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# Evaluation of some newer insecticides in comparison with botanicals against *Heliothis armigera* on Pigeonpea, *Cajanus cajan*

**PS Neharkar, VR Dhepe, NG Dhurve, VN Nandanwar, RW Gawande and Ram Masal**

**Abstract**
A field experiment was conducted during Kharif 2016-17 using variety PKV TARA with eight treatments against the pod borer complex of Pigeon pea (*Cajanus cajan* L.)
The lowest population of *H. armigera* i.e 0.00 L/plant (100.00% larval reduction) was noticed in Flubendiamide 20 WDG and was most effective treatment and was found at par with Chlorantraniliprole 18.5 SC with 0.04 L/plant (90.47% larval reduction) followed by Spinosad 45 SC with 0.05 L/plant (88.63% larval reduction), Emamectin benzoate 5 SG with 0.05 L/plant (81.57% larval reduction), Indoxacarb 14.5 SC with 0.10 L/plant (75.00% larval reduction), Neem oil 2% with 0.13 L/plant (67.50% larval reduction) and ($T_1$) i.e NSE 5% which was least effective than chemicals and recorded 0.13 L/plant (67.50% larval reduction) whereas highest population of *H. armigera* i.e 0.50 L/plant was recorded in control (water spray).
All the treatments recorded significantly higher yield over control. It was highest in Flubendiamide 20 WDG (15.66 q/h) with highest incremental cost benefit ratio of 6.32 over the control.

**Keywords:** Pigeon pea, pod borer, *heliothis armigera*, botanicals

## Introduction
Pigeon pea (*Cajanus cajan*) (L.) commonly known as "Tur" or "Arhar" is major pulse crop grown extensively for its rich protein content (21%) and forms important constituent of Indian vegetable diet.
Being the leguminous the crop, improves soil fertility by fixing atmospheric nitrogen through rhizobium root nodules and shaded leaves add large quality of organic matter to the soil and therefore its inclusion in the cropping system is always beneficial, besides it is mainly used of protein source (Nene and Sheila, 1990) [7]. India is one of the largest producers of pigeon pea. In India, Pigeon pea occupies about 3.90 million hectare of area with an annual production of 3.17 M tones and productivity of 813 kg/ha (Anonymous 2015 b.) Maharashtra accounts for approximately 30% Percent of pigeon pea cultivation over an area of 1.03 M ha with annual production of 661 Metric tons and average productivity of 447kg/ha (Anonymous, 2015-16 a). In Vidarbha, pigeon pea is mostly cultivated as inter crop with soybean, cotton and mungbean under rainfed condition. The area under pigeon pea is 4.1 lakh ha with production of 4.05 lakh tones and productivity of 455 kg/ha. Though the area and production of pigeon pea in India is more the productivity is comparatively very low due to several reasons of which the pest problem is major one.
Over 250 species of insects recorded on the crop, only few are economically important as pests (Lal, 1998). Among the pod borer complex including pod borer *Helicoverpa armigera* (Hubner) is one of the most important pests infesting from bud formation to the maturity stage of the crop. The losses due to *Helicoverpa armigera* alone contribute up to 50 Percent (Thakare, 2001) [9].
Ravages of lepidopteran pod borer during flowering and pod formation stage and pod fly during pod formation stage is the major bottleneck in attainment of desired productivity levels of pigeon pea (Wadaskar *et al*, 2013) [10]. The main thrust of cultivators has been towards application of insecticides for the management of Insect pests because of convenience and easy availability of chemicals.

Insecticides resistance and resurgence in insect pest occur due to repeated use of same chemical insecticides. In view the above present investigation was planned to generate the information of some approaches for the management of pod borer complex of pigeon pea by treating insecticides like Chlorantraniliprole 18.5 SC, Flubendiamide 20 WDG, Emamectin benzoate 5 SG, Spinosad 45 SC, indoxacarb 14.5 SC, NSE 5%, Neem oil 2%,NSE 5% etc.

