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Impact of Abiotic Factors and Dates of Sowing on *Helicoverpa armigera* (Hübner) Parasitoid *Campoletis chloridae* (Uchida) under Chickpea Cropping System in Tarai Region of Uttarakhand

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ABSTRACT

Background: The solitary endo-larval parasitoid *Campoletis chlorideae* Uchida (Hymenoptera: Ichneumonidae) is an important biocontrol agent of *H. armigera* in chickpea ecosystem. Abiotic factors are likely to affect the insect host and activity of its parasitoid. Therefore, the present study was conducted to understand the impact of weather factors and different dates of sowing on per cent parasitization of *Helicoverpa armigera* (Hübner) by *Campoletis chlorideae* (Uchida) in chickpea ecosystem.

Methods: In this field-laboratory investigation were carried out at Pantnagar during the cropping season of 2017-18. Twenty-five larvae of *H. armigera* (first and second instars) were collected randomly at weekly basis from untreated chickpea crop. In the laboratory, the collected larvae were reared till parasitoid emergence and observed for per cent parasitisation.

Result: The observation recorded revealed that mean seasonal parasitism by *Campoletis* on larvae of *H. armigera* was found to be 21%, 43.5% and 34.5% in early (20th October), normal (11th November) and late sown crop (1st December), respectively. Various abiotic parameters like maximum and minimum temperature, maximum and minimum relative humidity registered high level of significant association with per cent parasitization in early and normal sown crop compared to the low level of association in late sown crop. The multiple regression analysis showed that the combined effect of all the meteorological parameters were responsible for 90%, 57.9% and 30.5% variation in per cent parasitization in early, normal and late sown crop, respectively.

Key words: *Campoletis chlorideae*, *Helicoverpa armigera*, Parasitization, Weather.

INTRODUCTION

Chickpea, *Cicer arietinum* is an important *rabi* pulse grown all over the world. India is the single largest producer of chickpea accounting for 65 per cent of the total production (FAOSTAT, 2017). Insect pests are the major limiting factors in chickpea production. It is known to be attacked by about 60 insect-pests (Reed *et al*., 1987), which causes 15% yield loss annually. Among these Chickpea pod borer (CPB), *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) is the most notorious insect pest. Yield losses due pod borer damage in chickpea may range from 70 to 95% (Prakash *et al*., 2007). The increasing concern for environmental problems that are created by the use of toxic pesticide, development of high-level resistance in *Helicoverpa* to the conventional insecticides (Kranthi *et al.,* 2002) has promoted a worldwide interest in the adoption of ecological basis of pest management. Biological control is one important tool of Integrated Pest Management that utilizes the contribution of natural enemies to reduce pest population. The ichneumonid, endo-larval parasitoid *Campoletis chlorideae* (Uchida) recorded to be the most effective natural enemy of, *Helicoverpa armigera* on chickpea. *Campoletis chlorideae* (Uchida) was found to parasitize the early instars of *Helicoverpa armigera*. The parasitoid deposit eggs singly into first or second instar larvae and comes out from the host during third or fourth instar to spin a cocoon and pupation takes place on the plant inside the spun cocoon. In chickpea ecosystem this endo-larval parasitoid reported to cause 0.98 to 68.50 per cent parasitization of *H. armigera* (Kaur *et al*., 2000). Date of sowing has a great impact on the activity of pod borer as well as *Campoletis* due to environmental variation. Therefore, the present study was conducted to observe the effect of chick pea sowing time on natural parasitization of gram pod borer by *Campoletis*.

