**Original Research Article**

**Efficacy of Newer Insecticides against Aphid, (*Aphis gossypii* Glover) on Okra** **[*Abelmoschus esculentus* (L.) Moench]**

**ABSTRACT**

Field experiments were conducted to evaluate the efficacy of newer insecticide against aphid on okra during- 2018 and 2019. All the insecticides treatments were found significantly effective over control plots in reducing the aphid population. The aphid population in treated plots ranged from 1.20 to 4.68 aphids per six leaves as against 6.29 aphids per six leaves in untreated plots. Data computed on per cent reducing in aphid population indicate that 25.7 to 80.9% population may be reduced by spraying of different insecticides. Among the insecticidal treatments imidacloprid 17.8SL @100 ml/ha (1.20 aphids per six leaves) found most effective followed by thiamethoxam 25WG @100 gm/ha and acetamiprid 20SP @120 gm/ha. Whereas, emamectin benzoate 5SG @200 gm/ha (4.68 aphids/six leaves) found least effective in both the years. The highest fruit yield (156.33 q/ha) was recorded in emamectin benzoate 5SG @200 gm/ha followed by spinosad 45SC @100 ml/ha. Whereas, minimum fruit yield was recorded in cypermethrin 10EC @250 ml/ha in both the years. Maximum fruit yield loss may be avoided by protecting the crop with emamectin benzoate (53.6%) followed by spinosad. The highest net profit was obtained from the plots treated with emamectin benzoate 5SG@ 200 gm/ha followed by spinosad 45SC @100 ml/ha (74,953 Rs/ha) and maximum benefit ratio in the imidacloprid 17.8 SL@ 100 ml/ha (1:19.10) followed by acetamiprid 20SP@ 120 gm/ha (1:15.93), thiamethoxam 25WG @100 gm/ha (1:15.87) and spinosad 45SC @ 100 ml/ha (1:14.87).

**Keywords:** Aphid, Efficacy, Insecticides, Okra, Yield

**INTRODUCTION**

Okra, [*Abelmoschus esculentus* (L.) Moench] belongs to family Malvaceae a common vegetable in India. Okra locally known as ‘Bhindi’ also called ‘Lady’s Finger’ is a popular and most common annual vegetable crop in tropical and subtropical parts of the world (Sree *et el*., 2019). India is the largest producer of okra in the world. It occupy nearly 513 thousand hectare area with production of 6170 thousand matric tonnes and productivity 12.00 matric tonnes ha-1. In Madhya Pradesh okra is grown in 0.4012 lakh ha area with production 5.3673 lakh MT and 13.02 tonnes ha-1 productivity (Anonymous, 2018-19).

Like other crops, okra also suffers from several biotic and abiotic factors, including insect pests. However, insect pests are major production constraints in okra cultivation and the crop is ravaged by numerous insect pests viz., aphids, leafhopper, whiteflies and thrips right from sowing till harvesting. These pests cause damage to the crop directly by sucking the sap or indirectly by transmitting a large number of viral diseases. Due to desapping and injection of toxic saliva into plants by sucking pests, leaves turn brownish and may eventually fall down (Rudra and Saikia, 2020). A number of insecticides are sprayed on vegetables as a key component for the management of crop pests. But indiscriminate use of these by the farmers has led to resistance and resurgence of pests and environmental pollution. The present study evaluates the efficacy of newer insecticides against aphid in okra.

**MATERIALS AND METHODS**

The field experiment was conducted at Entomological Research Farm, Department of Entomology, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, College of Agriculture, Gwalior Madhya Pradesh in *Kharif*- 2018 and 2019. The experiment were conducted with seven treatments in a Randomized Block Design and replicated thrice with plot size of 3.60 × 2.40 m2 each was sown at 60 × 45 cm spacing. All the recommended package of practices was adopted for raising the crop.

