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# Bio Efficacy of Bio-pesticides and Insecticides against Defoliators of *kharif* Groundnut

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**ABSTRACT: India is the second largest producer of groundnut in the world but has very low productivity as compare to other countries. Pests and diseases incidence are the major reason for low productivity of groundnut in India An experiment was conducted at Oil Seed Research Station, VNMKV, Latur (Maharashtra, India) during *kharif* 2019 to 2021 to study the evaluation of insecticides for the management of *Helicoverpa armigera* (Hubner) and *Spodoptera litura* (Fabricius) infesting groundnut under field condition. Insecticides evaluated in the present experiment were Bt-127 SC @3ml/lit, Delfin (Bt commercial formulation) @1g/lit, Quinalphos 25 EC @ 2ml/lit and Chlorantraniliprole 18.5 SC @ 0.3ml/lit. Single sprays of respective insecticides were applied on appearance of early instars of lepidopteran pests. The observations were recorded on population of defoliators larvae per randomly selected 5 plants per treatment. The results revealed that all the four insecticidal treatments were significantly superior over untreated control in reducing the infestation of both defoliator pests of groundnut. However, chlorantraniliprole 18.5 SC was significantly most effective among four insecticides tested. The three years pooled data also showed, significantly higher dry pod yield (1770 kg/ha) of groundnut in Chlorantraniliprole 18.5 SC @ 0.3ml/lit, however, it was found at par with treatments Bt-127 SC @3ml/lit (1579) and Quinalphos 25 EC @ 2ml/lit (1566 kg/ha). The highest ICBR (1:20.35) was recorded in treatment Quinalphos 25 EC @ 2ml/lit, followed by Bt-127 SC @3ml/lit (1:18.07).**

**Keywords:** Bio efficacy, Groundnut, *Helicoverpa armigera, Spodoptera litura.*

## INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is native of South America and valuable cash crop for millions of small scale farmers in the semi-arid tropic It is one of the most important oil seed crops grown in India contributes about 30% of the total domestic supply of oil. In India groundnut is mainly grown as rainfed crop by resource poor farmers. World's statistics revealed that India has the largest groundnut growing area in the world and is the second largest producer after china. Gujarat, Andhra Pradesh, Tamil Nadu, Rajasthan, Karnataka and Maharashtra are the major groundnut growing states of India and together account for about 90% of the national area under groundnut. In India, groundnut crop is cultivated in *kharif, rabi* and summer seasons on an area of about 55.71l lakh hectares with the production of 102 lakh tons and productivity of 1831kg/ha in 2020-21 (Anonymous 2022). Though, India ranks first in area under groundnut cultivation and is the second largest producer in the world. As far as the groundnut productivity is concern, India has very low productivity as compare to other countries like USA (4118.6kg/ha), China (3674.1kg/ha), Brazil (3654.2kg/ha), Egypt (3290.8kg/ha), Turkey (3886.6kg/ha), Taiwan (3160.80kg/ha), Argentina (2928.6kg/ha), and Sri Lanka (2065.5kg/ha) (Anonymous, 2020). The reason for low productivity of groundnut in India is due to biotic and abiotic stresses during crop growth. Pests and diseases are the major biotic stresses for groundnut production.

In recent years, tobacco caterpillar, *Spodoptera litura* (Fab.) and American bollworm, *Helicoverpa armigera* (Hubner) has emerged as a major pest of groundnut in India causes about 26 to 100% yield loss under field conditions (Dhir *et al*., 1992). This pest has acquired resistance to many of conventional and currently available insecticides. Hence there is a need to search for an alternate insecticide, which can fit in to farmer's budget as well in Integrated Pest Management

(IPM) programme. As per the available literature, bio-efficacy of various insecticides and bio-pesticides against the above two pests were studied by many entomologist (Gadhiya *et al.,* 2014; Chandrayudu *et al.*, 2015; Kumar *et al*., 2015; Venkataiah *et al*., 2015; Devaki *et al.,* 2020; Waykule *et al.,*2020; Sreekanth *et al*., 2021; Matcha *et al*., 2021; Pawar *et al.,* 2022). The present studies were conducted in search of most effective as well as economic insecticide against defoliators of groundnut at field conditions.

