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DETERMINATION OF ECONOMIC INJURY LEVELS OF *Helicoverpa armigera* (Hubner) IN CHICKPEA

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Abstract

Chickpea pod borer *Helicoverpa armigera* (Hubner) *is* considered to be one of the major pests of chickpea. The damage potential and economic threshold level for *Helicoverpa* armigera larvae on chickpea crop were worked out. On an average, single larva per m row reduced the yield to the extent of 155 kg/ha and 157 kg/ha in 2004-05 and 2005-06 cropping season, respectively. The ratio of the value of yield saved to the cost of insecticide application at one larva per m row was 1.06 and 1.12 in 2004-05 and 2005-06, respectively. EILs for *Helicoverpa armigera* were determined as 12 and 0.95 per m row and ETLs was at 09 and 0 73 larvae per m row in 2004-05 and 2005 - 06, respectively.

Key Words: Economic injury, chickpea, pod borer

Introduction

The knowledge of ETL helps determine whether an insect is to be classified as a pest or not. The ideas expressed by Pierce (1934) with regard to the assessment of insect damage and the initiation of control measures became one incentive for the development of a concept of Economic Injury Level (EIL) in the later years. Stem *et al. (1959)* who formally proposed the concept of economic threshold levels as the number of insect (density or intensity) when management action should be taken to prevent the increasing pest population from reaching economic injury level.

Chickpea is the third most important pulse in Bangladesh in terms of acreage and production (BBS, 1998).There are many factors responsible for low yield, among which insect pests appear to be the most vital. Chickpea is attacked by more than 36 species of insect pests in India (Nayar *et al.*, 1982; Davis and Lateef 1979). Among these pests, the pod borer. *Helicoverpa armigera* is the most serious one (Chaudhary and Chaudhary, 1975; Chhabra, 1980). *Helicoverpa armigera* (Hubner) belongs to family Noctuidae of order Lepidoptera. This pest is commonly known as pod borer. Alam *et al.* (1964) and Rao *et al.* (2001) listed this *insect* as a pest of cotton, pigeon pea, chickpea and lady's finger. According to Jiirgen *et* al. (1977) and Paid and Koshiya (1997) it attacks maize, sorghum, various legumes, sunflower, millet, okra, tomato and other horticultural crops. *H.*

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armigera adult is a light reddish-brown moth with a prominent dot near the middle of the forewing. The caterpillars have variable colours ranging from green, brown or yellow. They feed on the leaves, buds, flowers and rather serious on pods. Several young pods and developing seeds in pods are consumed.The losses in yield caused by the pest in Madhya Pradesh of India was 40 to 50 per cent (Bindra, 1968). In Bangladesh, 30 to 40 percent pods were found to be damaged by this borer (Rahman, 1990).Therefore, the present investigation was aimed to determine the economic injury levels of *H. armigera* infesting chickpea.

Materials and Method

The experiment was conducted at ARS, BARI, Buiirhat, Rangpur during *rabi* seasons of 2003-05 and 2005-06. The methods of artificial infestation by different levels of larval population were followed to establish the economic injury levels of *H. armigera.* The ETL was determined based on the benefit cost ratio as suggested by Farrington (1977). There were six treatments consisted of six different larval densities i.e., 0, 1, 2, 3, 4 and 5 larvae per m row length, released at flowering stage of the crop. Seeds were sown in row maintaining row to row distance of 30 cm. Spacing between plants was kept 30 cm. The experiment was laid out in RCBD. The second or third instars larvae were used for this purpose. The plants of one meter row length was covered with nylon mesh cages of 1.0 x 0.5 x 1.0m size before flowering to avoid natural infestation. The cages were designed in such a way that they did not interrupt ventilation and aeration to the growing plants inside. The bottom edges of the cages were inserted into the soil in all sides to check the escape or entry of larvae. These nylon net cages were erected on bamboo sticks fixed in four corners.

The larvae were released once at the time of flowering and subsequently at 15 days interval to maintain constant population throughout. Pupae and prepupal stages of larvae from the previous release were collected at the time of next release. The population density was maintained till the pod maturation stage.

The number of total and damaged pods and weight of grains from all the covered plants of each cage were recorded. Relationship between the larval density and the percentage of pod damaged were worked out by correlation co-efficient and regression equations. Yield data were converted into kg/ha. Yield losses due to different treatments were derived by deducting the yield of the respective treatment from the yield of control (where no larvae was released). The value of yield loss was determined according to the wholesale market price of chickpea grains prevailing at Rangpur just after harvest during the season. Eighty percent of the yield loss was considered to be avoided with insecticidal treatment, hence was taken as avoidable loss or yield saved. Benefit cost ratio (BCR) was worked out as the ratio of the value of yield saved to the cost of insecticidal application. Cypermethrin @ 0.02 percent was considered for

calculating the cost of insecticidal application. Finally, the economic injury level for pod borer larvae was calculated by fitting regression equation Y= a+bx, between larval population levels and BCR. The larval density corresponding to unit benefit cost ratio was the economic injury level and economic threshold level was set at 75% of ETL (Pedigo, 1991).