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MATERIALS AND METHODS

The present study was carried out in the Norman E. Borlaug crop research centre (NEB-CRC), G.B.P.U.A and T,

Pantnagar to study the impact of abiotic factors and the different dates of sowing on Percent parasitization of *Helicoverpa armigera by Campoletis chlorideae* in chickpea ecosystem. The chickpea variety PG 186 was sown on three dates (20th October, 11th November and 1st December) during 2017-18 in an area of 10 m^2. Twenty-five larvae of *H. armigera* (first and second instars) were collected randomly at weekly basis from untreated chickpea crop. The collected Larvae were brought to the laboratory in plastic vials and reared individually in laboratory till the parasitoid emergence. Observations were recorded on number of adult parasitoid emerging from *H. armigera* larvae and per cent parasitization was computed. Simple correlation coefficient was derived between the per cent parasitization during a standard week and average maximum temperature, minimum temperature, maximum relative humidity and minimum relative humidity. To find out the individual as well as combined impact of the abiotic factors on the per cent parasitization was worked out using regression analysis. The statistical analysis was done using SPSS statistical tool.

RESULTS AND DISCUSSION

Per cent parasitization of *H. armigera* in three different dates sown chickpea

In the present study the effect of different dates of sowing on seasonal parasitization of *Campoletis chlorideae*, a larval parasitoid on *Helicoverpa* was studied in chickpea ecosystem during 2017-18 and the results have been presented in Table 1. The first appearance of parasitoid was observed on 51st standard meteorological week (S.W.) in all the three different dates sown crop. It was observed that mean seasonal parasitism by *Campoletis* on larvae of *H. armigera* was found to be 21, 43.5 and 34.5 per cent in early (20th October), normal (11th November) and late sown crop (1st December), respectively. Higher parasitism of 80 per cent was occurred on 3rd S.W. in normal sown crop as compared to the 48 per cent (2nd S.W.) and 72 per cent (6th S.W.) in early and late sown crop, respectively (Fig 1). The present results were in agreement with Bisane *et al.* (2008) who also observed the incidence of *C. chlorideae* from 51st S.W. (17-23 December) until 3rd S.W. (15-21 January) and it reported to cause 8.11 to 11.54 per cent parasitization of *Helicoverpa*. Ojha *et al.* (2017) recorded the maximum natural parasitization of *H. armigera* by *C. chlorideae* as high as 51.67 and 56.67 per cent during 2010-11 and 2011-12, respectively.

Influence of abiotic factors on percent parasitization in *H. armigera*

The relationships between per cent parasitization and various abiotic factors were worked out through correlation and regression analysis. The perusal of the results reveals that the abiotic parameters mostly registered high level of significant association with the per cent parasitization data in early and normal sown crop compared to the low level of non-significant association in late sown crop (Table 2). In early and normal sown crop, it is observed that per cent parasitization by *Campoletis* had a highly significant negative correlation with maximum and minimum temperature compared to non-significant association in late sown crop. Whereas highly significant positive correlation was recorded between maximum and minimum relative humidity in early sown crop compared normal sown crop which recorded

Table 1: Effect of different sowing dates on per cent parasitization during 2017-18.

		Early sown (20.10.17)		Normal sown (11.11.17)		Late sown (1.12.17)	
Date of observation	No. of *H.armigera* larvae collected	No. of larvae parasitized	Per cent Parasitization (%)	No. of larvae parasitized	Per cent Parasitization (%)	No. of larvae parasitized	Per cent Parasitization (%)
51st S.W	25	6	24	6	24	1	4
52nd S.W	25	5	20	12	48	3	12
1st S.W	25	9	36	10	40	5	20
2nd S.W	25	12	48	11	44	7	28
3rd S.W	25	9	36	20	80	11	44
4th S.W	25	7	28	11	44	15	60
5th S.W	25	8	32	15	60	17	68
6th S.W	25	6	24	19	76	18	72
7th S.W	25	7	28	18	72	15	60
8th S.W	25	4	16	14	56	16	64
9th S.W	25	6	24	12	48	7	28
10th S.W	25	3	12	9	36	8	32
11th S.W	25	1	4	8	32	6	24
12th S.W	25	0	0	3	12	2	8
13th S.W	25	1	4	4	16	3	12
14th S.W	25	0	0	2	8	4	16
Mean			21		43.5		34.5

