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Estimation of avoidable yield losses caused by *Helicoverpa armigera* (Hubner) on chickpea

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Abstract

Experiment was carried out to evaluate the yield losses caused by *Helicoverpa armigera* (Hubner) infesting chickpea at RCA, MPUAT, Udaipur during 2013-14 and 2014-15. The loss estimation due to insect pests on chickpea showed that mean plant height under treated condition was 1.10 and 1.11 times more than when unprotected; likewise, the mean number of pods was 1.25 and 1.32 times more when the crop was protected. Mean number of damaged pods was 5.44 and 5.12 times more and the mean percent pod damage was 6.76 and 6.86 times more under unprotected condition. Similarly, the mean seed per pod was 1.68 and 1.70 times more in protected plot than when left unprotected. Mean yield /plant (g) and mean yield/plot (g) were 2.09 and 2.19 and 1.43 and 1.45 times more when the crop was kept protected. On the basis of yield, an avoidable loss of 29.93 and 31.28 per cent was recorded due to *H. armigera* infestation in chickpea variety GNG 1581.

Keywords: Chickpea, *Helicoverpa armigera*, yield losses, protected, unprotected, flubendiamide 480SC

1. Introduction

Gram pod borer, *Helicoverpa armigera* (Hubner) plays a detrimental role in the destruction of chickpea crop which is the world's third most important pulse crop^[13], grown in the semi-arid tropics around the world^[6]. The countries affected by the devastating attack of *H. armigera* on chickpea include India, Pakistan, Turkey, Mexico, Iran, Australia and Ethiopia^[4]. Chickpea (*Cicer arietinum*) is one of the most important pulse crop in India. It is cultivated on an area of 10.17 million ha with a production of 9.93 million tonnes, accounting for 30.9% and 39.9% of total pulse area and production^[19]. Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka, Chhattisgarh, Bihar and Jharkhand are major chickpea producing states contributing more than 95 per cent to the total chickpea production. Chickpea was cultivated in an area of 9.93 million hectares with a production of 9.53 million tonnes and a productivity of 960 kg/ha during 2013-14 in India^[2]. Rajasthan contributes about 14 per cent of total production and the major growing districts in Rajasthan are Kota, Sriganaganagar, Chittorgarh, Alwar, Tonk, Jhalawar, Pali, Jaipur, Sawai Madhopur, Bikaner, Churu, Sikar and Hanumanharh^[1]. In Rajasthan chickpea is cultivated in an area of 1923.00 thousands hectares with the production of 1640.40 thousands tonnes with a productivity of 853 kg/ha during 2013-14^[2]. Various factors responsible for low production and productivity of chickpea are; weeds, diseases and insects pests. Insect pests are the main constraints which limit the production of chickpea. Pod borer, *H. armigera* (Hubner) (Lepidoptera: Noctuidae) is the most prominent insect species that causes major economic damage to this crop. It is highly polyphagous pest attacks over 182 plants species including both widely grown and economically important crops as cotton, maize, tobacco, pigeon pea, chickpea and tomato etc^[5]. The yield loss in chickpea due to pod borer was reported as 10-60 per cent in normal weather conditions^[17], while it was 50-100 per cent in favorable weather conditions, particularly in the states where frequent rains and cloudy weather are prevailing during the crop season^[14]. It is estimated that *H. armigera* alone is responsible for losses over Rs. 35000 million annually in India despite heavy pesticide inputs^[7] because of its high fecundity, migratory behavior, high adaptation to various climatic conditions. Although it attacks chickpea throughout the crop growth, the damage caused during flowering and pod formation stages results in substantial yield loss^[11]. Therefore, the present experiment was conducted to estimate the yield losses caused by gram pod borer *H. armigera*.

2. Materials and methods

With a view to estimate the losses caused by pod borer *Helicoverpa armigera* in chickpea an experiment was conducted in plot size of 3.6m x 3.6m with 30cm x 10cm spacing. The two treatments viz. unprotected and protected plots were replicated thirteen times in Randomized Block Design as per model of Leclerg (1971)^[8] at the Instructional Farm, RCA, Udaipur during 2013-14 and 2014-15. One set of plots referred as protected was provided complete protection by spraying Flubendiamide 480SC at weekly intervals. Another set of plots termed unprotected was kept untreated and exposed to natural infestation by *H. armigera*. Yield of chickpea received from protected and unprotected plots was recorded separately at harvest.

2.1 Observations

Observations for pod borer population were taken from 5 plants, selected randomly from each replication in both protected and unprotected set of plots. Observations pertaining to various plant characters related to the yield viz., height of plants (cm), number of pods, number of damaged pods, percent pod damage, number of seeds per pod, yield per

plant (g) and yield per plot (kg) were taken and subjected to 't' test. The loss in yield due to *H. armigera* was calculated by using the equation:

$$\text{Loss in yield (\%)} = \frac{X_1 - X_2}{X_1} \times 100$$

Where, X_1 = Yield in treated plot
 X_2 = Yield in untreated plot

The yield data were subjected to statistical analysis and significance tested by "t" test:

$$t = \frac{Y_1 - Y_2}{S. Ed.}$$

Where

Y_1 = Average yield in treated plot

Y_2 = Average yield in untreated plot

S. Ed. = Standard error of difference of mean

$$\text{Standard deviation (s)} = \frac{S.S \text{ of the deviation from the mean difference}}{\text{Number of paired plots} - 1}$$

$$\text{Standard error of mean difference (S. Ed.)} = \frac{\text{Standard deviation (s)}}{\text{Number of paired plots (n)}}$$

