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Influence of intercropping on incidence of gram Pod borer (*Helicoverpa armigera*) in chickpea (*Cicer arietinum* L.)

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Abstract
An Experiment was conducted during the period from November 2017 to April 2018 to study 7 intercropping systems with chickpea (*Cicer arietinum* L.) on the incidence of gram pod borer at the department of the Entomology field, Sam Higginbottom University of Agriculture and Technology Science, Allahabad. The study aimed to get the yield advantages and economic gains from the randomized block design including three replication and seven treatments. In this experiment intercropping has been done as treatment; within the base crop of chickpea. Seven treatments included in this study *viz.*; T_1 Chickpea + Coriander, T_2 Chickpea + Wheat, T_3 Chickpea + Mustard, T_4 Chickpea + Tomato, T_5 Chickpea + Safflower, T_6 Chickpea + Lentil, T_7 Chickpea Sole. Lowest percent pod damage was recorded in Chickpea + Coriander and it was followed by Chickpea + Lentil, Chickpea + Safflower, Chickpea + Tomato, Chickpea + Mustard, Chickpea + Wheat. Chickpea sole was found with highest pod damage percent. As considered intercrops; coriander and wheat were not infected by *H. armigera*. Lowest infected intercrop was lentil followed by safflower, tomato and highest infection in mustard.

Keywords: Chickpea, intercropping, gram pod borer, intercrop infestation

1. Introduction
Chick pea *Cicer arietinum* L. is a major food legume that provides a cheap source of high quality protein in the diets of millions in developing countries. Chickpea, *Cicer arietinum* (L.) a member of family Fabaceae, is a self-pollinated crop; it is originated in south eastern Turkey. Gram commonly known as Chick pea or Bengal gram is the most important *rabi* season pulse crop of India. In India it is also known as 'King of pulses'. Chick pea provides rich source of soluble fiber. It is useful in lowering the cholesterol. It contains zinc, folic acid and protein. Chickpea also contains complex carbohydrates, vitamins, minerals and are the chief source of protein particularly to the vegetarian diet, fat content is low and most of this is unsaturated. Major chickpea producing states in India are Madhya Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Rajasthan, Gujarat and Karnataka, together they contribute 93 per cent of the production from 92 per cent of area (Ali M 2005) [1]. The total area and production of chickpea in Rajasthan is 1.06 million hectares and 0.998 million tonnes, respectively, having productivity of 937 kg/ha. Chickpea is grown as a post monsoon (*Rabi*) crop, between 30º ′4 to 31º 35 ′N and 71º 5 ′to 76º 55 ′E, both under irrigated and rainfed conditions. It occupies very important position in semi-arid farming system both for human nutrition and restoring the soil fertility (Singh PK, Sirohi MT 2003) [11]. It is a protein-rich supplement to all cereal based diets, especially for vegetarians. Its protein is rich in lysine and has low sulphur containing amino acids hence; it is widely appreciated as healthy food. On an average, chickpea contains protein (12.4 to 31.5%), carbohydrate (48.2 to 67.6%) and fat (6%) (Anwar F *et al*., 2009) [2]. India is the largest producer of chickpea (*Cicer arietinum*) with 67 per cent of the global production and occupies nearly 31 percent of area in the country contributing over 37 per cent to the national pulse production (Reena *et al*., 2009) [9]. Among these Gram pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is the most important pest of chick pea. The caterpillars of gram pod borer not only defoliate the tender leaves but also make holes in the pods and feeds upon the developing grains. Newly emerged larva is yellowish-white in colour whereas the older can be of many colors. Fully grown caterpillars are 40-48 mm long with whitish and dark grey longitudinal stripes. Adults are medium sized stout-built moth forewing yellow to brown in colour wavy lines in the form of a black spot appears on the

