

Sex aggregation pheromones have also been identified and synthesized for most of the *Helicoverpa* pest species, and thus pheromone trap is regarded as effective pest monitoring tool (Loganathan and Uthamasamy, 1998; VanEmden, 1996). This pheromone is largely used to determine the indication of the pest occurrence however, now a day in Nepal, this tool is also considered as management tool. There were variations regarding the population dynamics and infestation of *H. armigera* under different different weather condition, season, temperature and other biophysical environment. Considering these facts, a study was carried out to estimate the loss in chickpea due to *H. armigera* and to monitor its population under Chitwan condition during 2006.

MATERIALS AND METHODS

Field loss assessment

The loss assessment experiment was carried out at the farmer's field (one *ropani* area viz. 500 m²) at Mangalpur VDC of Chitwan in Chickpea of Dhanush variety in 2004/05. Treatments were allocated into Randomised Complete Block Design (RCBD) with four consecutive weeks as treatments. They were replicated six times. The observations were recorded starting from 115 days after sowing (DAS). Five randomly selected plants were taken as sampling unit (i.e. small, medium and large sized plants) taken from six corners and same sampled plants were repeatedly recorded four times in succeeding weeks. The numbers of larvae, no of borer damaged pods, total pods were recorded. The final field yield was also taken. Further, percent of pod damaged was calculated by formula below based on the recorded observation.

$$\text{Percent pod damage} = \frac{\text{Number of damaged pods}}{\text{Number of total pods}} \times 100$$

Based on the damage percent, extent of damage was scored by using the procedure given by Lateef and Reed (1983). Infestation rating scale (Scale 1 for No damage, Scale 3 for 1-20 % pod damage, Scale 5 for 21-40% pod damage, Scale 7 for 41-60% pod damage, Scale 9 for 61-100% pod damage). The daily weather records were taken throughout the cropping season from National Maize Research Program (NMRP), Nepal Agricultural Research Council, Rampur, Chitwan. The collected data were adjusted through Arc Sine transformation for analysis (Gomez and Gomez, 1984) and analysed with software MSTAT-C. The mean separation for treatments was done using Duncan's Multiple Range Test (DMRT).

Pheromone trap monitoring

One set of pheromone trap was installed in chickpea growing farmer's field at Mangalpur-4, Rampur at the beginning day (23rd November, 2005) and another set at farmers' field without chickpea crop at Fulbari-3, Chitwan from the same date. Rubber septum having Heli-lure (Pest Control India Pvt. Ltd. PCI) of *H. armigera* was changed at every 15 days interval. The trapped male moths of *Helicoverpa armigera* Hubner were collected and counted weekly throughout the cropped season. Daily records of weather data (temperature, relative humidity and rainfall) of cropping duration (November 2004 to April 2005) were taken from National Maize Research Program (NMRP), Nepal Agricultural Research Council, Rampur, Chitwan. Based on the collected male moths in both sites during growing time, seasonal occurrence and pattern of abundance were presented.

RESULTS

Larval infestation

The larval population at 115, 122, 129, and 136 days after sowing (DAS) were significant ($P < 0.01$). The maximum mean number of larva (3.10 per plant) were observed at 29th March (129 DAS) and were followed by 136 DAS, 122 DAS and 115 DAS with mean number of 1.80, 1.57 and 1.47 larva per plant, respectively (Table 1). The last two weeks showed significantly higher mean larva number than the first two weeks.

Pod damage

The percent pod damage of chickpea in succeeding weeks (115 DAS, 122 DAS, 129 DAS, 136 DAS) of pod setting were significant ($P < 0.01$). At initial observation (115 DAS), pod damage was 13.28% which increased by 3.30 % (Figure 1) after one week, i.e. at 122 DAS. However, damage percent were not significantly different between first two weeks (15th and 22th March) of experiment (Table 1). At 129 DAS, the percent damage (31.97%) was significantly different than previous weeks (115 and 122 DAS) but not significantly different from 136 DAS. Increases in pod damage were 15.39 %, and 4.36% at interval of 122-129 and 129-136 DAS, respectively (Figure 1).

The pod damage score was maximum 5.33 at 136 DAS followed by 5.00, 3.73 and 7.40 at 129 DAS, 122 DAS, 115 DAS, respectively (Table 1). There was a strong positive correlation ($r = 0.61$) between number of larvae and percent pod damage (Figure 2).

Yield and yield attributing characters

The average yield of the chickpea at farmers field was 670 kg/ha and 1000 grains weight was 209.25 g.

