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Oviposition Responses of *Helicoverpa armigera* towards Different Chickpea Varieties as Influenced by Sowing Dates and Irrigation Levels under Field Condition

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ABSTRACT: Oviposition by *H. armigera* in different chickpea varieties as influenced by sowing dates and irrigation levels under field conditions at Research Farm, Breeding Seed Production-Soybean, College of Agriculture, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) during *rabi* season of 2019-20. Weekly observations were recorded on the number of *H. armigera* eggs per meter row length (mrl) at five randomly selected places from the field emergence stage to the crop harvest from each plot. Sowing dates studies revealed wide variation on ovipositional preference and crop sown on 15th November stands best with significantly lower mean oviposition by *H. armigera* (0.45 eggs/mrl). The oviposition by *H. armigera* significantly influenced by irrigation levels and lowest Mean oviposition by *H. armigera* was observed with irrigation at 35 DAS (0.89 eggs/mrl). Among varieties, significant lowest Mean oviposition by *H. armigera* was observed in the JG14 chickpea variety (0.38 eggs/mrl). Sowing dates and irrigation levels interaction studies revealed that crop sown on 15th November with irrigation at 35 DAS was observed significantly lower mean oviposition by *H. armigera* (0.12 eggs/mrl) over rest of treatment combinations. Varietal and sowing environment interaction studies revealed superior performance of JG 24 with sowing on 15th November in relation to lowest mean oviposition by *H. armigera* (0.14 eggs/mrl) which was significantly at par with JG 14 (0.16 eggs/mrl). Hence Chickpea varieties JG 14 and JG 24 will be recommended to the farmers for sowing under both normal and late sown condition due to maximum podding and least insect incidence.

Keywords: Eggs of *H. armigera*, date of sowings, irrigation levels, and chickpea varieties.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops of the *rabi* season cultivated mainly in semi-arid and warm temperature regions of the world. Madhya Pradesh ranks first among both areas and production in India. In India during 2017-18. Chickpea was cultivated in about 10.56 million hectares, with a production of about 11.23 million tons with a productivity of 1063 kg/ha (Anon., 2018). Chickpea was cultivated in about 3.59 million hectares with a production of 4.59 million tons with a productivity of 1282 kg/ha in Madhya Pradesh's state (Anon., 2018).

Chickpea seed is recognized as a valuable source of dietary proteins (18 to 22%), carbohydrate (52 to 70%), fat (4 to 10%), minerals (calcium, phosphorus, iron), and vitamins. Its straw also has good forage value (Shrestha *et al.*, 2011).

The gram pod borer (*H. armigera* Hub., Lepidoptera: Noctuidae) is one of the most detrimental insect pests of Chickpea causing heavy economic losses to the crop every year in Madhya Pradesh. In Madhya Pradesh occurs from the germination to the harvest of the crop. yield loss is in the range of 8.75% to 11.22% due to recent changes in states climate. The continuous presence of single larva per meter row during the pod formation stage of the crop resulted in 6.9% pod damage, 6.2% grain damage, and 5.4% yield loss (Ambulkar *et al*., 2011).

Global warming and climate change will have a major impaction pest incidence and pest-associated losses in field crops. Therefore, we studied pest incidence in Chickpea across sowing dates to understand climatic factors' effect of chickpea varieties responses to pest incidence under normal, late sown and very late sown condition. In case of chickpea late sowing is practiced commonly in our state due to which the insect attack and yield loss is more. Abiotic stress particularly heat stress is limiting the chickpea yield due to its effect on grain filling, pollen fertility, seed setting and pod damage. The egg-laying by the pod borer, *H. armigera*, decreased across sowing dates from October to December, with a slight increase in oviposition during the January sown crops. ICC 3137 was most preferred for egg-laying, followed by KAK 2 (Pavani *et al.*, 2019). Therefore, we hypothesize that utilizing the natural variation in chickpea will leads to the development of climate resilient and insect resistant varieties.

The cultivation of resistant or tolerant varieties during right sowing time with efficient agronomic interventions is economically viable, feasible, and climate-resilient techniques of pest management strategies. In order to test our hypothesis, the present investigation entitled Oviposition Responses of *H. armigera* towards different chickpea varieties as influenced by sowing dates and irrigation levels under natural Environment is planned and undertaken with the objective to identify the climate smart and insect resistant varieties which will be able to perform efficiently under different sowing environment with high yield stability.