apical margin. Tip of the abdomen consist of tuft of hairs in case of females. *Helicoverpa armigera* (Hubner) causes up to 75 percent reduction in yield (Begum *et al*., 1992) [4]. On average about 30 to 40% pods are found to be damaged by the pod borer resulting in the yield loss of 400 kg/ha (Rahman, 1990) [10]. It is a polyphagous insect also known as American bollworm has become a pest of national importance in India, causing economic losses to several crops like chickpea, pigeon pea, cotton, tomatoes etc. (Sachan 1994) [12]. The intercropping is economical method of pest management and has become popular, particularly among the small and marginal farmers. Intercrops in the study were chosen on the basis of their wide cultivation among small-holder farmers in the region. The possible success of these crops in ensuring profit and reducing damage by the pests of chickpea. The application of chemical insecticides and biological insecticide is the common method of controlling this pest on chickpea. *Helicoverpa armigera* develops resistance to almost all the insecticides used for its control.

2. Materials and Method

The present investigation was undertaken to evaluate efficacy of certain intercrops against pod borer on chickpea at the Central Research Farm of Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad, Uttar Pradesh during *Rabi* season 2017-18. The research farm is situated on the right side of Allahabad. Field trial was laid out in randomized block design (RBD) with 3 replications and 7 treatments including untreated control during *rabi* 2017-18 to evaluate the efficacy of six intercrops i.*e.*, coriander, wheat, mustard, safflower, tomato, lentil against pod borer on chickpea they are intercrop with chickpea. Crop was raised in plots measuring 3x2 m with a spacing 45x5 cm between rows and plant, respectively. Transplanting was done on November 14th in 2017. Crop was raised according to all agronomic package of practices under irrigated condition except the plant protection measure. After pod infestation; observations were taken by per week i.e., 7, 8, 9, 10 meteorological week. Specific plant was selected for readings.

2.1 Data collection

Five plants were randomly selected from each plot and tagged. Periodic observations were 7rd, 8th, 9th and 10th meteorological week. Count total number of healthy pod and damaged pod on selected plant.

2.2 Percent pod damage:

The numbers of *H. armigera* larvae were counted on 5 randomly selected plants in each plot. Count damage pods and healthy pods on selected plant.

Pod damage percentage will be calculated using the following formula:

$$\% \text{ pod damage} = \frac{\text{No. of affected pods}}{\text{Total no. of pods}} \times 100$$

Treatments	Intercropping	Crop : intercrop ratio
T_1	Chickpea + Coriander	4:2
T_2	Chickpea + wheat	4:2
T_3	Chickpea + mustard	4:2
T_4	Chickpea + tomato	4:2
T_5	Chickpea + safflower	4:2
T_6	Chickpea + lentil	4:2
T_7	Chickpea sole	6:0

2.3 Statistical Analysis

Data were analyzed by using MSTAT software for analysis of variance. Percentage of shoot and fruit damaged by ESFB was transformed before analysis. ANOVA was made by *F* variance test and the pair comparisons were performed by Duncan's Multiple Range Test (Gomez and Gomez 1984) [5].

3. Result and Discussion

The intercropping is economical method of pest management and has become popular, particularly among the small and marginal farmers. Intercrops in the study were chosen on the basis of their wide cultivation among small-holder farmers in the region. The possible success of these crops in ensuring profit and reducing damage by the pests of chickpea. The application of chemical insecticides and biological insecticide is the common method of controlling this pest on chickpea.

The data present in the table is 7 weeks (12 Feb. to 18 Feb.), 8 weeks (19 Feb. to 25 Feb.), 9 weeks (26 Feb. to 4 March.) and 10 weeks (5 March to 11 March.)

Table 1: Effect of intercropping on infestation percentage of *Helicoverpa armigera* in chickpea (7 weeks, 8 weeks, 9 weeks and 10 weeks)