**Observations**

Observations on aphid (both adult as well as nymph) were recorded on six leaves during morning hours on five plants. The plants were selected randomly in each plot to record the population from six leaves, each to from top, middle and bottom canopy and mean population per six leaves was worked out.

First spray was given at time of initiation of insect infestation. The second spray was given at 15 days after first spray. Pretreatment observations on the population of aphid was recorded on six leaves (2 upper, 2 middle and 2 lower leaves of the plant canopy) at one day before treatment. Post treatment observations were recorded on 7 and 14 days after each spray. The population were calculated by applying the following formula – Population (per/leaf) = Total number of insects/ Number of leaves observed. The data obtained on pest infestation from experimental field were subjected to analysis of variance after transforming into (√x+0.5). Economics of different treatments were also worked out.

**RESULTS AND DISCUSSION**

The efficacy of treatments was assessed on the basis of sucking pests of aphid population. Data recorded on population of aphid different treatments at one day before and 7 and 14 days after each spray are presented in Table 1, 2 and 3.

**Efficacy of insecticides against aphid population on Okra during Kharif - 2018**

Observations recorded on aphid population at one day before spray ranged from 13.33 to 14.00 aphids per six leaves with statistically at par population in all the plots. Among the insecticidal treatments imidacloprid (2.00 aphids per six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam (2.33 aphids per six leaves). Whereas, emamectin benzoate (10.27 aphids/six leaves) was found least effective. Aphid population recorded at fourteen days after first spray showed that all the insecticidal treatments were found significantly effective over control plots (10.60 aphids/six leaves/plant) in reducing the aphid population. Among the insecticidal treatments imidacloprid (2.13 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam (2.47 aphids/six leaves). Whereas, emamectin benzoate (8.47 aphids/six leaves) was found least effective. Average of two observations recorded at 7 and 14 days after first spray indicated that all the treatments were found significantly effective over control plots (13.63 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (2.07 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam (2.40 aphids/six leaves). Whereas, emamectin benzoate (9.37 aphids/six leaves) was found least effective. Data recorded at seven days after second spray all the insecticidal treatments were found significantly effective in reducing the population of aphid over control plots (5.07 aphids/six leaves) except emamectin benzoate. Among the insecticidal treatments imidacloprid (1.47 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam. Whereas, emamectin benzoate (4.40 aphids/six leaves) was found least effective and statistically at par with control plots. At fourteen days after second spray showed significant differences in different treatments with regards to population of aphid. All the insecticidal treatments were found significantly effective over control plots (4.47 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (1.80 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam. Whereas, emamectin benzoate (4.53 aphids/six leaves) was found significantly least effective. The average of two observations recorded at 7 and 14 days after second spray, all the treatments were found significantly effective over control plots (4.77 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (1.63 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam. Whereas, emamectin benzoate (4.47 aphids/six leaves) was found least effective. Data recorded in *Kharif*- 2018, on the basis of average of four observations recorded at 7 and 14 days after first and second spray, all the treatments were found significantly effective over control plots (9.20 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (1.85 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam. Whereas, emamectin benzoate (6.92 aphids/six leaves) was found significantly least effective.

**Efficacy of insecticides against aphid population on Okra during Kharif – 2019**

The pooled data (Table 2) indicates that the aphid population in different insecticides at one day before spray ranged from 4.73 to 5.27 aphid/six leaves with statistically at par population in all the plots. Significant reduction in whitefly population was noted at 7 and 14 days after spray of insecticides compared to untreated control plot. Average population of aphid per six leaves at seven days after first spray, showed that all the insecticidal treatments were found significantly effective in reducing the population of aphid over control plots (5.27 aphids/six leaves). Among the insecticidal treatments imidacloprid (0.80 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam and acetamiprid. Whereas, emamectin benzoate (4.27 aphids/six leaves) was found least effective. Average populations of aphid was recorded at fourteen days after first spray, showed that all the insecticidal treatments were found significantly effective over control plots (7.20 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (1.20 aphids/six leaves) was found most effective and significantly superior than rest of the treatments except thiamethoxam and acetamiprid. Whereas, emamectin benzoate (4.67 aphids/six leaves) was found least effective. The population of aphid on the basis of average of two observations recorded at 7 and 14 days after first spray, all the treatments were found significantly effective over control plots (6.23 aphids/six leaves) in reducing the aphid population. Among the insecticidal treatments imidacloprid (1.00 aphids/six leaves) was found most effective followed by thiamethoxam, acetamiprid. Whereas, emamectin benzoate (4.47 aphids/six leaves) was found least effective.

