**Original Research Article**

**Relative Efficacy of Selective Insecticides against Gram Pod Borer, *Helicoverpa armigera* (Hubner) in chickpea**

**Abstract**

The present investigation entitled was conducted at the Students’ Instructional Farm of Acharya Narendra Deva University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.), India during *Rabi*, 2019-20. The experiment was laid out in a randomized block design with three replications along with seven treatments *viz*., Spinosad 45 SC (0.2%), Indoxacarb 14.5 SC (0.4%), Neem oil 0.5%, Cow urine 5%, Ha NPV 250 LE/ha, Garlic extract 5% and Untreated check. Results revealed that among treatments, application of Indoxacarb proved superior to other treatments concerning maximum pest control (81.30%), followed by Spinosad 45 SC 0.2%. Maximum net return and benefit cost ratio (1:18.8) was found with the application of Indoxacarb 14.5 SC.

**Key words:** Chickpea, efficacy, *H. armigera*, insecticides and benefit cost ratio.

**Introduction**

The chickpea, or *Cicer arietinum* L., is a significant legume crop member of the Fabaceae family. The great nutritional content of chickpea seeds, which are also abundant with vegetable protein, carbohydrate, cholesterol-lowering fibre, oil, ash, calcium, and phosphorus, makes them vital as well. Numerous insect pests that affect the roots, foliage, and pods of the chickpea plant (Rao and Shanower, 1999). One of the most significant chickpea insect pests is the Gram pod borer (*Helicoverpa armigera*), which is also very important economically (Ahmed and Awan, 2013). “It is a very polyphagous insect that also feeds on cotton, tobacco, safflower, tomato, maize, cabbage, peanuts, and lentils, among many other crops. Its main hosts are leguminous crops like chickpea, which experience significant production loss (37–50%) and, in extreme cases, up to 90% pod destruction. A single larva can destroy 40 pods and only feeds on the host plant's growth points and reproductive organs. It consumes flower buds, blossoms, and immature pods from the crop in growth. The gram pod borer was challenging to control due to its vast host range, many generations, migratory behaviour, and high fertility. Due to its quick known effects, chemical control is still regarded as the final resort for its management” (Sreekanth, 2014; Kora et al. 2018). Insecticides must, however, be used carefully to prevent their negative effects on the environment and natural biocontrol agents (Suhail *et al*., 2013). Exploring novel insecticides with a high level of effectiveness and a distinctive mode of action is therefore crucial. In recent years, efforts have been made to concentrate newer substances with unique mechanisms of action to control the gram pod borer infestation. The purpose of the current study was to assess the effectiveness of several pesticides against the gram pod borer in a field-grown chickpea crop in light of the severe gram pod borer attack.

**Materials and methods**

A field experiment was conducted at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya. Department of Agricultural Entomology. The trial was laid out during Rabi 2019-20 in a block design with seven treatments replicated thrice, having a plot size of 20 sqm. The chickpea variety Pant G-186 was sown, and all the normal agronomical practices were followed for the cultivation of the crop. Spraying was initiated at the ETL of *H. armigera,* i.e. 1 larva/mrl. The larval population of *H. armigera* was recorded before spraying and 1, 3 and 7 days after spraying.

**Results and Discussion**

**Relative efficacy of different treatments**

The data on the effect of various treatments on the larval population of *Helicoverpa armigera* are presented in Table 1, and it is evident from the data that the mean larval population per 10 plants was non-significant before application of different treatments. Data observed after 1 day of spray showed that all the treatments were effective in reducing the larval population of the pod borer. The most effective treatment was Indoxacarb 14.5 SC (0.7 larvae/10 plants), which was significantly superior to all the treatments. The next best treatment was Spinosad 45 SC (0.9 larvae/10 plants), which was at par with Neem oil 5% (1.1 larvae/10 plants). Rest all the treatments were significantly superior to the control. Data recorded after 3 days of spray reflect that Indoxacarb 14.5 SC @ 0.4% again significantly superior over all the treatments and recorded only 0.3 larvae/10 plants. Next best treatment was Spinosad 45 SC @ 0.2% (0.6 larvae/10 plants). Treatment Neem oil @ 5% had the third place in reducing larval population and recorded 1.0 larvae/10 plants, which was at par with *Ha* NPV @ 250 LE/Ha (1.2 larvae/10 plants).

Observation recorded after 7 days of spraying showed that Indoxacarb 14.5 SC @ 0.4% was superior (0.3 larvae/10 plants), followed by Spinosad 45 SC @ 0.2% (0.7 larvae/10 plants). Next best treatment was Neem oil @ 5%, which was at par with *Ha* NPV @ 250 LE/Ha. Cow urine @ 0.5% was least effective (2.2 larvae/10 plants) in reducing the larval population.

