* was active and caused 8.69 to 68.62 percent, with a mean of 41.61±4.78 percent parasitization in larvae collected from chickpea fields. It is also evident from data that this parasitoid was active throughout crop season with minimum parasitization (14th SW), 2015 which was 8.69 per cent and maximum parasitization of 68.62 percent in 2nd SW of 2015. Although, other researchers also found similar extent of parasitisation like, [14] recorded 12.69- 56.28 % during 1995-96 and 3.57 to 80.64 % during 1996-97 larval parasitization due to *C. chlorideae;* 0.98-68.5% parasitization [11]; 9.0-37.3% parasitization during 1999-2000 and 5-11% parasitization during 2000-2001 [15]; 25.0-59.2% parasitization[12]; 5.53% parasitization [16] and 1.66-88.23 parasitization with an average of 33.72±6.19% [17]. Data presented in [Table-1] also revealed that 7.20 to 24.44 percent, with a mean of 15.46±1.11 percent larvae died due to unknown causes and 19.60 to 78.26 percent, with a mean of 43.06±4.13 percent larvae successfully transformed into adults.

Table-1 *Weather parameters relationship H. armigeralarvae parasitisation by C. chlorideae and other causes of mortality during Rabi-2014-15*

Standard weeks	Temperature (°C)		Relative Humidity %	Rainfall (mm)/week	No. of larvae collected	(%) Parasitization / Mortality due to		Per cent adults emerged
	Max.	Min.				*Completes chlorideae*	Unknown causes (%)	
48	26.07	7.42	56.92	0.0	45	44.44	13.33	42.22
49	19.57	8.00	68.56	0.0	53	50.94	15.09	33.91
50	15.42	5.92	74.92	3.4	50	60.00	12.00	28.00
51	18.5	5.78	72.00	0.0	48	52.08	14.58	33.33
52	16.42	9.88	85.35	0.0	45	52.38	20.00	31.11
1	15	7.21	83.21	2.2	53	58.49	9.4	32.07
2	16.9	7.64	82.56	1.0	51	68.62	11.7	19.60
3	16.68	9.44	85.78	0.0	46	60.86	13.04	26.08
4	19.85	7.88	72.28	1.5	48	50.00	10.41	39.52
5	23.2	7.07	70.42	0.0	48	54.16	14.58	31.25
6	24.31	9.37	69.06	0.0	52	57.69	17.30	25.00
7	26.97	14.84	68.92	0.0	55	65.45	7.2	27.23
8	22.07	12.55	81.07	0.1	53	24.52	18.86	56.60
9	24.54	10.21	61.34	11.72	42	26.19	16.66	57.14
10	26.42	13.78	70.64	2.91	45	11.11	24.44	64.44
11	30.3	15.91	65.99	0	33	9.09	15.15	75.75
12	31.96	17.57	72.23	0	25	16.00	24.00	60.00
13	27.88	16.17	67.58	2.4	30	20.00	23.00	56.66
14	31.57	18.21	61.28	3.77	23	8.69	13.04	78.26
Range	15-31.96	5.78-18.21	56.92-85.78	0-11.72	23-55	8.69-68.62	7.2-24.44	19.6-78.26
Mean ± SEm	--	--	--	--	44.47±2.22	41.61±4.78	15.46±1.11	43.06±4.13

Correlation of weather parameters with the larval parasitization *H. armigera*

The association of weather parameters on parasitization computed with the early stage larval parasitization of *H. armigera* in chickpea ecosystem during 2014-15 revealed maximum and minimum temperature (°C) are playing highly negative significant role (r=-0.756) and (r=-0.760) with larval parasitization of pest [Table-2]. Whereas, maximum and minimum temperature has shown the significant positive correlation (r=0.386) and (r=0.434) respectively, with other causes of mortality. However, relative humidity (%) have shown significant positive response (r=0.453) with larval parasitisation while contrary, a non significant negative correlation with other causes of mortality. On the other hand, rainfall showed non-significant negative correlation (r=-0.293) with larval parasitisation and a non-significant positive correlation with other mortality factors.

The present investigation explores the possibilities that how larval parasitoid *C. chlorideae* can suitably be exploited by means of mass multiplication and mass release under favorable set of agro-climatic conditions, to combat gram pod borer havocs as well as to reduce the dependency of farmers on chemical control (insecticides) measures to control this pest.

Table-2 *Correlation of weather parameters with larval parasitization and other causes of mortality of H. armigera in chickpea*

Factors	Larval parasitization by *C. chlorideae*		Other causes of mortality	
	Correlation coefficient (r)	Regression equation	Correlation coefficient (r)	Regression equation
Temperature Max. Min.	 -0.756** -0.760**	 Y=106.353+(-2.836)X Y=83.273+(-3.864)X	 0.386NS 0.434*	 Y=7.793+0.336X Y=9.936+0.513X
Relative humidity	0.453*	Y= -40.432+1.138X	-0.048NS	Y=17.483+0.028X
Rainfall	-0.293NS	Y=44.947+(-2.182)X	0.053NS	Y=15.321+0.092

Conflict of Interest: None declared

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