## MATERIALS AND METHODS

The studies on "Bio efficacy of bio-pesticides and insecticides against defoliators of *kharif* groundnut." were conducted during consecutive three years from 2019 to 2021 in *Kharif* season at Oilseed Research Station, Latur, Maharashtra, India. The experiment was conducted under field condition in a randomized block design (RBD) with five treatments including untreated control with four replications. Groundnut variety (LGN-1) was sown in a gross plot of 4.2m × 5 m maintaining net plot of 3.6 m × 4.8m. The row to row distance of 30 cm and plant to plant distance of 10 cm was maintained. The dose of fertilizer at the rate of 20 kg N, 40 kg $P_2O_5$ and 40 kg $K_2O$ per hectare was given at the time of sowing. The crop was grown under protective irrigation. The treatments of different insecticides *viz.,* Bt-127 SC @3ml/lit (From IIOR, Hyderabad), Delfin (Bt commercial formulation) @1g/lit, Quinalphos 25 EC @ 2ml/lit, Chlorantraniliprole 18.5 SC @ 0.3ml/lit. were applied on appearance of early instars of lepidopteran pests using manually operated knapsack sprayer. The observations on total number of *Spodoptera litura and Helicoverpa armigera* larvae were recorded per five plant from each on top, middle and bottom leaves of five randomly selected plants from each treatment at one day before treatment and 10 days after application of insecticidal treatments. Dry pod yield was recorded after harvest; incremental cost benefit ratio was also calculated. The data were analyzed statistically and necessary conclusions were drawn.

## RESULTS AND DISCUSSION

***Spodoptera litura*:** As per the data given in the Table 1 and depicted in Fig. 1. revealed that the population of *Spodoptera litura* (per five plant) before insecticidal treatments were statistically non significant and ranged between 1.29 to 1.61,1.80 to 2.25, 1.59 to 1.68 and 1.59 to 1.83 per five plant during all the three consecutive *kharif* seasons of 2019 to 2021 and pooled analysis respectively.

However, after 10 days of insecticidal spray the population of *S. litura* were significantly varied among all the treatments. All the insecticidal treatments were significantly superior over untreated control. The minimum population of *S. litura* (0.11,0.28,0.43 and 0.27 per five plant) were recorded in the treatment $T_4$ (Chlorantraniliprole 18.5 SC @ 0.3ml/lit) during all the three consecutive *kharif* seasons and pooled analysis respectively, which was significantly superior over rest of the treatments except *kharif* 2021 in which the treatment $T_3$ (Quinalphos 25 EC @ 2ml/lit) was at par with the same. The maximum population of *S. litura* (2.24, 2.55, 1.91 and 2.23 per five plant) were recorded in untreated control during all the three consecutive *kharif* seasons and pooled analysis respectively. Similar results were recorded by Gadhiya *et al.* (2014), who noticed that chlorantraniliprole (0.006%), spinosad (0.018%) and emamectin benzoate (0.002%) were higher effective and statistically at par with each other in protecting the groundnut crop from the infestation of *H. armigera* and *S. litura.* Kumar *et al.* (2015); Venkataiah *et al.* (2015) also reported the same results. Devaki *et al.* (2020) also reported that *B. thuringiensis* based biopesticides are effective in controlling *S. litura.*

***Helicoverpa armigera*:** The data pertaining to the population of *H. armigera* presented in Table 2 and depicted in Fig. 2 revealed that, population of *H. armigera* before inseciticidal spray was uniformely distributed in all the treatments and found statistically non significant which was varied between 0.82 to 1.44, 0.90 to 1.45, 1.10 to 1.30 and 1.06 to 1.31 per five plant in all the three consecutive *kharif* seasons of 2019 to 2021 and pooled data respectively .