A number of insecticides like, Carbaryl, Chlorodemaform, Endosulfan, Quinolphos, Fenvalerate, Cypermethrin were reported to be effective against pigeon pea pod borer complex. Numbers of new insecticides are put forth in market. It is, therefore, imperative to test the efficacy of new insecticides along with previous promising ones and hence the present investigation was undertaken with this pigeon pea pod borer complex

**Materials and Methods**

A field experiment was conducted on Tur crop during the Kharif seasons 2016-17 using variety PKV TARA in the field of College of Agriculture Nagpur, (Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, M.S. India). The experiment was laid out in a randomized block design with eight treatments and three replications. Treatments comprise commercial insecticide as well as botanicals. The treatments were NSE 5% @ 50g/l, Neem oil 2% @ 20ml/l, Chlorantranilipro l18.5SC @ 0.25 ml/l, Spinosad 45 SC @ 0.3 ml/l, Indoxacarb 14.5 SC @ 0.55 ml/l, Emamectin benzoate 5 SG @ 0.2 g/l and Flubendiamide 20 WDG@ 0.5 g/l along with water spray as control. The plot size was kept 18.48 $m^2$ with a spacing of 60 × 30 cm between rows and plants respectively and recommended agronomical practices were followed. In all three sprays of the treatments wear scheduled. The application of first spray was initiated at 50 Percent flowering stage, thereafter two consecutive spraying wear given at an interval of 15 days.

The observations were recorded on 5 randomly selected plants and 3 twigs of 10 cm/plant, per plot from net plot and were recorded 24 hrs before and $3^{rd}$,$7^{th}$ and $10^{th}$ days after every treatments of insecticides

The damage caused by the larvae of pod borer (*H. armigera*), identified by the nature of damage caused by them to the pods by way of holes on the pods. The larvae of *H. armigera* cut a bigger and irregular hole on the pods and feed on the developing grains. The observation recorded on the number of *H. armigera* larvae per plant.

Five plants were randomly selected from each net plot and thr ee twigs per plant i.e one each from top middle and bottom were selected at the time of each observation the total number of *H. armigera* were recorded. The pre-treatment observation were recorded 24 hours before application of treatment and the post treatment observation were noted on $3^{rd}$,7th and $10^{th}$ days after every treatment, Percent larval reduction of *H. armigera* was calculated separately.

**Grain Yield and Economics of Different Treatments**

In order to compair efficacy of different treatments the grain yield of net plot from each treatment were recorded after harvest of crop. Thus, obtained yield per plot were converted into quintals per hectare.

The data on grain yields were used to calculate the economic viability of each treatment, the cost of each treatments and labour required for application were calculated as per market rate. Similarly the incomes obtained from the sale of grain as per prevailing rates were used to calculate monetary return an incremental cost benefit ratio (ICBR) at various treatments.

**Statistical Analysis**

The data thus obtained was transformed appropriately to Arc sine and Square root transformation. Wherever, necessary as per the methodology and further statistical analysis was done for testing the level of significance.

**Results and Discussion**

The data obtained after third spray against the larvae of *H. armigera* wear analysed and presented in table 1

**Three days after spray**

The data on variation in *H. armigera* larval population was summarised in Table 1 and fig 1. The data on larval population of *H. armigera* on pigeon pea at 3 days after spray revealed that all treatments were found statistically superior over control (water spray).The lowest population of *H. armigera* i.e 0.08 L/plant (80.95% larval reduction) was noticed in ($T_7$) i.e Flubendiamide 20 WDG and ($T_3$) i.e Chlorantraniliprole 18.5 SC, were most effective treatments. However, these treatments were found at par with ($T_4$) i.e Spinosad 45 SC with 0.12 L/plant (72.72% larval reduction), followed by ($T_6$) i.e Emamectin benzoate 5 SG with 0.12 L/plant (72.72% larval reduction), ($T_5$) i.e Indoxacarb 14.5 SC with 0.14 L/plant (65.00% larval reduction) and ($T_2$) i.e Neem oil 2% with 0.14 L/plant (65.00% larval reduction) and were significantly superior over ($T_1$) i.e NSE 5% with 0.16 L/plant (60.00% larval reduction) and control (water spray) with 0.44 L/plant.

**Seven days after spray**

The data on larval population of *H. armigera* on pigeon pea at 7 days after spray exhibited the significant difference among the treatments. The lowest population of *H. armigera* i.e 0.04 L/plant (90.47% larval reduction) was noticed in Flubendiamide 20 WDG and was most effective. However this treatment was found at par with Chlorantraniliprole 18.5 SC with 0.06 L/plant (85.71% larval reduction) and Spinosad 45 SC with 0.08 L/plant (81.81% larval reduction) and was significantly superior over treatment ($T_6$), ($T_5$), ($T_2$), ($T_1$) and control (water spray). Next effective treatment in order of efficacy was, ($T_6$) i.e Emamectin benzoate 5 SG with 0.10 L/plant (73.68% larval reduction)followed by ($T_5$) i.e Indoxacarb 14.5 SC with 0.12L/plant (70.00% larval reduction) and ($T_2$) i.e Neem oil 2% with 0.12 L/plant (70.00% larval reduction).