The population of aphid recoded at seven days after second spray showed significant differences among different treatments with regards to population of aphid over control plots (0.80 aphids/six leaves) except emamectin benzoate. Among the insecticidal treatments imidacloprid (0.13 aphids/six leaves) was found most effective followed by thiamethoxam (0.20 aphids/six leaves), acetamiprid (0.27 aphids/six leaves) and cypermethrin (0.33 aphids/six leaves). Whereas, emamectin benzoate (0.53 aphids/six leaves) was found significantly least effective. Data recoded at fourteen days after second spray showed significant differences in different treatments with regards to population of aphid over control plots. Minimum population (0.07 aphids/six leaves) was recorded in plots treated with imidacloprid which found significantly less than control and emamectin benzoate but was at par with rest of the imidacloprid treated plots. The average of population of aphid two observations recorded at 7 and 14 days after second spray, showed significant differences among insecticidal treated plots, maximum population (0.40 aphids/six leaves) was recorded in emamectin benzoate which found significantly higher than the population in imidacloprid, thiamethoxam and acetamiprid but was at par with rest of the insecticidal treated plots. Data recorded in *Kharif*- 2019, on the basis of average of four observations recorded at 7 and 14 days after first and second spray, all the treatments were found significantly effective over control plots (3.38 aphids/six leaves/plant) in reducing the aphid population. Among the insecticidal treatments imidacloprid (0.55 aphids/six leaves) was found effective followed by thiamethoxam (0.70 aphids/six leaves), acetamiprid (0.77 aphids/six leaves). Whereas, emamectin benzoate (2.43 aphids/six leaves) was found least effective.

The data observations of the average of two years indicated that all the treatments found significantly effective over control plots in reducing the aphid population. The aphid population in treated plots ranged from 1.20 to 4.68 aphids/six leaves as against 6.29 aphids/six leaves in untreated plots. Data computed on per cent reducing in aphid population indicate that 25.7 to 80.9% population may be reduced by spraying of different insecticides. Among the insecticidal treatments imidacloprid 17.8SL @100 ml/ha (1.20 aphids/six leaves) found most effective followed by thiamethoxam 25WG @100 gm/ha and acetamiprid 20SP @120 gm/ha. Whereas, emamectin benzoate 5SG @200 gm/ha (4.68 aphids/six leaves) found least effective. Similar to the present finding Kumar (2015) also reported imidacloprid 17.8SL to be effective against aphid in okra. Pawar *et al*. (2016) also reported imidacloprid 17.8SL @20 g a.i./ha WG found most effective followed by thiamethoxam 25WG @25 g a.i./ha and acetamiprid 20SP @20g a.i./ha which were at par. Berwa *et al*. (2017) also reported that imidacloprid 17.8SL @35.6 g a.i./ha found to be significantly effective against jassid, aphid and whitefly. Saha (2015) also reported that thiamethoxam 25WG found most effective against aphid population followed by acetamiprid 20SP. Bade *et al.* (2017) and Satyanarayana and Arunakumara (2022) also reported acetamiprid 20SP @15 g a.i./ha and thiamethoxam 25WG @25 g a.i. to be found most effective against aphids four sprays, which corroborate the present findings.

