

Original Research Article

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Study of Biology and Effective Management of Gram Pod Borer, *Helicoverpa armigera* Hub on Field Pea

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ABSTRACT

Keywords

Helicoverpa armigera, Cow urine, Incremental Cost Benefit Ratio, Lantana leaf, Efficacy, Neem

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The experiment was conducted to study of biology of *H. armigera* in relation to abiotic factors (temperature, relative humidity, rainfall etc.), to evaluate the efficacy of some botanicals and organic compounds against *H. armigera* and work out the economics of different treatments with Incremental Cost Benefit Ratio (ICBR), *H. armigera* on field pea in Rabi 2018-19. Result showed that the population of *H. armigera* appeared on 4th week of November (1.15 larvae/ 5plant) i.e. 47th Standard Meteorological Week (SMW) & reach its peak (15.10 larvae/ 5plant) during 52nd SMW i.e. last week of December. The pest population gradually decreased (0.8 larvae/ 5plant) in the 3rd week of February i.e. 7th SMW due to the reason of crop maturity. Regarding efficacy of treatments cow urine + neem leaf proved most effective which was closely followed by cow urine + tobacco leaf and cow urine + lantana leaf. Maximum yield i.e. 21.40q/ha was given by cow urine + neem leaf which was closely followed by cow urine + tobacco leaf and cow urine + lantana leaf. ICBR of cow urine i.e. 1:15.5 was the highest followed by cow urine + neem leaf having ICBR 1:13.52. Similar trend in percent increased yield over control was observed in this investigation.

Introduction

Field Pea, *Pisum sativum* L. is an important leguminous vegetable crop & mostly grown in all states of the country during Rabi season and because of its taste, nutritive value, fast growth and high yield this crop is patronized throughout the world. It is used as vegetable purpose as well as pulse (10). Insect pests are probably the main factor limiting the legume production. Gram pod borer, *H. armigera* Hubner, (Lepidoptera: Noctuidae) is one of the most devastating crop pest worldwide (9).

Sixty cultivated and sixty-seven wild host plants attacked by *H. armigera* have been recorded from India (2). In India, the extent of losses due to *H. armigera* in chickpea is up to 27.9% in northwest plain zone, 13.2% in north east plain zone, 24.3% in central zone and 36.4% in south zone (4). The crop has been noted to suffer an avoidable loss of 9 to 60% (12). The problem of this pest is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility, fecundity and multivoltine overlapping generations (8) and (11).

Materials and Methods

The present investigation was conducted during Rabi season of 2018-2019 at Student Instruction Farm (SIF) in Chandra Shekhar Azad University of Agriculture & Technology, Kanpur- 208002 (U.P.). It lies between 26.26° N latitude and 80.24° east longitudes at an altitude of 125.9 meters above mean sea level.

General climatic information of experimental site

Kanpur has subtropical and semi-arid climate with hot summer and severe cold winter. The winters are severe with a minimum temperature of about 5 °C with occasional ground frost. In summer the temperature often goes up to 40 to 45 °C in the month of May and June. The mean precipitation is about 800 mm of which about 80-90 per cent is received during July to September.

Soil of the experimental field and Preparation of the field

The soil of the experimental field was sandy loam with an average fertility level. Field was ploughed twice with the help of tractor mounted disc harrow. Each ploughing was followed by leveling with the help of leveler with pre sowing irrigation.

Layout and sowing of experiment

The field trial with chickpea variety KPMR-522 in randomized block design in a plot measuring 3 X 6m area and 8 treatments including control with 3 replications was laid out on October 20, 2018 in a well prepared field. Seed was sown @ 100kg/ha.

The furrows were opened with the help of furrow opener adjusted at a row distance of 30 cm and plant to plant of 5 cm apart. The

furrows were covered with soil and field was made smooth after completing the total sowing.

Fertilizer application

Recommended dose of 20 kg/ha N, and 40 kg/ha P₂O₅ were applied for good crop production. Total dose of the nitrogen as starter dose which can meet plant requirement before the formation of nodules and total quantity of phosphorus were applied as basal at the time of final field preparation. All the fertilizers are drilled in furrows at a depth of 7-10 centimeters.

Weeding

First weeding was done at 15 days after germination with the help of "*Khurpi*" and second weeding was done when the crop was 35 days old.

Identification

The adult of *Helicoverpa armigera* Hub. is a typical stout built noctuid moth with a wing span of 30 to 40 mm, and colour varying from olive gray to red brown. Fore wings are dark speck and dark area found at outer margin. The hind wings are white with dark veins and a broad blackish band along the outer margin.

Life Cycle of *Helicoverpa armigera*

The moth begins ovipositing on pea plant at the seedling stage but this behavior is checked by the adverse climatic and geographical conditions (13). The population peaks were observed in different months of the year. The population peaks generally corresponds to the full bloom and pod formation stage of Chickpea (6). This is active from October to April and has 7-8 overlapping generations. Each female lays eggs singly on tender parts of the plants. A single female may lay as

many as 740 eggs in 5 days. They hatch in 6 days in November to April. The larval population of the pest can be seen initially on the young leaves, under heavy infestation young shoots are also attacked and the plants become weak. The young larvae feed on the foliage for some time and later bore into the pods and feed on the developing grains with their bodies hanging outside. They move from pod to pod and full feeding in 13-19 days.