Results and Discussion

Total number of pods per plant ranged from 49.33 to 56.95 during 2004 -05 and 53.00 to 56.66 during 2005-06. In both the years, the differences among the various treatments were found insignificant indicating no effect of the pest density on the pod formation. Sharma (1985) reported that there was no significant effect on the bearing of the pods in chickpea. Similar results were also reported by Reddy *et al.* (2001) in Pigeonpea.

The percent pod damage increased significantly with rise in larval density per plant during the two seasons (Table 1 and 2). A density of one larva per plant caused about 11 percent pod damage (11.11% during 2004 - 05 and 10.58% during 2005 - 06). This was in conformity with earlier studies (Anonymous, 1990 and Reddy *et al.,* 2001.) where 5-10 percent pod damage was reported with single larva of *Helicavera armigera.* However, increase in larval population per meter row did not show proportionate increase in pod damage. Sharma (1985), Prabhakar *et al.* (1998) and Reddy *et al.* (2001) also found in-proportionate increase in the damage of chickpea pods with increase in the larval population levels. A strong positive correlation was found (r = 0.94) during 2004 - 05 and (r = 0.987) during 2005 - 06, between larval density and pod damage (Fig. 1). The grain yield per plant varied from 7.02g to 12.41g during 2004 - 05 (Table 1) and from 8.18g to 13.63g during 2005 - 06 (Table 2), corresponding to larval densities of 5 and 0 per meter row length, respectively. Single larva was found to cause 11.37 and 10.24 percent loss in grain yield during 2004 - 05 and 2005 - 06 which represent 155 and *157* kg yield loss per hectare, respectively (Table 3 and 4).

The ratio of the value of yield saved to the cost of insecticide application at one larva per m row was 1.17 and 1.18 during 2004 - 05 and 2005 06, respectively. EIL lies at the pest population density where BCR would be 1.1. In order to calculate the exact larval density at which BCR would be 1.1, the correlation of larval density (X) with the BCR (Y) was calculated. There was a strong positive correlation and linear relationship between those two variables (Fig. 2 and 3). The regression equations derived were Y 1.1063 X - 0.179 (during 2004 - 05), Y 0.9291 X + 0.2605 (during 2005-06) where, X =Larval density per m row and Y= BCR.

Table 1. Effect of larval densities of *Helicoverpa annigera* on pod damage and yield loss of chickpea at ARS, Burirhat, Rangpur during 2004-05.

No. of larvae/m row	Pods/plant (Average of 10 plants)	Pod damage (%)	Yield/plant (g) (Average of 10 plants)	*Yield loss (%)
0	56.95	0.00 e	12.41 a	0.00 f
1	56.67	11.11 d	11.00 b	11.37 e
3	51.33	20.55 c	9.68 d	21.96 c
4	49.33	29.94 b	8.70 e	29.86 b
5	55.56	47.31 a	7.02 f	43.46 a
	ns			

In a column means having same letter (s) denote no significant difference by DMRT at 5% level.

$$*\text{Yield loss (\%)} = \frac{Wt\ of\ \text{inf}\ ested\ \ pods}{Wt\ of\ \ healthy\ \ pods} \times 100$$

Table 2. Effect of larval density *of Helicoverpa armigera* on pod damage and yield loss of chickpea at ARS, Burirhat, Rangpur during 2005-06.

No. of larvae/m row	Pods/plant (Average of 10 plants)	Pod damage (%)	Yield/plant (g) (Average of 10 plants)	*Yield loss (%)
0	47.66	0.00f	13.63a	0.00f
1	51.66	10.58e	12.23b	10.24e
2	56.66	17.16d	10.95c	19.68d
3	56.33	21.48c	9.95d	28.03c
4	54.33	27.08b	9.03e	33.66b
5	53.00	38.21a	8.18f	39.85a
	ns			

In a column means having same letter (s) denote no significant difference by DMRT at 5% level.

$$*\text{Yield loss (\%)} = \frac{Wt\ of\ \ infested\ \ pods}{Wt\ of\ \ healthy\ \ pods} \times 100$$

Table 3. Economic analysis of *Helicoverpa armigera* management of chickpea at Burirhat, Rangpur during 2004-05.

