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EFFECT OF SOWING DATES AND WEATHER PARAMETERS ON THE INCIDENCE OF *HELICOVERPA ARMIGERA* (HUBNER) IN CHICKPEA

S. K. PARMAR, A. S. THAKUR AND R. S. MARABI*
Department of Entomology, J.N. Agricultural University, College of Agriculture,
Jabalpur - 482 004 (Madhya Pradesh), INDIA
e-mail: rsmarabi78@rediffmail.com

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***Corresponding author**

ABSTRACT
An experimental trial was conducted to confirm the optimum sowing date of chickpea to determine the infestation of *H. armigera* and grain yield. It is observed that the incidence and population fluctuation of this pest was much dependent on the prevailed weather parameters during the cropping season of all seven different date of sowing. The overall minimum mean eggs population (3.04/10 plants) was recorded on early sown crop on November 07 which was significantly superior over the other sowing dates. Correlation analysis revealed that morning RH% exhibited significantly positive correlation with eggs population on November 07 (r= 0.60), December 27 (r= 0.64) and maximum temperature on December 17 (r= 0.57) while, significantly negative correlation (r= -0.61) was found with evening RH% on December 17 sown crop, respectively. Minimum larval population (1.74/mrl) was observed on November 07 sown crop which was significantly superior over other six sowing dates. Correlation coefficient of larval population with sunshine hours exhibited significantly positive correlation (r =0.55) on November 07 sown crop. Whereas, maximum temperature (r= 0.66) showed positively significant association with mean larval population while, both morning and evening RH% exhibited negative correlation (r= -0.54, -0.55) on November 27 sown crop. On December 07 sown crop, the correlation of mean larval population with maximum and minimum temperature was also exhibited significantly positive (r= 0.70, 0.62). Maximum grain yield 1855 kg/ha was recorded from early sown crop on November 07, whereas minimum yield 612 kg/ha was obtained from late sown crop of chickpea.

INTRODUCTION

India ranks first in the production and consumption of chickpea (*Cicer arietinum* L.) in the world. Chickpea is a most important pulse crop of India which is mostly grown under dry land condition with heavy cloudy soil. It is a rich source of nutritional values in the diet of Indian people because of containing 21.5 per cent protein, 64.5 per cent carbohydrates and 4.5 per cent fat (Ahlawat and Omprakash, 1996) which is comparatively deficient in the cereals and oilseeds. Its green leaves and pods are used as green vegetables and germinated grains for breakfast and other delicious dishes by the people in their daily meals. Among the states Madhya Pradesh is the largest producer of chickpea in India. In M.P. chickpea is cultivated in 3.13 million ha with the production of 3.81 million tones with an annual productivity of 1220 kg/ha (Commissioner Land Records, M.P. Gwalior, 2012-13). Since, last few decades average production of chickpea has experienced very low in our country due to attack of gram pod borer, *Helicoverpa armigera* (Hubner) which is voraciously cause economic damage to this crop. It is a most serious pest of important agricultural crops like tomato, cotton, chickpea, pigeonpea and besides cereals, oil seeds and vegetable crops etc, but it mainly attacks chickpea (Jat and Ameta, 2013). The attacks of this dreaded pest begins right from vegetative stage and continue up to maturity. Young larvae of *H. armigera* were found to feeding leaflets, buds, flowers and pods of *Cicer arietinum* (Mandal and Roy, 2012). A single caterpillar of this insect can damage 25-40 pods (Sanap and Deshmukh, 1987). It has been reported as a prolific pest of chickpea and caused yield losses mainly due to pod damage which range from 14-38 per cent, whereas if the environmental conditions are congenial to *H. armigera*, then pod damage goes up to 90-95 per cent in Madhya Pradesh (Sachan and Katti, 1994; Pandey and Ujagir, 2008). To control this insect pest numbers of chemical insecticides are used injudiciously which result lead ability to resistance in insect, secondary pest outbreaks, threat to their natural enemies and residual effect on environment. To overcome above threats some workers have been advocated about the agronomical practices like altering the date of sowing might be a possible resort to escape chickpea crop from this pest (Summerfield, 1990 and Singh *et al.*, 2002). Several researchers have studied the effect of different dates of sowing and the seasonal abundance of gram pod borer with the corresponding yield of chickpea in different parts of India. It is learnt from the past studies of Deka *et al.* (1989), Yadava *et al.* (1991) and Cumming and Jenkins (2011) where they stated that the date of sowing has a great impact on the incidence of the pest which may be attributed to the difference in weather conditions. Early planted crops have less harbored with lowest pest population have the corresponding increase in the yield than the late planted crops (Chaudhary and Sachan, 1995, Ambulkar *et al.*, 2011, Prasad *et al.*, 2012). Although, little work has been carried out on this subject and the information available at present is very scanty.