Table 1. Infestation and damage in chickpea due to *H. armigera* under Chitwan condition, 2004/05.

Crop stage	Infestation		
	Pod damage (%)	Larva (Number./plant)	Damage score
115DAS	13.28 ^b ±0.39 (21.35)	1.47 ^b ±0.08	3.40
122 DAS	16.58 ^b ±1.07 (23.96)	1.57 ^b ±0.09	3.73
129 DAS	31.97 ^a ± 2.24 (34.36)	3.10 ^a ±0.30	5.00
136 DAS	36.33 ^a ±1.83 (37.04)	1.80 ^a ±0.11	5.33
CV%	7.96	21.29	
CD (P = 0.05)	2.860	0.5192	
SEm±	0.9487	0.1722	

SEm± = Standard error of mean difference, CV% = Coefficient of variation, CD (P = 0.05) = Critical difference at probability value 0.05, Values with the same letters in a column are not significantly different at 5 % by DMRT, Figures after ± indicate standard error of mean, Figures in the parentheses are ArcSine √ percent transferred values.

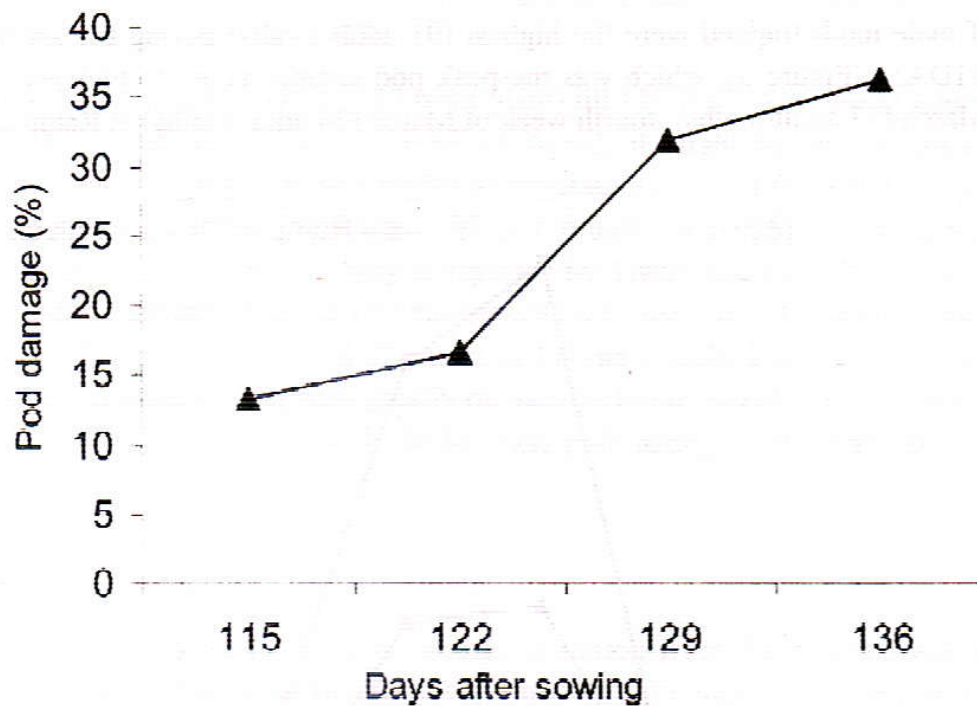


Figure 1. Pod damage due to *H. armigera* in chickpea at farmer's field Chitwan, 2004/05