**Fruit yield under different chemical insecticides**

Data recorded in Kharif- 2018, all the chemical insecticides were found significantly effective in registering the higher yield (155.44 to 120.33 q/ha) over control with (99.78 q/ha). Maximum fruit yield (155.44) was recorded in emamectin benzoate 5SG followed by spinosad 45SC (154.44 q/ha) and imidacloprid 17.8 SL (124.22 q/ha). Whereas, minimum fruit yield (120.33 q/ha) was recorded in cypermethrin 10 EC followed by acetamiprid 20 SP and thiamethoxam 25WG. In Kharif- 2019, maximum fruit yield (157.22 q/ha) was recorded in emamectin benzoate 5SG followed by spinosad 45 SC (155.77 q/ha) and imidacloprid 17.8 SL (125.98 q/ha). Whereas, minimum fruit yield (121.78 q/ha) was recorded in cypermethrin 10 EC followed by acetamiprid 20 SP and dimethoate 30 EC. The average of two year observations data, all the insecticides found significantly effective in registering the higher yield (121.06 to 156.33 q/ha) than control plots (101.78 q/ha). Maximum fruit yield (156.33 q/ha) was recorded in plot treated with emamectin benzoate 5SG @200 gm/ha followed by spinosad 45SC @100 ml/ha. Whereas, minimum fruit yield (121.06 q/ha) obtained in plot treated with cypermethrin 10EC @250 ml/ha (Figure-2).Data computed on per cent avoidable loss in fruit yield caused by shoot and fruit borer indicate that 18.9 to 53.6 % loss in fruit yield may be avoided by the protecting with different insecticides. Maximum fruit yield loss may be avoided by protecting the crop with emamectin benzoate (53.6%) followed by spinosad (Table 4). Similar to the present findings Dhaka *et al*. (2016), Aarwe *et al*. (2017) and Mohanta *et al*. (2020) also reported that highest yield was recorded in emamectin benzoate 5SG as compared to control. Sarkar *et al*. (2015) observed highest marketable fruit yield of okra in spinosad treated plots. Pachole *et al*. (2017) noticed the highest yield in spinosad 45SC @0.05% (197.22 q/ha) followed by imidacloprid 17.8SL @0.3 ml/l (156.25 q/ha). These findings are supported with the study of Gummadidala and Kumar (2018) who also reported highest fruit yield in imidacloprid 17.8SL. Jayarao *et al*. (2016) also reported highest fruit yield in imidacloprid followed by thiamethoxam. Singh and Thakur (2018) reported highest yield in imidacloprid 17.8SL followed by acetamiprid 20SP.

**Economics of different chemical insecticides**

The data computed on economics of different treatments, revealed that all the insecticidal treatments were economical over control. Maximum net profit was recorded in emamectin benzoate 5SG @200 gm/ha followed by spinosad 45SC @100 ml/ha (74,953 Rs/ha), imidacloprid 17.8SL @100 ml/ha (33,240 R/ha) and thiamethoxam 25WG @100 gm/ha (31,749 Rs/ha). However maximum cost benefit ratio recorded in imidacloprid 17.8 SL @100 ml/ha (1:19.10) followed by acetamiprid 20SP @120 gm/ha (1:15.93), thiamethoxam 25WG @100 gm/ha (1:15.87) and spinosad 45SC @ 100 ml/ha (1:14.87). Similar to the present findings Dhaka *et al*. (2016), Berwa *et al*. (2017) and Sharma and Verma (2019) reported the maximum net returns obtained in emamectin benzoate 5SG followed by spinosad 45SC. Aarwe *et al*. (2017) also report highest net return in emamectin benzoate 5SG. Pachole *et al*. (2017) reported spinosad most economical followed by imidacloprid which is similar to the present finding. Berwa *et al*. (2017) and Gummadidala and Kumar (2018) also report maximum cost benefit ratio record in imidacloprid 17.8 SL. Singh and Thakur (2018) reported higher cost benefit ratio in imidacloprid 17.8SL followed by acetamiprid 20SP, which corroborate the present findings.