Hence, keeping the above facts, present study was carried out to know the effect of different dates of sowing and weather parameter on the incidence of *H. armigera* in chickpea ecosystem.

MATERIALS AND METHODS

An experimental field trial was carried out in randomized block design during *Rabi* season 2009-10 in Research Farm Adhartal, Department of Plant Breeding and Genetics, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.), India to study on effect of different dates of sowing and weather parameters against the *Helicoverpa armigera* in chickpea using variety JG-9605. Sowing of chickpea was done on seven different dates with intervals of ten days viz; November 07, 17, 27, December 07, 17, 27 and January 06, respectively. Each sowing dates were replicated four times and each plot size was kept 8 × 3 m^2 with the spacing of 30 × 10 cm between rows and plants, respectively, and all recommended agronomical practices were followed. Weekly observations were recorded on number of eggs of *H. armigera* on 10 randomly selected plants, while larval population were recorded from one meter row length (mrl) at four different places from each plot, respectively, following the methodology of Saini and Jaglan (1998). Pod damage was recorded at the time of harvest and the sample size was kept one meter row length per plot. The per cent of pod damage was computed by using following formula:

$$\text{Per cent pod damage} = \frac{\text{Total number of damaged pods}}{\text{Total number of pods}} \text{X } 100$$

Correlation studies of the weather parameters viz., maximum and minimum temperature, relative humidity, rainfall and sunshine hours with the eggs and larval fluctuation population of *H. armigera* and per cent pod damage on different sowing dates were statistically analyzed. The data on insect population (eggs and larvae) and per cent pod damage was analyzed using square root transformation ($\sqrt{x+0.5}$) in RBD as described by Panse and Shukhatme (1985), while yield data were recorded from the all plots after harvest and converted in grain yield kg per ha.

RESULTS AND DISCUSSION

Effect of dates of sowing on egg and larval population of *H. armigera*

Over all mean population of egg was observed ranges between 3.04 to 4.99 eggs/10 plants from different date of sown chickpea crop (Table 1). The minimum egg population (3.04/10 plants) was recorded on early sown crop on November 07 which was significantly superior over the crop sown on November 17 (3.68/10 plants) followed by December 07 (3.69/10 plants), November 27 (3.71/10 plants), December 27 (4.03/10 plants), December 17 (4.48/10 plants) and January 06 (4.99/10 plants), respectively. Correlation studies revealed that morning relative humidity % exhibited significantly positive correlation with egg population on November 07 (r= 0.60), December 27 (r= 0.64) and maximum temperature (r= 0.57) on December 17 while significantly negative correlation was found with evening RH% (r= -0.61) on December 17 sown crop, respectively (Table 2).

Whereas, over all mean larval population was also significantly differ among the sowing dates (Table 1). Minimum larval population (1.74/mrl) was observed on sown crop November 07 which was exhibited significantly superior over the crop sown on November 27 (1.85/mrl) followed by November 17 (2.08/mrl), December 07 (2.27/mrl), December 17 (2.95/mrl) and December 27 (4.09/mrl), respectively. Whereas, the maximum larval population (5.00/mrl) was observed on late shown crop of January 06. Similar finding was also obtained by Ambulkar *et al.* (2011) on sown crop on October 28 and November 20 with least larval population (3.79 and 6.83 larvae/0.25 sqm) than December 11 sown crop (14.96 larvae/ 0.25sqm). Hossain *et al.* (2009) has studied the damage severity of *H. armigera* incidence started in 2nd to 4th week of January irrespective of sowing dates of chickpea crop. Chatar *et al.* (2010) were also reported that pest was active during the last week of December to 3rd week of January and later on, the pest population declined gradually towards the maturity of the crop. Muhammad *et al.* (2014) were recorded maximum larval population (0.45/mrl) during 4th week of February on chickpea sown crop on November 19 of both years of study while minimum larvae (*i.e.* 0.20 and 0.10/mrl) was recorded on the chickpea sown on October 20 during the years 2012 and 2013, respectively in the Faisalabad, Pakistan.