No	Treatment	7 weeks		8 weeks		9 weeks		10 weeks	
	(All values in percent-age)	pod infestation	intercrop infestation	pod infestation	intercrop infestation	pod infestation	intercrop infestation	pod infestation	intercrop infestation
T1	Chickpea + Coriander	3.25 (10.35)	0.0 (0)	5.58 (13.65)	0 (0)	8.33 (16.66)	0 (0)	13.83 (21.08)	0 (0)
T2	Chickpea + wheat	6.22 (14.42)	0.0 (0)	10.01 (18.43)	0 (0)	16.70 (24.11)	0 (0)	23.67 (29.11)	0 (0)
T3	Chickpea + mustard	6.40 (14.55)	0.75 (4.92)	11.54 (19.82)	0.95 (4.21)	13.52 (21.47)	1.33 (6.60)	19.02 (25.82)	1.66 (7.40)
T4	Chickpea + tomato	6.30 (14.32)	0.70 (4.90)	11.42 (19.58)	0.93 (4.03)	12.51 (20.66)	1.26 (6.45)	17.03 (24.23)	1.46 (6.95)
T5	Chickpea + safflower	4.49 (12.12)	0.53 (4.17)	8.29 (16.69)	0.73 (3.95)	11.72 (19.94)	1.10 (5.73)	16.29 (23.72)	1.26 (6.43)
T6	Chickpea + lentil	4.09 (11.41)	0.46 (3.89)	7.78 (16.11)	0.66 (3.25)	9.71 (17.97)	1.00 (5.71)	16.08 (23.50)	1.20 (6.28)
T7	Chickpea sole	7.51 (15.88)	0.0 (0)	12.31 (20.53)	0 (0)	18.22 (25.26)	0 (0)	26.30 (30.84)	0 (0)
	F-test	S	S	S	S	S	S	S	S
	SE	1.18 (1.56)	0.05 (0.28)	1.15 (1.03)	0.05 (1.37)	1.46 (1.33)	0.10 (0.28)	2.14 (1.57)	0.11 (0.15)
	CD at 5%	2.59 (3.41)	0.16 (0.62)	2.51 (2.26)	0.16 (2.98)	3.18 (2.90)	0.23 (0.62)	4.67 (3.43)	0.25 (0.61)

Table 2: Mean Effect of intercropping on infestation percentage of *Helicoverpa armigera* in chickpea (7 weeks, 8 weeks, 9 weeks and 10 weeks)

MEAN										
Treatment	**Chickpea + Coriander**	**Chickpea + Wheat**	**Chickpea + Mustard**	**Chickpea + Tomato**	**Chickpea + Safflower**	**Chickpea + Lentil**	**Chickpea sole**	**F-test**	**SE**	**CD at 5%**
Main crop	7.74 (15.43)	14.45 (21.51)	12.62 (20.41)	11.81 (19.69)	10.19 (18.11)	9.41 (17.24)	16.08 (23.12)	S	1.48 (1.37)	3.23 (3.00)
Intercrop	0 (0)	0 (0)	1.16 (6.18)	1.10 (6.01)	0.86 (5.33)	0.85 (5.27)	0 (0)	S	0.01 (0.24)	0.19 (0.55)

● Figures in parenthesis are arc sine transformed values.

The data on the pod damage per cent revealed that all the intercrop treatments were significantly superior over the chickpea sole crop. Among all the intercrop treatments, lowest per cent pod damage was recorded in chickpea + coriander treatment with 7.74 found among and it was followed by chickpea + lentil, chickpea + safflower, chickpea + tomato and chickpea + mustard with 9.41, 10.19, 11.81 and 12.62 per cent pod damage respectively. The highest pod damage treatments were, chickpea + wheat and chickpea sole with 14.45 and 16.08 per cent pod damage respectively and they were found high damage than other. Chickpea sole was found to be predominantly affected by highest pod damage per cent compared to other treatments with 16.08 per cent (Table 1). Yadav (1989) [14] and Kumar *et al*., (2008) [7] mixed crop with lentil and coriander found reduced gram pod borer population and per cent pod damage. The other authors also supported our present investigation that chickpea intercropped cropped with mustard has been observed with reduced gram pod borer damage Lal *et al*., (1985) [8], Yadav, (1989) [14], Singh (2014) [13] and Yadav, (1989) [14]. Chickpea + marigold were recorded with maximum yield which was at par with the Chickpea + coriander by Hossain *et al*., (2010) [6] revealed that, chickpea intercropped with mustard was most economic module for the management of gram pod borer with early sowing.