**Conclusion**

Inconclusion, the study affirms the significant efficacy of insecticides imidacloprid 17.8 SL was the most effective for aphid control and thiamethoxam 25 WG and acetamiprid 20 SP in effectively controlling aphid populations on okra crops and economic return, while **emamectin benzoate** offered the best yield and profit despite lower aphid control in okra cultivation in Madhya Pradesh in India.

**Table-1: Efficacy of chemical insecticides against aphid, *Aphis gossypii* Glover on okra (*Kharif*- 2018)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dose/ha** | **Number of Aphid population/6 leaves** | | | | | | | |
| **1 DBS** | **First spray** | | | **Second spray**  **Mean** | | | **Mean of four observation** |
| **7 DAS** | **14 DAS** | **Mean** | **7 DAS** | **14 DAS** | **Mean** |
| T1 Imidacloprid 17.8 SL | 100 ml | 13.47 (3.74) | 2.00 (1.58) | 2.13 (1.62) | 2.07 (1.60) | 1.47 (1.40) | 1.80 (1.52) | 1.63 (1.46) | 1.85 (1.53) |
| T2 Thiamethoxam 25 WG | 100 gm | 13.60 (3.75) | 2.33 (1.68) | 2.47 (1.72) | 2.40 (1.70) | 1.93 (1.56) | 2.07 (1.60) | 2.00 (1.58) | 2.20 (1.64) |
| T3 Acetamiprid 20 SP | 120 gm | 14.00 (3.81) | 2.67 (1.78) | 2.73 (1.80) | 2.70 (1.79) | 2.20 (1.64) | 2.27 (1.66) | 2.23 (1.65) | 2.47 (1.72) |
| T4 Cypermethrin 10 EC | 250 ml | 13.33 (3.72) | 3.00 (1.87) | 3.33 (1.96) | 3.17 (1.91) | 2.93 (1.84) | 3.13 (1.90) | 3.03 (1.87) | 3.10 (1.89) |
| T5 Emamectin benzoate 5 SG | 200 gm | 13.67 (3.76) | 10.27 (3.28) | 8.47 (2.99) | 9.37 (3.14) | 4.40 (2.21) | 4.53 (2.24) | 4.47 (2.23) | 6.92 (2.68) |
| T6 Dimethoate 30 EC | 200 ml | 14.00 (3.81) | 3.73 (2.06) | 3.53 (2.00) | 3.63 (2.03) | 2.47 (1.72) | 2.73 (1.80) | 2.60 (1.76) | 3.12 (1.90) |
| T7 Spinosad 45 SC | 100 ml | 13.60 (3.75) | 5.27 (2.40) | 5.00 (2.34) | 5.13 (2.37) | 3.13 (1.91) | 3.33 (1.96) | 3.23 (1.93) | 4.18 (2.15) |
| T8 Control (untreated) |  | 13.93 (3.80) | 16.67 (4.14) | 10.60 (3.33) | 13.63 (3.74) | 5.07 (2.36) | 4.47 (2.23) | 4.77 (2.29) | 9.20 (3.71) |
| **SEm ±** |  | **(0.18)** | **(0.05)** | **(0.05)** | **(0.04)** | **(0.05)** | **(0.04)** | **(0.04)** | **(0.02)** |
| **CD at 5%** |  | **NS** | **(0.15)** | **(0.15)** | **(0.12)** | **(0.15)** | **(0.12)** | **(0.12)** | **(0.06)** |