While the application of ($T_1$) i.e NSE 5% which was least effective among insecticidal treatments and recorded 0.16 L/plant (60.00% larval reduction) whereas highest population of *H. armigera* i.e 0.53 L/plant was recorded in control (water spray).

**Ten days after spray**

The data on larval population of *H. armigera* on pigeon pea at 10 days after spray revealed that all treatments were found statistically superior over control (water spray). The lowest population of *H. armigera* i.e 0.00 L/plant (100.00% larval reduction) was noticed in ($T_7$) i.e Flubendiamide 20 WDG and was most effective treatment. However this treatment was found at par with ($T_3$) i.e Chlorantraniliprole 18.5 SC with 0.04 L/plant (90.47% larval reduction) and followed by ($T_4$) i.e Spinosad 45 SC with 0.05 L/plant (88.63% larval reduction), ($T_6$) i.e Emamectin benzoate 5 SG with 0.05

L/plant (81.57% larval reduction), ($T_5$) i.e Indoxacarb 14.5 SC with 0.10 L/plant (75.00% larval reduction), ($T_2$) i.e Neem oil 2% with 0.13 L/plant (67.50% larval reduction) and ($T_1$) i.e NSE 5% which was least effective and recorded 0.13 L/plant (67.50% larval reduction) whereas highest population of *H. armigera* i.e 0.50 L/plant was recorded in control (water spray).

The above finding are in agreement with the result found by Wadaskar *et al.* (2013) [10] who reported the efficacy of newer insecticides *viz.*, Rynaxypyr, Spinosad, Emamectin benzoate, Flubendiamide, Indoxacarb along with Endosulfan (as standard check) for the management of pigeon pea borer complex. mean reduction of *H. armigera* larval population, 7 and 14 days after treatment, revealed superiority of Flubendiamide 20 WDG @ 0.5 g/l which resulted in reduction to the extent of 96.1 and 95.4 Percent, over control. Flubendiamide was also efficacious against plume moth larvae, 7 and 14 days after application, with 83.9 and 93.3 Percent reduction over control, respectively.

**Effect of different treatments on grain yield of pigeon pea**

The data presented in table 2 and revealed that the results of yield were statistically significant. The highest grain yield was recorded in the ($T_7$) Flubendiamide 20 WDG (15.66 q/ha), It was at par with ($T_3$) Chlorantraniliprol 18.5 SC (14.90 q/ha) followed by ($T_6$) Emamectin benzoate 5 SG (12.83 q/ha), ($T_4$) Spinosad 45 SC (10.69 q/ha), ($T_5$) Indoxacarb 14.5 SC (8.26 q/ha), ($T_2$) Neem oil 2% (7.82 q/ha), ($T_1$) NSE 5% (6.40 q/ha).

The lowest yield of (4.43 q/ha) was recorded in control (water spray). The finding about effectiveness of Flubendiamide 20 WDG in recording the higher yield is in accordance with the report of Chavan *et al*. (2009) [3], who studied the bio-efficacy of Flubendiamide 480 SC @ 24, 36, 48 g a.i/ha, Indoxacarb 14.5 SC @ 75 g a.i/ha and Spinosad 45 SC @ 375 g a.i/ha against *H.armigera.* Among all the treatment the Flubendiamide 480 SC @ 48 g a.i/ha recorded highest grain yield

Deshmukh *et al*. (2010) [4] revealed that Flubendiamide 0.007 Percent, Indoxacarb 0.0075 Percent, Spinosad 0.009 Percent were found the most effective in reducing *H. armigera* population and pod damage of chickpea. The highest yield was also recorded in the treatment of Flubendiamide 0.007 Percent (1850 kg/ha).

Thus the results of these workers are in agreement with the findings of present investigation and gave support to the present data

**Incremental cost benefit ratio (ICBR) of treatments**

The value of ICBR of treatments is presented in table 2. The data indicated that, an application of Flubendiamide 20 WDG was found as the most economically viable treatment since these treatment recorded maximum ICBR of (1: 6.32). It was followed by the insecticidal treatment of Emamectin benzoate 5 SG which recorded the ICBR of (1:6.28). However the treatment Chlorantraniliprol 18.5 SC and NSE 5% better recording the ICBR of (1:5.24) and (1:2.98), respectively. Wheres Indoxacarb 14.5 SC which recorded ICBR of (1:2.85),Neem oil 2% recorded ICBR (1:2.68) other treatment Spinosad 45 SC ICBR of (1:2.25) recorded lower ICBR.