Whereas, after 10 days of insecticidal spray all the insecticidal treatments were significantly effective over untreated control in reducing the population of *H. armigera.* Among them the minimum population of *H. armigera* (0.13, 0.20, 0.37 and 0.23 per five plant) were recorded in the treatment $T_4$ (Chlorantraniliprole 18.5 SC @ 0.3ml/lit) during all the three consecutive *kharif* seasons and pooled analysis respectively, which was significantly superior over rest of the treatments except *kharif* 2021 in which the treatment $T_3$ *i.e.* Quinalphos 25 EC @ 2ml/lit (0.55 per 5 plant) and treatment $T_1$ *i.e.* Bt-127 SC @3ml/lit (0.62 per five plant) were at par with the same. The maximum population of *H. armigera* (2.28, 1.50, 1.58 and 1.79 per five plant ) were recorded in untreated control during all the three consecutive *kharif* seasons and pooled analysis respectively. Waykule *et al.* (2020) reported that chlorantranilliprole 0.0185 per cent was most effective for managing gram pod borer larvae population on groundnut with Significantly higher seed yield (3286 kg/ha).

**Pod yield (kg/ha) :** As per the data given in the Table 3 and depicted in Fig. 3, among all the five treatments the per hector yield of dry groundnut pod were ranged from 1121 to 1866, 999 to 1771, 1021 to 1672 and 1047 to 1770 kg/ha in all the three consecutive *kharif* seasons and pooled data respectively. All the four insecticidal treatments were significantly superior over untreated control in respect of dry pod yield. The treatment $T_4$ (Chlorantraniliprole 18.5 SC @ 0.3ml/lit) recorded highest yield (1866, 1771, 1672 and

1770kg/ha) in all the three consecutive *kharif* seasons and pooled data respectively which was significantly superior over rest of the treatments except *kharif* 2021 in which treatment $T_1$ *i.e*. Bt-127 SC @3ml/lit (1579kg/ha) and the treatment $T_3$ *i.e*. Quinalphos 25 EC @ 2ml/lit (1566kg/ha) were at par with the same. Chandrayudu *et al.* (2015) conducted field experiment at Department of Entomology, S.V. Agricultural College, ANGRAU, Tirupati- and concluded that NPV (*S. litura*) @ 250 LE $ha^{-1}$ and *Bacillus thuringiensis* (*Bt*) sprays were significantly effective in reducing larval population, leaf damage and resulted in significant increase in dry pod yield and cost benefit ratio.

**Incremental Cost Benefit Ratio (ICBR):** The data presented in Table 3 showed that, among the four insecticidal treatments the ICB ratio were ranged from 12.25 to 23.05, 11.72 to 22.58, 9.40 to 17.38 and 11.12 to 20.35 in all the three consecutive *kharif* seasons and pooled data respectively. The treatment $T_3$ (Quinalphos 25 EC @ 2ml/lit) recorded highest ICB ratio (23.05, 22.58 and 20.35) in two consecutive *kharif* seasons 2019 and 2020 as well as pooled data respectively. The treatment $T_1$ (Bt-127 SC @3ml/lit) was the next best treatment with higher ICB ratio (18.04, 18.80 and 18.07) in above respective seasons. However in the year 2021, the treatment $T_1$ (Bt-127 SC @3ml/lit) reported highest ICB ratio (17.38) which was closely followed by and the treatment $T_3$ *i.e.* Quinalphos 25 EC @ 2ml/lit (15.41). These variations are due to the cost existence of different costs for the treatments.