3. Results and discussion

The results from table 1 and 2 indicated that the mean plant height (cm) in the respective years of study (2013-14 and 2014-15) was 1.10 and 1.11 time more under protected condition (44.78 and 45.32) as compared to that under unprotected conditions (40.56 and 40.64). Mean number of pods/plant was 1.25 and 1.32 times higher under protected condition (72.77 and 74.65) as compared to that under unprotected conditions (57.82 and 56.17) in the respective years. Zahid *et al* reported that the total mean number of pods per plant was 53.96 and 53.27 on chickpea during 2004-2005 and 2005-2006, respectively^[18]. Similarly, Narayanamma *et al* reported total number of pods per plant to be 107 and 81 under protected and unprotected plots of chickpea^[10]. In the present findings, during the respective years of observation, the mean numbers of damaged pods were 5.44 and 5.12 times higher under unprotected condition (25.82 and 26.49) as compared to that under protected condition (4.74 and 5.17). Zahid *et al* recorded the mean number of damaged pods to be 11.52 and 10.37 on chickpea during 2004-2005 and 2005-2006, respectively^[18]. We observed the percent pod damage to be 6.76 and 6.86 times greater under unprotected conditions (44.61 and 47.62) as compared to that under protected conditions (6.59 and 6.94) in the respective years. Narayanamma *et al* reported that the mean percent pod damage recorded was 2.09 and 17.01 in protected and unprotected plots of chickpea^[10]. Deshmukh *et al* observed that mean percent pod damage was 17.78 and 34.76 in protected and unprotected conditions in chickpea^[3]. Our findings recorded that the number of seeds per pod in the respective crop seasons was 1.68 and 1.70 times more under

protected condition (1.90 and 1.88) as compared to that under unprotected condition (1.13 and 1.11). Narayanamma *et al* reported that the number of seeds per pods ranged from 1.09 to 1.36 on chickpea^[10]. From our experimental results, the mean yield /plant (g) was 2.09 and 2.19 times higher under protected condition (21.76 and 22.06) as compared to that under unprotected condition (10.41 and 10.06). Narayanamma *et al* reported the grain yield of plant (g) among the genotypes ranged from 15.54 to 23.65 and 10.22 to 19.79 gram in protected and unprotected^[10]. The year-wise mean yield/plot (g) in our investigation was 1.43 and 1.45 times higher under protected condition (2248.92 and 2162.54) as compared to that under unprotected condition (1567.46 and 1480.00). On the basis of yield an avoidable loss of 29.93 and 31.28 per cent was recorded during 2013-14 and 2014-15, respectively. Narayanamma *et al* reported mean losses in grain yield due to *H. armigera* across genotype was 24.84 per cent under protected and unprotected conditions^[10]. Likewise, Mehta *et al* recorded yield losses due to the pod borer in two cultivars of chickpea to be 23.35 per cent (CV. C-235) and 20.08 per cent (CV. HPG-17) during 1996-98^[9]. Similarly, Singh *et al* reported yield loss in chickpea due to *H. armigera* to vary from 36.88 to 50 per cent in different localities of Uttar Pradesh (India)^[15]. Deshmukh *et al* opine that chickpea when protected against pod borer, *H. armigera* resulted in avoiding grain yield loss of 41.17 per cent^[3]. Prabhakar *et al* the maximum pod damage by *H. armigera* on chickpea was 42.33 per cent and the maximum yield reduction was 37.33 per cent^[12]. Srivastava reported that pod damage and yield loss due to *H. armigera* on chickpea varied from 39.12 to 67.30 per cent and 27.52 to 42.16 per cent, respectively^[16].

Table 1: Comparative losses due to *H. armigera* infestation in chickpea GNG 1581 (2013-14)

S. No.	Parameters	Protected	Unprotected	t- calculated value	Mean Loss (%)
1	Mean plant height (cm)	44.78	40.56	9.14*	--
2	Mean number of pods	72.72	57.82	7.44*	--
3	Mean number of damaged pods	4.74	25.82	20.02*	--
4	Mean (%) pod damage	6.59	44.61	29.39*	--
5	Mean seed/pod	1.90	1.13	28.85*	--
6	Mean yield/plant(g)	21.76	10.41	16.94*	--
7	Mean yield /plot(g)	2248.92	1567.46	9.06*	--
8	Estimated mean yield (Kg/ha)	1735.82	1209.46	---	29.93

*The t-value significant at P = 0.05

Table 2: Comparative losses due to *H. armigera* infestation in chickpea GNG 1581 (2014-15)

S. No.	Parameters	Protected	Unprotected	t- calculated value	Mean Loss (%)
1	Mean plant height (cm)	45.32	40.64	8.90*	--
2	Mean number of pods	74.65	56.17	9.68*	--
3	Mean number of damaged pods	5.17	26.49	29.43*	--
4	Mean (%) pod damage	6.94	47.62	21.77*	--
5	Mean seed/pod	1.88	1.11	15.93*	--
6	Mean yield/plant(g)	22.06	10.06	17.01*	--
7	Mean yield/plot(g)	2162.54	1480.00	13.06*	--
8	Estimated mean yield (Kg/ha)	1668.63	1141.98	---	31.28

*The t-value significant at P = 0.05

4. Conclusion

The study revealed that the avoidable quantitative loss was estimated as 29.93 and 31.28 per cent due to *H. armigera* infestation in chickpea variety GNG 1581 during 2013-14 and 2014-15, respectively.

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