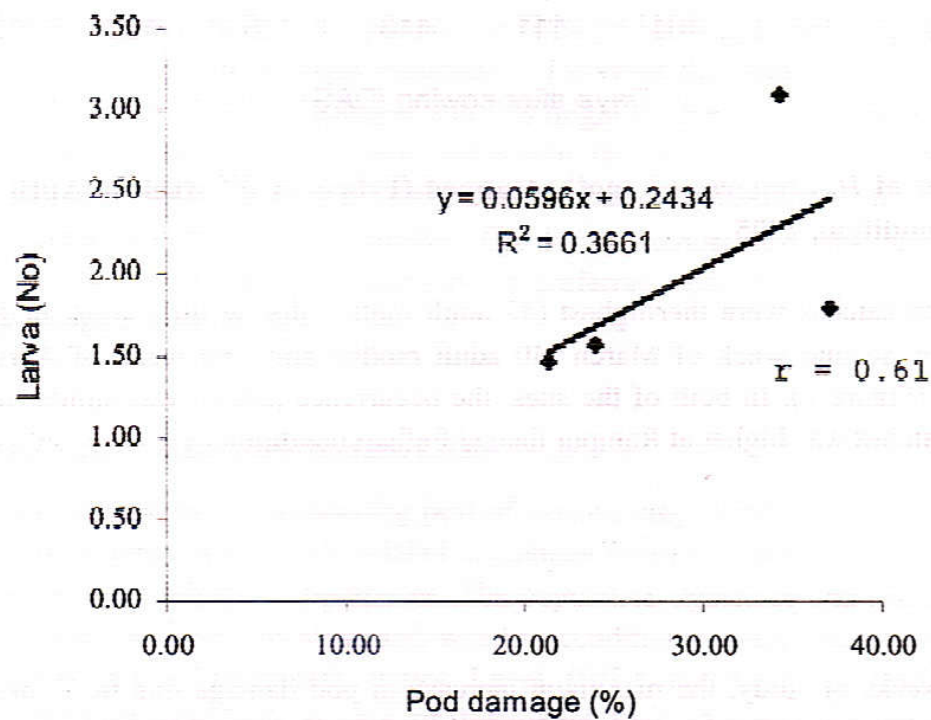


Figure 2. The relationship between larval number and pod damage in chickpea under Chitwan condition, 2004/05

Pheromone trap monitoring

The number of male moth trapped were the highest (91 adult moths) during the second week of March, i.e. (111DAS) (Figure 3), which was the peak pod setting stage of chickpea followed by third week of March (77 adult moths), fourth week of March (24 adult moths) at Rampur.

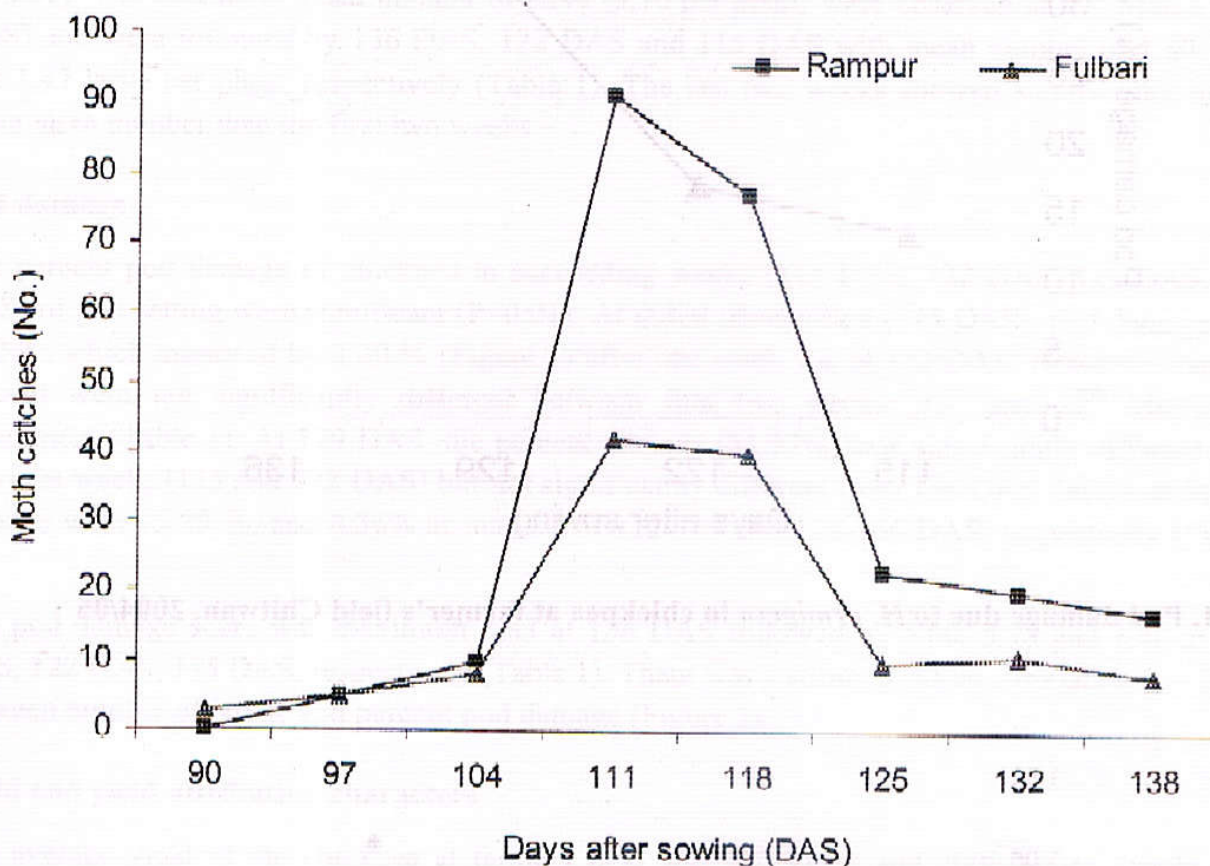


Figure 5. Number of *H. armigera* (♂ moth) trapped (February 3rd week to April 2nd weeks) under Chitwan condition, 2005