**Table 1: Effect of different insecticidal spray on *Spodoptera litura* infestation in groundnut (3 years pooled data kh.2019-2021).**

| Tr. No. | Treatment details | *Spodoptera litura* population/m | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pre count | | | | 10 DAS | | | |
| | | 2019 | 2020 | 2021 | Pooled mean | 2019 | 2020 | 2021 | Pooled mean |
| 1. | Bt-127 SC @3ml/lit | 1.58 (1.44) | 1.80 (1.51) | 1.65 (1.46) | 1.68 (1.47) | 0.51 (1.00) | 0.70 (1.09) | 0.80 (1.14) | 0.67 (1.08) |
| 2. | Delfin (Bt commercial formulation) @1g/lit | 1.33 (1.35) | 2.05 (1.59) | 1.50 (1.41) | 1.63 (1.46) | 1.52 (1.41) | 1.40 (1.38) | 0.95 (1.20) | 1.29 (1.33) |
| 3. | Quinalphos 25 EC @ 2ml/lit | 1.61 (1.45) | 2.25 (1.66) | 1.63 (1.45) | 1.83 (1.53) | 0.48 (0.99) | 0.58 (1.03) | 0.67 (1.08) | 0.57 (1.03) |
| 4. | Chlorantraniliprole 18.5 SC @ 0.3ml/lit | 1.30 (1.34) | 2.10 (1.61) | 1.68 (1.47) | 1.69 (1.48) | 0.11 (0.78) | 0.28 (0.88) | 0.43 (0.96) | 0.27 (0.88) |
| 5. | Untreated control | 1.29 (1.34) | 1.90 (1.55) | 1.59 (1.44) | 1.59 (1.46) | 2.24 (1.65) | 2.55 (1.74) | 1.91 (1.55) | 2.23 (1.65) |
| SE ± | | | | | | 0.05 | 0.04 | **0.05** | 0.05 |
| CD at 5% | | NS | NS | NS | NS | 0.16 | 0.14 | **0.16** | 0.11 |
| CV % | | | | | | 10.00 | 7.20 | **9.06** | 6.20 |

**Table 2: Effect of different insecticidal spray on *Helicoverpa armigera* infestation in groundnut.**

| Tr. No. | Treatment details | *Helicoverpa armigera* population/m | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Pre count | | | | 10 DAS | | | |
| | | **2019** | **2020** | **2021** | **Pooled mean** | **2019** | **2020** | **2021** | **Pooled mean** |
| 1. | Bt-127 SC @3ml/lit | 1.18 (1.29) | 0.90 (1.18) | 1.10 (1.26) | 1.06 (1.25) | 0.51 (1.00) | 0.50 (0.99) | 0.62 (1.05) | 0.54 (1.02) |
| 2. | Delfin (Bt commercial formulation) @1g/lit | 1.44 (1.37) | 1.25 (1.32) | 1.15 (1.28) | 1.28 (1.33) | 1.62 (1.44) | 0.70 (1.09) | 0.70 (1.09) | 1.01 (1.22) |
| 3. | Quinalphos 25 EC @ 2ml/lit | 1.19 (1.29) | 1.45 (1.39) | 1.30 (1.34) | 1.31 (1.35) | 0.48 (0.99) | 0.40 (0.95) | 0.55 (1.02) | 0.48 (0.99) |
| 4. | Chlorantraniliprole 18.5 SC @ 0.3ml/lit | 0.74 (1.11) | 1.30 (1.34) | 1.28 (1.33) | 1.10 (1.27) | 0.13 (0.79) | 0.20 (0.84) | 0.37 (0.93) | 0.23 (0.86) |
| 5. | Untreated control | 0.82 (1.15) | 1.40 (1.36) | 1.20 (1.30) | 1.14 (1.28) | 2.28 (1.66) | 1.50 (1.41) | 1.58 (1.44) | 1.79 (1.51) |
| SE ± | | | | | | 0.06 | 0.03 | **0.05** | 0.05 |
| CD at 5% | | NS | NS | NS | NS | 0.17 | 0.10 | **0.13** | 0.10 |
| CV % | | | | | | 10.26 | 6.00 | **8.18** | 6.19 |