It could be seen that the intercrop infestation in chickpea; intercropped with mustard, tomato, safflower and lentil found to be significant. Coriander was not infected due to essential oil having insecticidal activity and wheat is not a host crop so it is also not infected. The mean result of treatments (T_3) chickpea intercropped with mustard (1.16) and (T_4) chickpea intercropped with tomato recorded (1.10) highest pest infestation. Followed by the treatment (T_5) chickpea intercropped with safflower recorded (0.86) pest infestation and treatment (T_6) chickpea intercropped with lentil recorded (0.85) pest infestation. Whereas treatments T_2 and T_1 chickpea intercropped with coriander and wheat recorded (0.00) pest infestation. (Table 2)

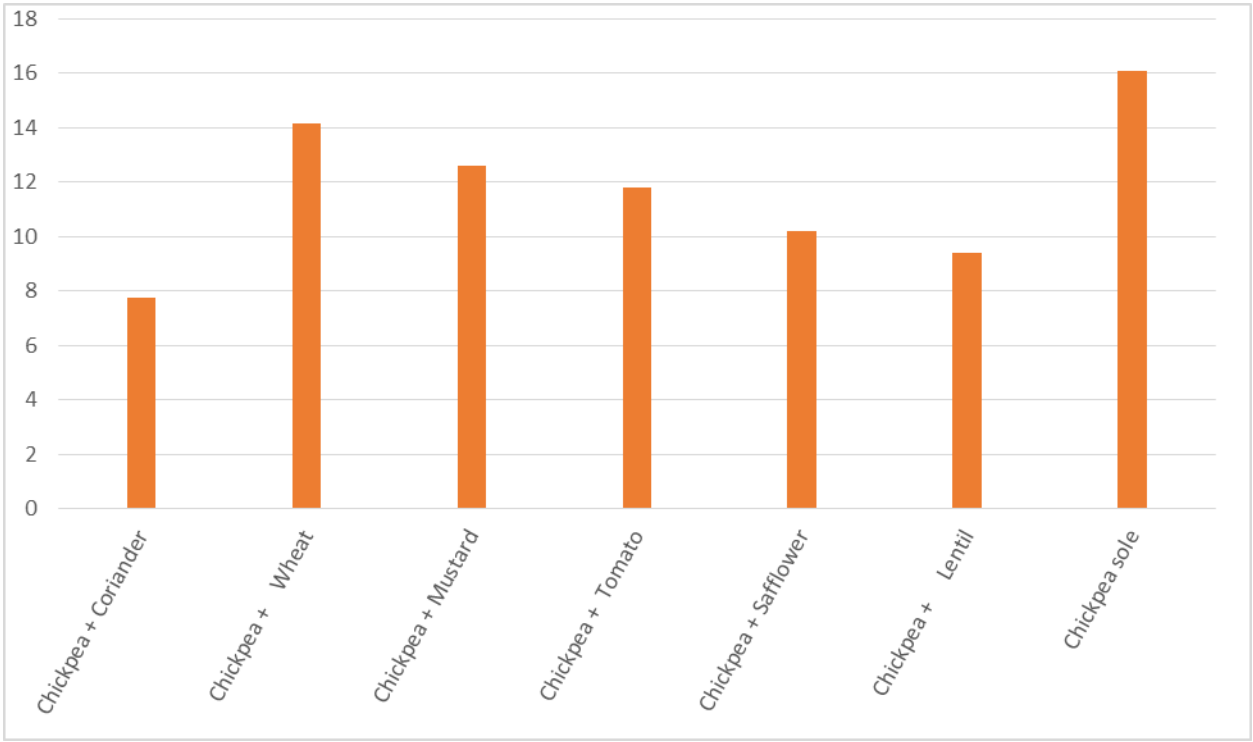

Fig 1: Mean Effect of intercropping on infestation percentage of *Helicoverpa armigera* in chickpea (7 weeks, 8 weeks, 9 weeks and 10 weeks)

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