No. of larvae/m row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk/ha)	Vvlue of yield loss saved (Tk/ha)	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide (Tk.)	Labour charges (Tk.)	Total cost (Tk)	
0	1923 a	-	-					
1	1768 b	155	3100	2480	1437.50	675	2112.5	1.17
2	1672 bc	251	5020	406	1437.50	675	2112.5	1.90
3	1577 e	346	6920	5536	1437.50	675	2112.5	2.62
4	1418 d	505	10100	8080	1437.50	675	2112.5	3.82

Price:

Chickpea grin = 20 Tk./kg.

Cypermethrin = 1150 Tk./lit.

1.25 Lit Cypermethrin was used.

Table 4. Economic analysis of *Helicoverpa armigera* management of chickpea at Burirhat, Rangpur during 2004-05.

No. of larvae per m row	Grain yield (kg/ha)	Yield loss (kg/ha)	Value of yield loss (Tk/ha)	Value of yield loss saved (Tk/ha)	Cost of insecticide application (Tk.)			BCR
					Cost of insecticide (Tk.)	Labour charges (Tk.)	Total cost (Tk)	
0	1893a	-	-					
1	1736b	157	3140	2512	1437.50	675	2112.5	1.18
2	1566c	327	6540	5232	1437.50	675	2112.5	2.47
3	1458d	435	8700	6960	1437.50	675	2112.5	3.29
4	1393e	500	10000	8000	1437.50	675	2112.5	3.78
5	1261f	632	1240	10112	1437.50	675	2112.5	4.78

Price:

Chickpea grin = 20 Tk./kg.

Cypermethrin = 1150 Tk./lit.

1.25 Lit Cypermethrin was used.

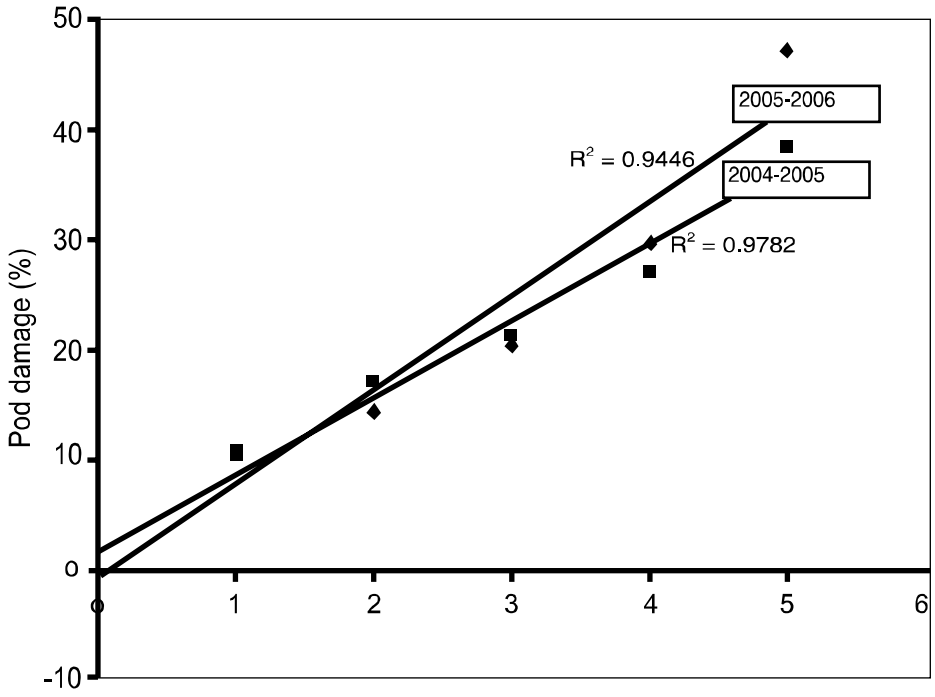

Fig. 1. Relationship between larval densities and pod damage of *Helicoverpa armigera* in chickpea correlation coefficient at ARS, Burirhat during 2004-05 and 2005-06.