Sreekanth *et al.* (2014) carried out field experiment against the pod damage due to pod borer, *H. armigera* and reported lower damage in plot treated with Flubendiamide (1.16%), Chlorantraniliprole (1.26) and Spinosad (1.92) with 88.7 and 8102 Percent reduction over control respectively. The cost effectiveness of Chlorantraniliprole and flubendiamide was also high and very favorable with incremental cost benefit ratios 1:4.64 and 1:4.50 followed by Indoxacarb (1: 3.67), Emamectin benzoate (1:3.13) and Spinosad (1:2.97).

Dodia *et al*. (2009) [5] reported that, (73 kg/ha) Indoxa carb at 50 g/ha (1598 kg/ha) and Bifenthrin at 80g/ha (1573 kg/ha). The maximum monitory return returned was gained in Indoxacarb (ICBR=1:5.94), Flubendiamide (ICBR=1:6.88) followed by bifenthrin (ICBR=1:5.94), Flubendiamide (ICBR=1:4.56), Spinosad at 73 g/ha (ICBR=1:3.61) and Emamectin benzoate at 11 g/ha (ICBR=1:3.4).

The results of the present investigation are agreed with the result of said workers and give support to the data.

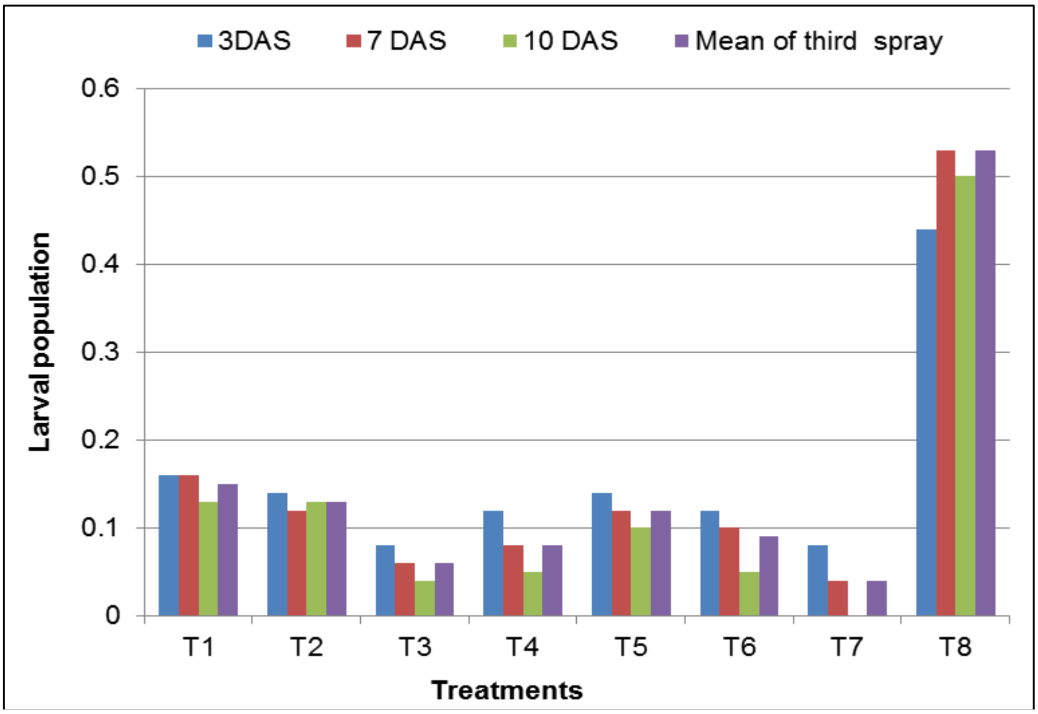


**Fig 1:** Effect of different treatments on larval population of *H. armigera*, after third spray.

**Table 1:** Effect of different treatments on larval population of *H. armigera* after third spray.

| Treatment no | Treatment | *H. armigera* larva /plant | | | Mean of third spray | Percent reduction In larval population over control of *H. armigera* | | | Mean reduction- on after third spray |
|---|---|---|---|---|---|---|---|---|---|
| | | 3DAS | 7 DAS | 10 DAS | | 3 DAS | 7 DAS | 10 DAS | |
| $T_1$ | NSE 5% | 0.16 (0.81) | 0.16 (0.81) | 0.13 (0.79) | 0.15 (0.80) | 60.00 | 60.00 | 67.50 | 62.50 |
| $T_2$ | Neem oil 2% | 0.14 (0.80) | 0.12 (0.78) | 0.13 (0.79) | 0.13 (0.79) | 65.00 | 70.00 | 67.5 | 67.50 |
| $T_3$ | Chlorantraniliprole 18.5 SC | 0.08 (0.76) | 0.06 (0.74) | 0.04 (0.73) | 0.06 (0.74) | 80.95 | 85.71 | 90.47 | 85.71 |
| $T_4$ | Spinosad 45 SC | 0.12 (0.78) | 0.08 (0.76) | 0.05 (0.74) | 0.08 (0.76) | 72.72 | 81.81 | 88.63 | 81.05 |
| $T_5$ | Indoxacarb14.5 SC | 0.14 (0.80) | 0.12 (0.78) | 0.10 (0.77) | 0.12 (0.78) | 65.00 | 70.00 | 75.00 | 70.00 |
| $T_6$ | Emmamectin benzoate 5 SG | 0.12 (0.78) | 0.10 (0.77) | 0.05 (0.75) | 0.09 (0.76) | 72.72 | 73.68 | 81.57 | 74.55 |
| $T_7$ | Flubendiamide 20 WDG | 0.08 (0.76) | 0.04 (0.73) | 0.00 (0.70) | 0.04 (0.73) | 80.95 | 90.47 | 100.00 | 90.47 |
| $T_8$ | Control (water spray) | 0.44 (0.96) | 0.53 (1.01) | 0.50 (1.00) | 0.53 (1.01) | - | - | - | - |