Data presented in Table 1 also showed that overall, per cent reduction of larval population recorded maximum 81.3 per cent in treatment Indoxacarb 14.5 SC followed by in Spinosad 45 SC (69%). Neem oil treated plot was the next best treatment recorded 55.3% reduction followed by *Ha* NPV (43.6%). Lowest population reduction was observed in cow urine treated plot (16.6%). These findings are in partial agreement with Reddy *et al.* (2010) who reported that larval reduction was highest with NSKE 1.66% + Ha NPV 250LE/ha + Endosulfan 0.023% followed by NSKE 1.66% + Endosulfan 0.023%, NSKE 2.5% + Ha NPV 250LE sprayed twice at 15 days interval. Findings are also in accordance with the findings of Gautam *et al. (*2018) who found that “the Indoxacarb @ 14.5SC, Neem seed oil @ 5ml and karanj oil @ 5ml were significantly superior over untreated control. Indoxacarb 14.5@ SC, gave maximum grain yield of chickpea in compared to other treatments as well as in managing the population of *H. armigera*. Besides Neem seed oil @ 5ml and karanj oil @ 5 ml were found the second and third most effective treatments respectively.” Neem oil, a botanical insecticide rich in azadirachtin, disrupts insect growth and feeding, as supported by **Schmutterer (1990)** and **Ascher (1993)**. Mihretie *et al. (*2020)also observed that “percentage pod damage, mean larval count per plant, hundred seed weight and grain yield were significantly affected by the treatments; all tested insecticides significantly reduced the percentage pod damage and mean larvae per plant accordingly increased grain yield ha-1 among insecticides Indoxacarb (48.11%) and Spinosad (43.37%) gave higher relative yield increment with maximum MRR 8112.24% and 7698.28% respectively. Thus, the application of Indoxacarb (Avaunt 150 SC) 0.3 Lha-1 or Spinosad (Tracer 480 SC) 0.15 Lha-1 three times with a week interval can be advised for the management of *H. armigera*; however, it needs further investigation for the interval and frequency”.

**Effect of treatments on yield**

All the treatments were found effective over control that gave significantly higher grain yield of chickpea. Indoxacarb 14.5 SC treated plots gave maximum grain yield (19.5 q/ha) (Table 2). Next higher grain yield producing treatments was Spinosad 45 SC @ 0.2% which recorded 17.2 q/ha grain yield. Cow urine @ 0.5% treated plots gave 11.80 q/ha that was at par with untreated control (11.20 q/ha). Present results endorse the findings of Mihretie *et al.*(2020) who observed that “percentage pod damage, mean larval count per plant, hundred seed weight, and grain yield were significantly affected by the treatments; all tested insecticides significantly reduced the percentage pod damage and mean larvae per plant accordingly increased grain yield ha-1 among insecticides Indoxacarb (48.11) and Spinosad (43.37%) gave higher relative yield increment with maximum MRR 8112.24% and 7698.28% respectively. Thus, the application of Indoxacarb (Avaunt 150 SC) 0.3 Lha-1 or Spinosad (Tracer 480 SC) 0.15 Lha-1 three times with a week interval can be advised for the management of *H. armigera*; however, it needs further investigation for the interval and frequency”.

## Economics of treatments

The economics of treatments were determined to find out the cost effectiveness of treatment in the term of cost -benefit ratio. The maximum cost - benefit ratio was obtained in plot treated with 0.4 % Indoxacarb 14.5 SC (1:18.8). Next effective treatments in the term of cost -benefit ratio were Neem oil @ 5% (1:16.4) followed by Garlic extract 5% (1.16:3). Lowest cost -benefit ratio (1:6.7) was found in cow urine 0.5% treated plot (Table 3). Present results are in partial agreement with Singh *et al* (2020) who found that “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”.

**Conclusion**

The present study clearly demonstrated that all the tested treatments were effective in reducing the larval population of *Helicoverpa armigera* in chickpea, compared to the untreated control. Among the treatments, Indoxacarb 14.5 SC @ 0.4% consistently showed the highest efficacy by recording the lowest larval population across all observation intervals (1, 3, and 7 days after spray), achieving a maximum larval reduction of 81.3% and significantly enhancing grain yield (19.5 q/ha) with the highest cost-benefit ratio (1:18.8). Spinosad 45 SC @ 0.2% ranked second in effectiveness, followed by Neem oil 5% and HaNPV @ 250 LE/ha. Neem oil 5% also proved to be an economically viable alternative with a high cost-benefit ratio (1:16.4). Cow urine 0.5% was the least effective treatment, showing minimal reduction in larval population and a cost-benefit ratio comparable to the untreated control. Thus, Indoxacarb 14.5 SC @ 0.4% can be recommended as the most effective and economically feasible option for the management of *H. armigera* in chickpea, while Neem oil 5% offers a promising eco-friendly alternative.