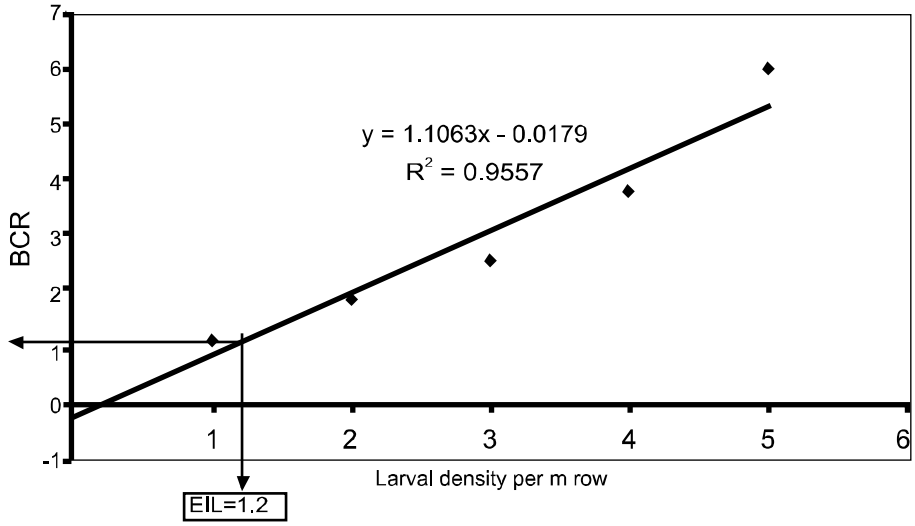

Fig. 2. Relationship between larval densities (per m row) and BCR during 2004-05.

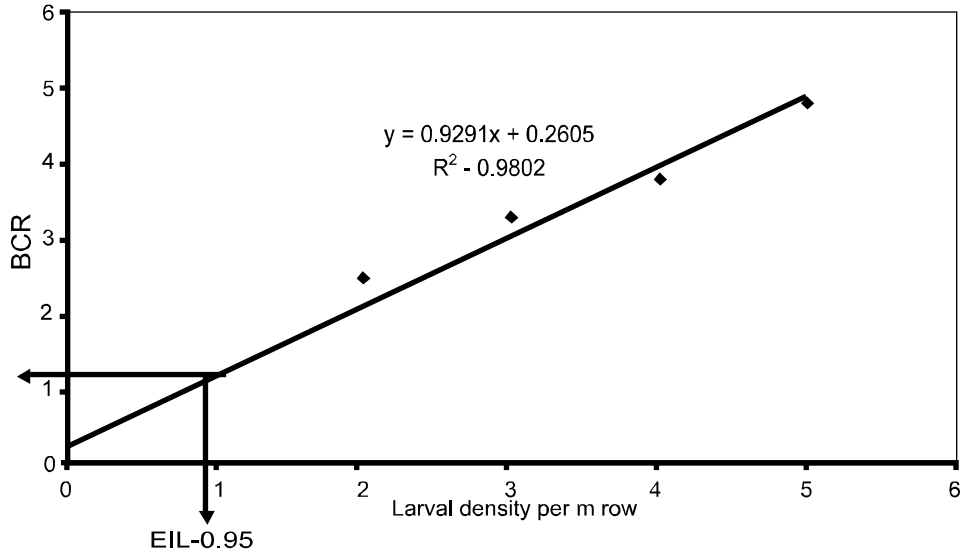

Fig. 2. Relationship between larval densities (per m row) and BCR during 2004-05.

From the above equations the EILs of *H. armigera* larvae determined as 1.20 and 0.95 larva per m row during 2004 - 05 and 2005 – 06, respectively. On the basis of means of two years, the ML value was 1.1 larva per m row in chickpea. Odak and Thakur (1975) reported that more than four larvae per m^2 in chickpea at flowering stage caused economic injury. Nath and Rai (1995) found ETL of gram pod borer under natural condition to be 1.77 to 2.00 larvae per m row length. Reddy *et al.* (2001) also noticed that EIL of *Helicoverpa* in pigeonpea was 0.78 to 0.80 larvae per plant. However, Prabhakar *et al.* (1998) found ETL of chickpea pod borer 0.9 and 1.2 larvae per m for non-nirrigated and irrigated crops, respectively.

Economic threshold level indicates the population density at which control measures should be initiated in order to prevent the population in reaching EIL. According to Pedigo (1991), “we may choose to set ETL conservatively below EIL, say at 75 percent of ETL”. Accordingly in the present study ET values were determined from EILs and they were 0.90 and 0.7 3 larvae per m row during 2004 - 05 and 2005 -06, respectively. So on the basis of means of two years, the ETLs value was 0.81 larvae per m row in chickpea. Chaudhary and Sharma (1982’ calculated ETL values for *armigera* of chickpea to be 1.0. Reports by Singh and Reddy (1976) and Whitman *et al.* (1995) are also very close to 1.0 larva per/m row.

Conclusion

Results of the present study showed that the control measures should be initiated when the *Helicoverpa* larval population reaches one larva per m row length in

chickpea plants, in order to prevent the population in reaching economic injury levels.

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