| F test | | Sig | Sig | Sig | Sig | - | | | |
| S.E (m)± | | 0.012 | 0.011 | 0.010 | 0.011 | | | | |
| CD at 5% | | 0.038 | 0.035 | 0.030 | 0.034 | | | | |
| CV | | 13.79 | 13.45 | 14.14 | 13.06 | | | | |

{Figures in parentheses are the corresponding square root transformed values ($\sqrt{x+0.5}$)}, DAS = Days after spraying)

**Table 2:** Incremental cost benefit ratio (ICBR) of different treatments

| Treat. No. | Treatments | Dose | Quantity of treatment required for three spray kg/lit/ha | Cost of insecticide/ha for three spray (Rs) | Labour charges/ha for three spray (Rs). | Spray pump hiring charges/ha three spray/ha (Rs.) | Total cost of application of three spray (ha) (Rs) (A) | Yield kg/ha | Increase in yield over control (kg/ha) | Value of increasing yield (Rs) (B) | Incremental benefit Rs/ha (B-A)= (C) | ICBR (C/A) | ICBR Ranking |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $T_1$ | NSE 5% | 50gm/l | 25kg | 750 | 1110 | 300 | 2160 | 640 | 210 | 8610 | 6450 | 2.98 | lV |
| $T_2$ | Neem oil 2% | 20ml /l | 10lit | 2500 | 1110 | 300 | 3910 | 782 | 352 | 14432 | 10512 | 2.68 | Vl |
| $T_3$ | Chlorantraniliprol 18.5 sc | 0.25 ml/l | 375ml | 5550 | 1110 | 300 | 6960 | 1490 | 1060 | 43460 | 36500 | 5.24 | lll |
| $T_4$ | Spinosad 45 SC | 0.3 ml/l | 450 ml | 6630 | 1110 | 300 | 8040 | 1069 | 639 | 26199 | 18159 | 2.25 | VlI |
| $T_5$ | Indoxacarb14.5 SC | 0.55 ml/l | 825 ml | 2805 | 1110 | 300 | 4215 | 826 | 396 | 16236 | 12021 | 2.85 | V |
| $T_6$ | Emmamectin benzoate 5 SG | 0.2g/l | 435 gm | 3393 | 1110 | 300 | 4803 | 1283 | 853 | 34973 | 30170 | 6.28 | II |
| $T_7$ | Flubendiamide 20 WDG | 0.5 g/l | 750 gm | 4950 | 1110 | 300 | 6360 | 1566 | 1136 | 46576 | 40216 | 6.32 | I |
| $T_8$ | Control (water spray) | - | - | - | 1110 | 300 | 1410 | 430 | - | - | - | - | - |

Cost of inputs

| | | | | | |
|---|---|---|---|---|---|
| Labour charges | - | Rs185/day/man | Charges of hired spray pump | - | Rs 50/day |
| Spinosad 45 SC | - | Rs 14733/lit | Labour rssequird/spray | - | 2 Labour |
| Indoxacarb 14.5 SC - | | Rs 3400/lit | Market price of pigeon pea | - | 4100/q |
| Emamectin benzoate 5 SC | - | Rs 780/100 g | Flubendiamide 20 WDG | - | Rs 6600/lit |
| Chlorantriniliprol18.5 SC | - | Rs14800/lit | NSE (5%) | - | Rs 30/kg |

Neem oil (2% - 250/lit

(Considering 500 lit of water required for one spray /ha area of the crop)

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