Correlation coefficient of *H. armigera* with different weather parameter indicated that sunshine exhibited significantly positive correlation (r =0.55) on November 07 sown crop, while, maximum temperature showed positively significant association (r= 0.66) and morning and evening RH% exhibited negative correlation (r= -0.54, -0.55) with mean larval population on November 27 crop sown, respectively (Table 2). Mean larval population on December 07 sown crop indicated that maximum and minimum temperature revealed significantly positive (r= 0.70, 0.62) and negative correlation

Table 1: Effect of sowing dates on overall mean population of eggs, larvae of *H. armigera* and % pod damage and grain yield kg/ha.

Date of sowing	Eggs /10plants*(H. armigera)*	Larvae/mrl*(H. armigera)*	% Pod damage	Grain yield kg/ha
November 07	3.04 (1.88)	1.74 (1.49)	11.5 (3.46)	1855
November17	3.68 (2.04)	2.08 (1.60)	12.00 (3.55)	1610
November 27	3.71 (2.05)	1.85 (1.53)	33.17 (5.80)	1540
December 07	3.69 (2.04)	2.27 (1.66)	35.90 (6.03)	1498
December 17	4.48 (2.23)	2.95 (1.85)	39.05 (6.28)	1450
December 27	4.03 (2.12)	4.09 (2.14)	45.52 (6.78)	1030
January 06	4.99 (2.34)	5.00 (2.34)	55.12 (7.45)	612

Figures in parenthesis are square root transformation $\sqrt{X+0.5}$) values.

Table 2: Correlation coefficient between the *H. armigera* (egg and larval stage) with weather parameters during *Rabi* season 2009-10

Weather parameters	Mean population of *H.armigera* eggs and larvae on different dates of sown crop													
	November 07		November 17		November 27		December 07		December 17		December 27		January 06	
	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae
Max. Temp. (^{0}C)	0.47 ^{NS}	-0.17 ^{NS}	0.28 ^{NS}	-0.01 ^{NS}	0.09 ^{NS}	0.66*	0.34 ^{NS}	0.70*	0.57*	0.83**	-0.27 ^{NS}	0.58*	-0.33 ^{NS}	0.60 ^{NS}
Min. Temp. (^{0}C)	-0.29 ^{NS}	-0.13 ^{NS}	0.07 ^{NS}	-0.01 ^{NS}	-0.02 ^{NS}	0.00 ^{NS}	0.27 ^{NS}	0.62*	0.22 ^{NS}	0.65**	-0.32 ^{NS}	0.36 ^{NS}	-0.34 ^{NS}	0.18 ^{NS}
Sunshine (hrs)	0.13 ^{NS}	0.55*	0.01 ^{NS}	-0.31 ^{NS}	0.42 ^{NS}	0.36 ^{NS}	0.37 ^{NS}	0.26 ^{NS}	0.42 ^{NS}	0.54*	0.12 ^{NS}	0.05 ^{NS}	0.33 ^{NS}	0.50 ^{NS}
Rainfall (mm)	0.26 ^{NS}	-0.07 ^{NS}	-0.24 ^{NS}	0.19 ^{NS}	-0.24 ^{NS}	-0.25 ^{NS}	-0.03 ^{NS}	-0.19 ^{NS}	-0.53 ^{NS}	-0.35 ^{NS}	0.58 ^{NS}	-0.46 ^{NS}	-0.23 ^{NS}	-0.23 ^{NS}
RH morning %	0.60*	-0.15 ^{NS}	0.09 ^{NS}	0.42 ^{NS}	-0.14 ^{NS}	-0.54*	-0.42 ^{NS}	-0.62*	-0.31 ^{NS}	-0.72**	0.64*	0.38 ^{NS}	0.44 ^{NS}	-0.38 ^{NS}
RH evening %	0.42 ^{NS}	-0.21 ^{NS}	0.07 ^{NS}	0.44 ^{NS}	-0.19 ^{NS}	-0.55*	-0.30 ^{NS}	-0.64*	-0.61*	-0.80**	0.36 ^{NS}	-0.59*	0.31 ^{NS}	-0.59 ^{NS}
Number of rainy days	0.18 ^{NS}	0.07 ^{NS}	-0.28 ^{NS}	0.15 ^{NS}	-0.14 ^{NS}	-0.02 ^{NS}	0.03 ^{NS}	0.15 ^{NS}	-0.24 ^{NS}	-0.34 ^{NS}	0.21 ^{NS}	-0.43 ^{NS}	-0.23 ^{NS}	-0.11 ^{NS}