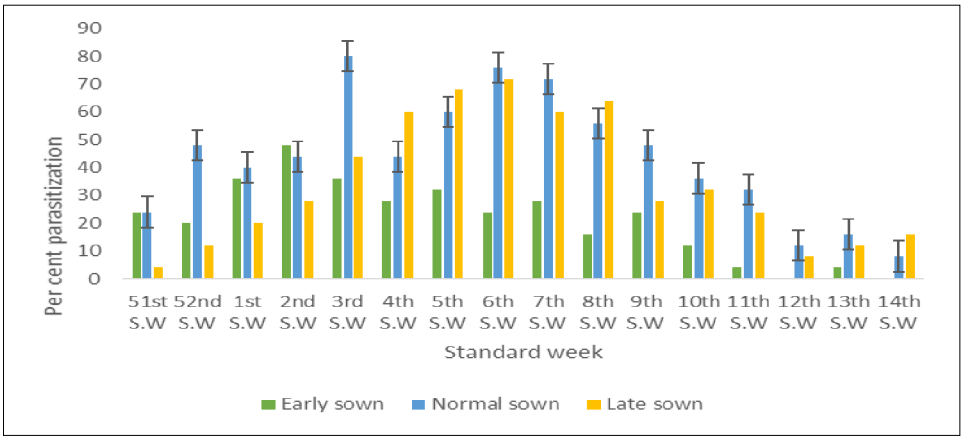

Fig 1: Effect of different sowing dates on per cent parasitization during 2017-18.

Table 2: Correlation coefficient (r) between per cent parasitization and abiotic factors.

Variable		Temperature °C		R. humidity %	
		Max.	Min.	Max.	Min.
Per cent parasitization	Early sown	-.940**	-.855**	.831**	.797**
	Normal sown	-.517*	-.708**	.667**	0.278 ^{NS}
	Late sown	-0.294 ^{NS}	-0.401^{NS}	0.386^{NS}	0.067^{NS}

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

Table 3: Multiple regression equations of per cent parasitization and abiotic factors.

Date of sowing	Regression equation	Coefficient of determination (R^2)	'F' estimate
20th October	Y = 100.457-2.856 (TMAX)+0.366 (TMIN)+0.079 (RHM)-0.349 (RHE)	0.9	0.001
11th November	Y = -26.509 +1.256 (TMAX)-4.734 (TMIN)+1.067 (RHM)-0.218 (RHE)	0.579	0.035
01st December	Y = 344.626-5.584 (TMAX)+0.065 (TMIN)-0.567 (RHM)-2.145 (RHE)	0.305	0.363

highly significant positive correlation in maximum relative humidity with per cent parasitization. Non-significant positive correlation was observed between minimum relative humidity in normal sown crop, maximum and minimum relative humidity in late sown crop with per cent parasitization. The result was in cogent evidence with Pillai *et al*. (2016) who observed the significant negative correlation between weather parameters and the population of the larval parasitoid with maximum temperature and minimum temperature. Whereas positive correlation was recorded with maximum relative humidity and minimum relative humidity during 2010-11 and 2011-12, respectively.

The multiple regression analysis of the per cent parasitization data with the abiotic factors for the three different dates sown crop reveals that the combined effect of all the meteorological parameters was statistically significant in early and normal sown crop as compared to non-significant up to 95% probability level in late sown crop as evident from the estimated values of 'F' (Table 3). Together all the weather factors were responsible for 90%, 57.9% and 30.5% variation in per cent parasitization in early, normal and late sown crop, respectively.

CONCLUSION

The abiotic factors and different dates of sowing were found to have high level of influence on the per cent parasitization by *C. chloridae* on *H. armigera* during the experimental period in tarai region. Maximum and minimum temperature had significant negative correlation with per cent parasitisation in early and normal sown crop compare to non significant negative correlation in late sown crop. Maximum and minimum humidity had significant positive correlation with per cent parasitisation in early sown crop.

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Conflict of interest

We the authors of the manuscript declare not conflict of interest.

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