MATERIALS AND METHODS

The field experiment was conducted at Research Farm, Breeding Seed Production-Soybean, College of Agricultural, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (M.P.) *rabi* season 2019-20. The experimental site lies between 23°10′ N latitude and 79°56′ E longitude, and 411.78 m above mean sea level. The field experiment was laid out in split split-plot design with 24 treatments and three replications. The treatments included three dates of sowing, *i.e.,* 15th November, 30th November, and 15th December as a main plot, two irrigation levels, *i.e.*, I_0-no irrigation and I_{1-} irrigation at 35 DAS as a sub plots and four chickpea varieties *i.e.*, JG 12, JG 36, JG 14 and JG 24 as sub plots. The treatments were randomly allocated in each replication.Weekly observations were recorded on the number of *H. armigera* eggs per meter row length (MRL) at five randomly selected places from the field emergence stage to the crop harvest from each plot. The counts recorded from five randomly selected places were averaged separately for each plot and made into the number of eggs per meter row length (mrl). Statistical analysis was performed to test the variation of oviposition by *H. armigera* with different treatments. The data recorded on different observations were tabulated and analyzed statistically using the techniques of analysis of variance (ANOVA).

RESULT AND DISCUSSION

Weekly observation of the ovipositional preference of *H. armigera* revealed that it was significantly affected by sowing dates, irrigation levels, and chickpea varieties, shown in Table 1 and graphically presented in Fig. 1.

Variation in sowing dates intimidated that, crop sown on 15th November recorded significantly lower mean oviposition by *H. armigera* (0.45 eggs/mrl) as compared to 30th November (0.80 eggs/mrl) and 15th December (0.1.61 eggs/mrl) sowing. In contrary, Shankar, *et al.*, (2014) evaluated chickpea genotypes in two sowing date at 30 days intervals (early sown crop in November and late sown crop in December) under field conditions reported that no significant differences in numbers of *H. armigera* eggs occurs among the genotypes tested. Similar to the present finding, Parmar *et al*., (2015) observed that the incidence and population fluctuation of *H. armigera* was much dependent on the prevailed weather parameters during the cropping season of all seven different dates of sowing. The overall minimum mean eggs population (3.04/10 plants) was recorded on early sown crop on 07th November, which was significantly superior over the other sowing dates. Pavani *et al.,* (2019) revealed significant differences in the numbers of *H. armigera* eggs across different sowing dates across the seasons. The egg-laying by the *H. armigera* females decreased as the sowing dates advanced from October to December (19.9 – 5.2 eggs/5 plants in 2012/13; 9.2 – 3.7 eggs/5 plants in 2013/14 and 13.9 – 4.3 eggs/5 plants across the seasons), but a slight increase in oviposition was recorded in the January sown crop (5.9 eggs/5 plants in 2012-13, 4.3 eggs/5 plants in 2013 – 2014, and 5.1 eggs/5 plants across the seasons). Irrigation studies revealed that oviposition by *H. armigera* was influenced by irrigation levels. The significantly lowest Mean oviposition by *H. armigera* was observed with irrigation at 35 DAS (0.89 eggs/mrl) followed by no irrigation (1.02 eggs/mrl). However, based on rigorous literature mining, it was observed that no studies were conducted on the effect of variation in irrigation levels over oviposition responses of *H. armigera.*

Table 1: Overall mean ovipositional preference of *H. armigera* to different chickpea varieties as influenced by sowing dates and irrigation levels in 2019-20.

Treatment	The overall mean of eggs/mrl					
	I_0 (no irrigation)		I_1 (irrigation at 35 DAS)		Mean	
D_1(15th Nov.)	0.47 (0.94)		0.43 (0.93)		0.45 (0.93)	
D_2(30th Nov.)	0.87 (1.13)		0.73 (1.08)		0.80 (1.10)	
D_3(15th Dec.)	1.73 (1.40)		1.49 (1.32)		1.61 (1.36)	
Mean	1.02 (1.16)		0.89 (1.11)			
	JG12	**JG36**	**JG14**	**JG24**	**Mean**	
D_1(15th Nov.)	0.92 (1.14)	0.59 (1.01)	0.16 (0.81)	0.14 (0.79)	0.45 (0.93)	
D_2(30th Nov.)	1.24 (1.29)	1.13 (1.24)	0.55 (1.00)	0.28 (0.88)	0.80 (1.10)	
D_3(15th Dec.)	2.66 (1.71)	1.14 (1.23)	0.44 (0.95)	2.20 (1.57)	1.61 (1.36)	
Mean	1.61 (1.38)	0.95 (1.16)	0.38 (0.92)	0.87 (1.08)		
I_0 (no irrigation)	1.73 (1.42)	1.01 (1.18)	0.42 (0.93)	0.92 (1.10)	1.02 (1.16)	
I_1 (irrigation at 35DAS)	1.49 (1.34)	0.89 (1.14)	0.34 (0.90)	0.82 (1.06)	0.89 (1.11)	
Mean	1.61 (1.38)	0.95 (1.16)	0.38 (0.92)	0.87 (1.08)		
Treatment	D_1(15th Nov.)		D_2(30th Nov.)		D_3(15th Dec.)	
	I_0	I_1	I_0	I_1	I_0	I_1
JG12	0.97 (1.16)	0.87 (1.11)	1.37 (1.33)	1.11 (1.24)	2.85 (1.77)	2.47 (1.65)
JG36	0.61 (1.01)	0.56 (1.00)	1.21 (1.27)	1.05 (1.21)	1.21 (1.25)	1.07 (1.21)
JG14	0.17 (0.81)	0.15 (0.80)	0.57 (1.00)	0.52 (0.99)	0.53 (0.99)	0.36 (0.91)
JG24	0.13 (0.78)	0.15 (0.80)	0.31 (0.90)	0.25 (0.86)	2.33 (1.61)	2.07 (1.53)
	Sem±			**C.D. (P=0.05)**		
Sowing Dates(D)	0.01			0.04		
Irrigation Level(I)	0.01			0.02		
Varieties(V)	0.01			0.03		
DXI	0.01			0.03		
DXV	0.02			0.04		
X	0.01			NS		
DX I X V	0.02			NS		