**Table 3: Effect of different insecticidal spray on yield in groundnut.**

| Tr. No. | Treatment details | Yield (kg/ha) | | | | ICBR | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 2019 | 2020 | 2021 | Pooled mean | 2019 | 2020 | 2021 | Pooled mean |
| 1. | Bt-127 SC @3ml/lit | 1620 | 1557 | 1559 | 1579 | 18.04 | 18.80 | 17.38 | 18.07 |
| 2. | Delfin (Bt commercial formulation) @1g/lit | 1598 | 1503 | 1315 | 1472 | 13.51 | 13.26 | 7.39 | 11.39 |
| 3. | Quinalphos 25 EC @ 2ml/lit | 1678 | 1583 | 1436 | 1566 | 23.05 | 22.58 | 15.41 | 20.35 |
| 4. | Chlorantraniliprole 18.5 SC @ 0.3ml/lit | 1866 | 1771 | 1672 | 1770 | 12.25 | 11.72 | 9.40 | 11.12 |
| 5. | Untreated control | 1121 | 999 | 1021 | 1047 | | | | |
| SE ± | | 62 | 52.38 | 75.47 | 131.24 | | | | |
| CD at 5% | | 185 | 154.52 | 223.38 | 274.69 | | | | |
| CV % | | 8.00 | 7.06 | 10.78 | 12.49 | | | | |
| **Per hector cost of Inputs** (2021): Bt-127 SC-Rs.910, Delfin- Rs.1368, Quinalphos 25 EC- Rs.700, Chlorantraniliprole 18.5 SC- Rs.2900 **Lobour charges** : 370/day, **Cost of output** (pod): Rs.5200/q | | | | | | | | | |

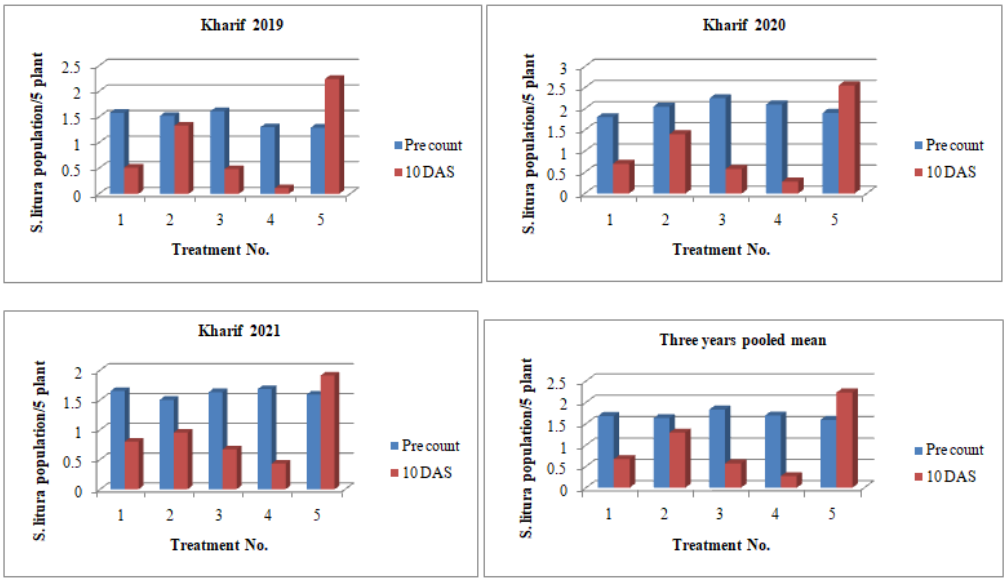


**Fig. 1.** Effect of different insecticidal spray on *S. litura* infestation in groundnut (3 years pooled data kh.2019 - 2021).