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

(r= -0.62, -0.64) with morning and evening RH%. Further when the crop sown on December 17, larval population expressed highly significant positive (r= 0.83, 0.65) with maximum and minimum temperature and positive correlation (r= 0.54) with sunshine, while, highly negative correlation (r= -0.72, -0.80) were found with morning and evening RH%, respectively, on December 17 crop sown. Whereas, mean larval population exhibited positive (r= 0.58) and negative correlation (r= -0.59) with maximum temperature and evening RH%, respectively, on December 27sown crop. Rests of all weather parameters were found to be statistically not significant on January 07 sown crop. Present results supported by Chatar *et al.* (2010) finding in which different weather parameters showed that maximum temperature exhibited highly negative significant correlation (r= -0.75) with larval population of *H. armigera*, while, minimum temperature (r= -0.58) and mean temperature (r= -0.68) exhibited significantly negative correlation.

Effect of dates of sowing on pod damage at harvest and grain yield

The data on overall average pod damage was observed which range from 11.5 to 55.12 per cent at harvest of the crop (Table 1). Minimum average pod damage (11.5per cent) was recorded on November 07 sown crop, while pod damage was increased correspondingly 12.00, 33.17, 35.90, 39.05, 45.52 and 55.12 per cent with late sown crop on November, 17, 27, December 07, 17, 27 and January 06, respectively. The present finding is in corroboration with finding of Singh *et al.* (2008). They reported in their experiment during 2003, *H. armigera* larvae were observed from the last week of December to the first week of January, with an average pod damage of 37.0 per cent on chickpea. Increasing larval populations were observed under high temperature and relative humidity conditions. Whereas, Ambulkar *et al.* (2011) reported least pod damage (7.17% and 7.58%) when the crop was sown on October 28 and November 20 than December 11 (13.36%), respectively, while, Muhammad *et. al.* (2014) observed maximum pod damage was recorded in November 19 sown chickpea followed by November 09, October 30 and October 20 sown crop. The data on grain yield of chickpea was recorded after harvesting of the crop. Maximum grain yield was recorded from sown crop on November 07 (1855 kg/ha) followed by November 17 (1610 kg/ha), whereas minimum grain yield (612 kg/ha) was obtained from the crop sown on January 06. The present finding was at par with finding of Kumar *et al.* (1983), Borah (1998) and Patnaik (2004) also reported the sowing dates had greater effect on pod damage and grain yield of chickpea when the crop was sown on October 30 than December 15.

Kabir *et al.* (2009) were also observed maximum yield in November 22 sown chickpea crop followed by December 2 and December 12 sown crop. Similar results was also find out by Ambulkar *et al.* (2011) on October 28 and November 20 sown crop which has given highest grain yield (2513 and 2609 kg/ha, respectively) whereas December 11 sown crop yielded lowest (1653 kg/ha). Singh *et al.* (2008) were also recorded yield losses from different locations varied from 36.88 to 50 per cent due to *H. armigera*. The infestation of the pest was increased on late sown crop, during this period weather parameter favored the activity of *H. armigera* which result grain yield was obtained very less as compared to early sown crop. Present finding were corroborated with the results of Prasad and Singh, 1997 and Singh *et al.,* 2002.

It is revealed that the pod filling ability in chickpea varieties also varied with sowing dates and exhibited a definite trend with pod damage. The mean larval population was fewer on early sown crop and with delayed dates of sowing population was fluctuate in positive direction. It was observed that both the very early and late sown (December and onward) crop received higher pod damage and produced lower yield. But mid sown (November 07 to 27) crops received fewer pod damage and produced higher yield. Infestation of insect pests become active during the last week of December to 3rd week of January and later on, due to fluctuation trends in weather parameters which were absolutely responsible for pest population dynamics towards the maturity of the crop. Hence for ensuring higher yield with less pod damage, best fitted sowing dates were found to be November 07 to 27.

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