Figures in the parentheses are transformed (√n+0.5) values, NS= Non-significant

* DBS - Day before spray
* DAS - Day after spray

**Table-2: Efficacy of chemical insecticides against aphid, *Aphis gossypii* Glover on okra (*Kharif*- 2019)**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dose/ha** | **Number of Aphid population/6 leaves** | | | | | | | |
| **1 DBS** | **First spray** | | | **Second spray** | | | **Mean of four observation** |
| **7 DAS** | **14 DAS** | **Mean** | **7 DAS** | **14 DAS** | **Mean** |
| T1 Imidacloprid 17.8 SL | 100 ml | 5.27 (2.40) | 0.80 (1.14) | 1.20 (1.30) | 1.00 (1.22) | 0.13 (0.79) | 0.07 (0.75) | 0.10 (0.77) | 0.55 (1.00) |
| T2 Thiamethoxam 25 WG | 100 gm | 5.00 (2.34) | 1.00 (1.22) | 1.47 (1.40) | 1.23 (1.31) | 0.20 (0.84) | 0.13 (0.79) | 0.17 (0.82) | 0.70 (1.06) |
| T3 Acetamiprid 20 SP | 120 gm | 5.13 (2.37) | 1.13 (1.28) | 1.53 (1.42) | 1.33 (1.35) | 0.27 (0.87) | 0.13 (0.79) | 0.20 (0.83) | 0.77 (1.09) |
| T4 Cypermethrin 10 EC | 250 ml | 4.93 (2.33) | 1.93 (1.56) | 2.00 (1.58) | 1.97 (1.57) | 0.33 (0.91) | 0.20 (0.84) | 0.27 (0.87) | 1.12 (1.22) |
| T5 Emamectin benzoate 5 SG | 200 gm | 5.20 (2.39) | 4.27 (2.18) | 4.67 (2.27) | 4.47 (2.23) | 0.53 (1.02) | 0.27 (0.87) | 0.40 (0.94) | 2.43 (1.59) |
| T6 Dimethoate 30 EC | 200 ml | 5.20 (2.39) | 1.93 (1.56) | 2.13 (1.62) | 2.03 (1.59) | 0.40 (0.94) | 0.20 (0.84) | 0.30 (0.89) | 1.17 (1.24) |
| T7 Spinosad 45 SC | 100 ml | 4.73 (2.29) | 2.87 (1.83) | 2.07 (1.59) | 2.47 (1.71) | 0.40 (0.95) | 0.20 (0.83) | 0.30 (0.89) | 1.38 (1.30) |
| T8 Control (untreated) |  | 5.07 (2.36) | 5.27 (2.40) | 7.20 (2.77) | 6.23 (2.59) | 0.80 (1.14) | 0.27 (0.87) | 0.53 (1.01) | 3.38 (1.80) |
| **SEm ±** |  | **(0.04)** | **(0.03)** | **(0.07)** | **(0.04)** | **(0.04)** | **(0.03)** | **(0.03)** | **(0.02)** |
| **CD at 5%** |  | **NS** | **(0.09)** | **(0.21)** | **(0.11)** | **(0.12)** | **(0.09)** | **(0.08)** | **(0.06)** |

Figures in the parentheses are transformed (√n+0.5) values, NS= Non-significant

* DBS - Day before spray
* DAS - Day after spray

**Table-3: Efficacy of chemical insecticides against aphid, *Aphis gossypii* Glover on okra**

**(Pooled- 2018 & 2019)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dose/ha** | **Number of Aphid population/6 leaves** | | | **Reduction in aphid population (%)** |
| **Mean 2018** | **Mean 2019** | **Average of two years** |
| T1 Imidacloprid 17.8 SL | 100 ml | 1.85 (1.53) | 0.55 (1.00) | 1.20 (1.30) | **80.9** |
| T2 Thiamethoxam 25 WG | 100 gm | 2.20 (1.64) | 0.70 (1.06) | 1.45 (1.40) | **76.9** |
| T3 Acetamiprid 20 SP | 120 gm | 2.47 (1.72) | 0.77 (1.09) | 1.62 (1.45) | **74.2** |
| T4 Cypermethrin 10 EC | 250 ml | 3.10 (1.89) | 1.12 (1.22) | 2.11 (1.61) | **66.5** |
| T5 Emamectin benzoate 5 SG | 200 gm | 6.92 (2.68) | 2.43 (1.59) | 4.68 (2.27) | **25.7** |
| T6 Dimethoate 30 EC | 200 ml | 3.12 (1.90) | 1.17 (1.24) | 2.15 (1.62) | **65.9** |
| T7 Spinosad 45 SC | 100 ml | 4.18 (2.15) | 1.38 (1.30) | 2.78 (1.81) | **55.8** |
| T8 Control (untreated) |  | 9.20 (3.71) | 3.38 (1.80) | 6.29 (2.61) |  |
| **SEm ±** |  | **(0.02)** | **(0.02)** | **(0.01)** |  |
| **CD at 5%** |  | **(0.06)** | **(0.06)** | **(0.03)** |  |