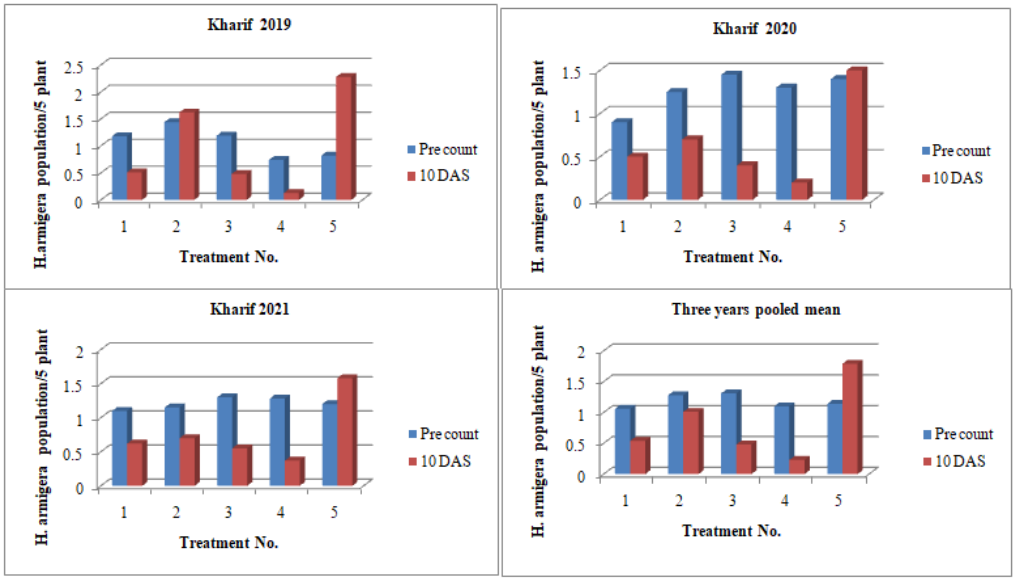


**Fig. 2.** Effect of different insecticidal spray on *H. armigera* infestation in groundnut (3 years pooled data kh.2019 - 2021).

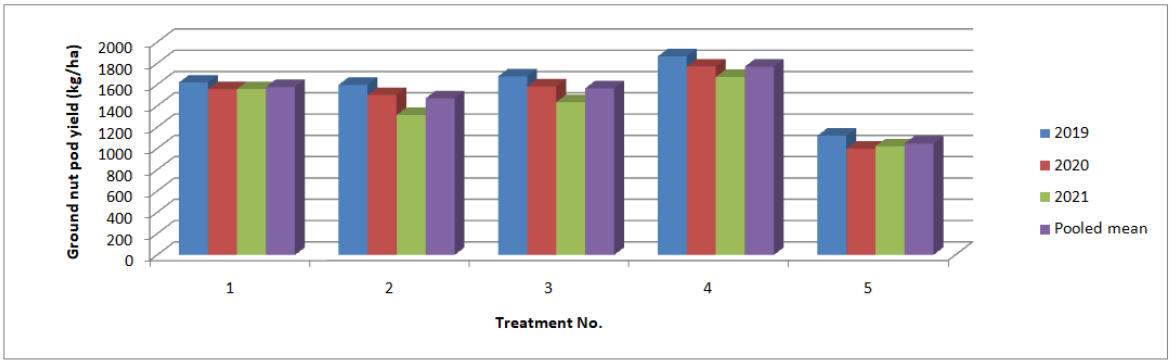


**Fig. 3.** Effect of different insecticidal spray on yield in groundnut.

## CONCLUSION

From the present studies it is concluded that all the four insecticidal treatments, were more effective than untreated control in reducing the *S. litura* and *H. armigera* larval population under field condition, among which chlorantranilliprole 18.5 SC @ 0.3ml/lit was found extremely effective for controling larval population of *S. litura* and *H. armigera* with highest dry pod yield of groundnut.

## FUTURE SCOPE

The new formulation of Bt *i.e.* Bt-127 SC formulated by Indian institute of oil seed research (IIOR),Hyderabad was also effective as well as economic bio pesticide against defoliators of groundnut at field conditions, can be used as a eco-friendly alternative to chlorantranilliprole 18.5 SC to avoid development of insecticidal resistance in the pests and environmental hazards.

**Conflict of Interest.** None.

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