*mean of five samples and three replications
*Figures in parenthesis are the transformed data √x+0.5

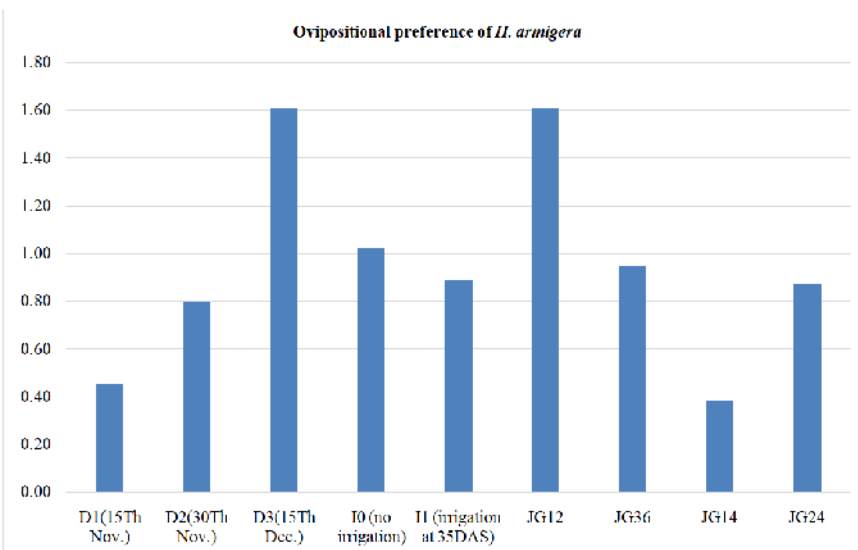

Fig. 1. Overall mean ovipositional preference of *H. armigera* to different chickpea varieties as influenced by sowing dates and irrigation levels in 2019-20.

Therefore, we identify it as one of the research gap for designing our hypothesis and objectives of study. Varietal studies revealed that significantly lowest Mean oviposition by *H. armigera* was observed in JG14 chickpea variety (0.38 eggs/mrl) followed by JG 24 (0.87 eggs/mrl), JG 36 (0.73 eggs/mrl), and highest with JG 12 (1.61 eggs/mrl). Chickpea variety JG 14 being the universally accepted heat tolerant variety developed by JNKVV, Jabalpur has also shown resistant against the insect pest incidence under different sowing environment. The result stands to be one of the first report on the expression of JG 14 resistance character to *H. armigera*. Varietal studies were also conducted by Bhagwat and Sharma (2000) who reported that the resistant genotypes, ICC 506, ICCV 10, ICCL 86102, and ICCV 95992, had a pod damage rating of 3 (1 = less susceptible to 9 = highly susceptible scale) to *H. armigera* due to low oviposition. (Jaba *et al*., 2019) revealed that among the genotypes tested, ICC 3137 had the highest number of *H. armigera* eggs (11.6) across the seasons. The lowest number of *H. armigera* eggs was observed on JG 11 (6.3) in 2012, on ICCV 10 (3.6) in 2013. Interaction studies between sowing dates and irrigation levels revealed thatcrop sown on 15th November with irrigation at 35 DAS was observed significantly lower mean oviposition by *H. armigera* (0.12 eggs/mrl) over rest of treatment combinations. The studies of interaction between sowing dates and chickpea varieties revealed that variety JG 24 sown on 15th November shown significantly lowest mean oviposition by *H. armigera* (0.14 eggs/mrl) significantly at par with JG14 (0.16 eggs/mrl). The interaction between irrigation levels and chickpea varieties and sowing dates, shown on significant difference.

CONCLUSION

In our research suggests that under late sown condition in chickpea, the incidence of pod borer is high as compare to normal sown. However, the incidence of pod borer was decreased by scheduling irrigation at 35 DAS under normal and late sown condition. Varietal performance revealed that JG 24 and JG 14 stands superior in terms of less oviposition by *H. armigera* exhibiting insect resistance trait over all the sowing environment. Hence Chickpea varieties JG 14 and JG 24 will be recommended to the farmers for sowing under both normal and late sown with one irrigation condition due to maximum podding and less oviposition by *H. armigera* in term of insect incidence.

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Conflict of interest. Nil.

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