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**Table 1. Relative efficacy of different treatments against larval population of gram pod borer (*H. armigera* Hub.) in chickpea during *Rabi,* 2019-20**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Tr.**  **No.** | **Treatments** | **Dose** | **Mean larval population/10plants** | | | | **Percent reduction of larval population over control** | | | |
| **Before one day of spray** | **After1dayof spray** | **After 3**  **Days of spray** | **After7**  **Days of spray** | **After1dayof spray** | **After3**  **Days of spray** | **After 7**  **Days of spray** | **Mean** |
| T1 | Neem oil | 5% | 2.0  (1.58) | 1.1  (1.25) | 1.0  (1.21) | 1.1  (1.26) | 50.0 | 56.5 | 59.3 | 55.3 |
| T2 | Garlic extract | 5% | 1.9  (1.56) | 1.4  (1.38) | 1.6  (1.45) | 1.6  (1.46) | 36.4 | 30.4 | 40.7 | 35.8 |
| T3 | Cow urine | 0.5% | 2.2  (1.63) | 1.8  (1.50) | 2.0  (1.57) | 2.2  (1.63) | 18.2 | 13.0 | 18.5 | 16.6 |
| T4 | *Ha* NPV | 250  LE/Ha | 2.1  (1.61) | 1.6  (1.45) | 1.2  (1.29) | 1.2  (1.32) | 27.3 | 47.8 | 55.6 | 43.6 |
| T5 | Spinosad 45 SC | 0.2% | 1.9  (1.54) | 0.9  (1.18) | 0.6  (1.06) | 0.7  (1.11) | 59.1 | 73.9 | 74.1 | 69.0 |
| T6 | Indoxacarb 14.5 SC | 0.4% | 2.2  (1.63) | 0.7  (1.08) | 0.3  (0.91) | 0.3  (0.91) | 68.2 | 87.0 | 88.9 | 81.3 |
| T7 | Untreated control | - | 1.8  (1.53) | 2.2  (1.65) | 2.3  (1.67) | 2.7  (1.78) | - | - | - | - |
|  | **SEm±** |  | - | 0.03 | 0.04 | 0.03 | - | - | - | - |
|  | **C.D.(p=0.05)** |  | NS | **0.09** | **0.11** | **0.10** | - | - | - | - |

**Figures in parentheses indicates transformed value (√x+0.5)**

**Table 2: Efficacy of different treatments against *H. armigera* based on seed yield of chickpea during *Rabi,* 2019-20**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tr. No.** | **Treatments** | **Dose** | **Total** | **Mean** |
| T1 | Neem oil | 5% | 43.8 | 14.6 |
| T2 | Garlic extract | 5% | 40.1 | 13.4 |
| T3 | Cow urine | 0.5% | 35.5 | 11.8 |
| T4 | *Ha* NPV | 250LE/Ha | 41.8 | 13.9 |
| T5 | Spinosad45SC | 0.2% | 51.5 | 17.2 |
| T6 | Indoxacarb 14.5 SC | 0.4% | 58.6 | 19.5 |
| T7 | Untreated control | - | 33.5 | 11.2 |
|  | SEm± | | | **0.39** |
|  | CDat5% | | | **1.21** |
|  | CV% | | | **4.7** |

**Table 3: Benefit Cost - ratio of different treatments used for the management of gram pod borer (*H. armigera* Hub.) in chickpea during *Rabi,* 2019-20**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Tr.**  **No.** | **Treatments** | **Dosage** | **Cost of treatment (Rs/ha)** | **Yield (q/ha)** | **Saved yield over control (q/ha)** | **Benefit due to treatment (Rs/ha)** | **Benefit-Cost ratio** |
| T1 | Neem oil | 5% | 1059.00 | 14.6 | 3.4 | 17340.00 | 1:16.4 |
| T2 | Garlic extract | 5% | 680.00 | 13.4 | 2.2 | 11050.00 | 1:16.3 |
| T3 | Cow urine | 0.5% | 480.00 | 11.8 | 0.6 | 3230.00 | 1:6.7 |
| T4 | *Ha* NPV | 250 LE/Ha | 1390.00 | 13.9 | 2.7 | 13940.00 | 1:10.0 |
| T5 | Spinosad 45 SC | 0.2% | 3776.00 | 17.2 | 6.0 | 30430.00 | 1:8.1 |
| T6 | Indoxacarb 14.5 SC | 0.4% | 2260.00 | 19.5 | 8.3 | 42500.00 | 1:18.8 |
| T7 | Untreated control | - | - | 11.2 | - | - | - |

Price of Seed: Rs.5100.00/q, Labour charges Rs.215.00/day/man, Sprayer Rent :Rs.50/day