Similarly, the moth catches were the highest (42 adult moths) during third week of March (118 DAS), followed by second week of March (40 adult moths) and first week of April (10 adult moths) at Fulbari (Figure 3). In both of the sites, the occurrence pattern was similar but the total number of moth catches was higher at Rampur than at Fulbari condition.

DISCUSSION

Field loss

During the four weeks of study, the maximum increase in pod damage due to *H. armigera* was observed in second week to third week of March, i.e. 16.58 % to 31.97%, this was due to the coincidence of the higher larval infestation in the field with high temperature. Similar result is reported by many authors (Singh and Singh, 1975; Sharma and Chaudhary, 1988) that there was a negative correlation between temperature and egg incubation but positive between hatchability and temperature range of 20 to 30°C. Pod damage at harvest (136 DAS) was observed 36.33% which is

still lower as compared to 60% (Pande and Rao, 2000) under farmer's field condition in Banke and Bardiya districts (Pandey *et al.*, 2000), while it is higher than national average of India (29.2%) (Krishnamurthy Rao and Murthy, 1983).

The larval infestation was increased (3.10 larva/plant) till 129 DAS (24 March) while mean number of larva was decreased to 1.80 at 136 DAS (1 April), it might be due to full maturity of the chickpea pods since its infestation was higher at vegetative and pod formation stages. This finding was also supported by Parihar and Singh (1986); Lal and Lal (1996) in tomato while infestation was increasing upto second week of May as reported by Tiwari and Rao (1987). Its infestation was recorded the highest during winter in rose flower with 6.1 larvae/rose flower (Gahukar, 2002) but it was 19 larva/sunflower plants even at 3rd weeks of February under Hyderabad condition. Although larval population in chickpea depends greatly on various biotic and abiotic factors (Olla and Saina, 2000). Number of larva increased with the increase pod damage with correlation coefficient ($r = 0.61$).

Pheromone trap monitoring

The occurrence of the male moth of *H. armigera* started from the fourth week of February at Rampur while it was one week earlier at Fulbari condition. Though, a deviated result (last week of January) was observed at National Grain Legume Program trial (Annual Report, 1990). The maximum number of moths (91 adult males) was observed during the second week of March and this result (98 adult males) is supported by other results at Rampur condition (Annual Report, 1990). Similar findings are reported by G.C. and Thapa (2000) and Pandey *et al.* (1997) which coincide with the present finding that March–April was the peak period of moth activities under tropical and subtropical climate. This period was from pod setting to maturity stage and might be due to subsequent increase in average temperature. However this finding varies more or less with the finding of Sah *et al.* (1988) at Rampur and this might be due to variation in weather condition of experimental period since various biotic and abiotic factors are involved in population variation (Zehnder *et al.*, 1995; Olla and Saina, 2000). The number of moth trapped in two locations varied though the weather conditions were similar. The lower number of moth occurrence at Fulbari condition might be due to the unavailability of preferred host chickpea. This result was also supported by Bilapate *et al.* (1988).

CONCLUSION AND RECOMMENDATION

The chickpea pod borer is the threatening pest of various crop plants all over the world. The pest incidence and occurrence is indirectly related to ambient weather condition of the specific locations and other management related mal-practices. The population dynamics and loss assessment due to *H. armigera* under particular location and weather condition is very important to set Economic Threshold Level (ETL), Economic Injury Level (EIL) and to make decision for positive intervention under the modern concept of Integrated Pest Management (IPM). Based on the research result, the pod damage is found more than thirty percent in chickpea and loss was found highest at 129 days after sowing. There was a strong positive correlation between number of larvae and percent pod damage. The male moth population trapped through pheromone trap monitoring, the peak catch of male moth was found during the second week of March at Rampur whereas it was

maximum during third week of March at Fulbari condition. Both experiment results would be the basis for the formulation of effective pest management tactics against *H. armigera* under particular weather condition of Chitwan in chickpea.

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