Observation Recorded

Larval observations

Larval duration: It was taken from the hatching of eggs till pupation.

Larval weight: It was observed on the fifth instar.

Full size: It was observed on the fifth instar.

Pupal observations

Pupal duration: It was taken from the starting of pupation till adult emergence.

Pupal weight: It was taken few days after pupation.

$$\text{Female emergence per cent} = \frac{\text{No. of female emerged} \times 100}{\text{Total no. of adult emerged}}$$

$$\text{Male emergence per cent} = \frac{\text{No. of male emerged} \times 100}{\text{Total no. of adult emerged}}$$

Growth and Fitness Index

The larval and pupal growth index and the fitness index were calculated using the following equations

$$\text{Larval growth index} = \frac{\text{Pupation per cent}}{\text{Larval period (days)}}$$

$$\text{Pupal growth index} = \frac{\text{Emergence per cent}}{\text{Pupal period (days)}}$$

$$\text{Fitness index} = \frac{\text{Pupation per cent} \times \text{pupal weight}}{\text{Larval period} + \text{pupal period}}$$

Results and Discussion

The present study are supported by (14), who stated that the larval population of *H. armigera* occurred on chickpea throughout its growth phase, being low at the vegetative and flowering stage and high at the grain development stage. There were two larval peaks, first between 47-50 standard weeks and second between 11-15 standard weeks (Table 1).

The present findings are supported by (1) who reported that cow urine and its combination with *neem* leaf, lantana leaf was effective in reducing the population of *Helicoverpa armigera* Hub. in chickpea crop. (7) who studied four botanicals viz., mahogany oil, mahogany seed extract, tobacco leaf extract and *neem* seed kernel extract were tested for their efficacy against *H.armigera*. The lowest fruit infestation, both by number and weight, was observed in *neem* seed kernel extract (27.15%, 22.29%) treated plot which was statistically similar to tobacco leaf extract (27.71%, 23.31%) treated plot.

(5) studied bio-efficacy of different botanicals against thrips, *Scirtothrips dorsalis* in *Bt* cotton. Among the nine botanicals evaluated against *S. dorsalis* in *Bt* cotton, *neem* seed kernel extract (NSKE) 5% found the most effective followed by *neem* oil 1 per cent, *neem* leaf extract (NLE) 10 per cent, garlic bulb extract (GBE) 5 per cent and ginger rhizome extract (GRE) 5 per cent with seed cotton yield 2304, 2295, 2275, 2252 and 2238 kg/ha, respectively. The highest (1: 7.34) ICBR obtained with the treatment of NLE followed by NSKE (1: 6.20) and GBE (1:

4.54).(3) conducted an experiment to study the efficacy of botanical insecticides against tomato fruit borer, *Helicoverpa armigera* Hub. on tomato, *Lycopersicon esculentum* Mill, during 'rabi' season of 2013 - 2014. The result revealed that the maximum reduction of 100% was recorded in the plot treated with Chloropyriphos 40 EC 0.2% and it was found significantly superior over all treatments. Next better treatments were of botanicals i.e., Nimbicidine 0.4%, *Neem* oil 5% and Neemazol 0.4% with 83.33, 77.78 and 72.22% of fruit damage respectively. Treatments followed to these were NSE, Tobacco leaf extract, leaf extract of *lantana camara* and control with 66.67, 66.67, 55.56 and 0.00% fruit damage reduction respectively. The data on cost benefit ratio of (1:21.59) was recorded in Chloropyriphos and proved to be most effective among the treatments. However, nimbicidine recorded second highest benefit cost ratio of (1:19.23) followed by *Neem* oil, (1:18.18), NSE (1:17.75), neemazol (1:16.48), tobacco leaf extract (1:15.95) and leaf extract of *lantana camara* (1:15.43).

The monetary gain from the treatment was determined by the calculating the cost of production and value of saved yield. The highest net income (Rs. 36465/ha) was found in the treatment, cow urine + *neem* leaf followed by cow urine + tobacco leaf (Rs. 29185/ha). The lowest net income (Rs. 17582/ha) was obtained from *lantana* leaf extract.

Based on ICBR, the treatment with cow urine was found most economic treatment which gave the maximum benefit (1:15.50) as compared to all other treatments. The next profitable treatment was cow urine + *neem* leaf (1:13.52) based on higher cost-benefit ratio. All treatments were found cost effective over the control.

It may be concluded from the present investigation, that the response of treatments in terms of per cent reduction of larval population over control during *Rabi* season 2018-19 is as under-

Cow urine+*neem* leaf >cow urine+tobacco leaf >cow urine+*lantana* leaf >*neem* leaf extract >cow urine >tobacco leaf extract >*lantana* leaf extract.

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Compliance with ethical standards:

The authors declare that they have no conflict of interest. This article does not contain any studies with human participants or animals performed by any of the authors.

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