Figures in the parentheses are transform (√x+0.5) values, NS= Non-significant

* DBS - Day before spray
* DAS - Day after spray

**Table-4: Fruit yield under different chemical insecticides**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dose/ha** | **Yield (q/ha)** | | | **Per cent Avoidable/ha** |
| ***Kharif*-** **2018** | ***Kharif*- 2019** | **Average of two years** |
| T1 Imidacloprid 17.8 SL | 100 ml | 124.22 | 125.98 | 125.10 | **22.91** |
| T2 Thiamethoxam 25 WG | 100 gm | 123.00 | 125.55 | 124.28 | **22.11** |
| T3 Acetamiprid 20 SP | 120 gm | 122.55 | 124.33 | 123.44 | **21.28** |
| T4 Cypermethrin 10 EC | 250 ml | 120.33 | 121.78 | 121.06 | **18.94** |
| T5 Emamectin benzoate 5 SG | 200 gm | 155.44 | 157.22 | 156.33 | **53.59** |
| T6 Dimethoate 30 EC | 200 ml | 122.00 | 124.33 | 123.17 | **21.02** |
| T7 Spinosad 45 SC | 100 ml | 154.44 | 155.77 | 155.11 | **52.39** |
| T8 Control (untreated) |  | 99.78 | 103.78 | 101.78 |  |
| **SEm ±** |  | **1.72** | **1.76** | **1.23** |  |
| **CD at 5%** |  | **5.04** | **5.16** | **3.61** |  |

Figures in the parentheses are mean values

**Table-5: Economics of different chemical insecticides for the control of major insect pests on okra crop**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Treatments** | **Dose/ha** | **Yield (q/ha)** | **Additional yield over control (q/ha)** | **Additional profit (Rs/ha)** | **Cost of treatments (Rs/ha)** | **Net profit (Rs/ha)** | **C:B ratio** |
| T1 Imidacloprid 17.8 SL | 100 ml | 125.10 | 23.32 | 34980 | 1740 | 33240 | 1:19.10 |
| T2 Thiamethoxam 25 WG | 100 gm | 124.28 | 22.50 | 33749 | 2000 | 31749 | 1:15.87 |
| T3 Acetamiprid 20 SP | 120 gm | 123.44 | 21.67 | 32498 | 1920 | 30578 | 1:15.93 |
| T4 Cypermethrin 10 EC | 250 ml | 121.06 | 19.28 | 28915 | 2200 | 26715 | 1:12.14 |
| T5 Emamectin benzoate 5 SG | 200 gm | 156.33 | 54.55 | 81825 | 6800 | 75025 | 1:11.03 |
| T6 Dimethoate 30 EC | 200 ml | 123.17 | 21.39 | 32083 | 2640 | 29443 | 1:11.15 |
| T7 Spinosad 45 SC | 100 ml | 155.11 | 53.33 | 79993 | 5040 | 74953 | 1:14.87 |
| T8 Control (untreated) |  | 101.78 | - | - | - | - | - |

**Note: Rate of insecticides Rs/litre or kg.**

Selling rate of okra fruit (Rs/q) : 1500 Imidacloprid :2700

Labour charge for sprays (Rs) : 600 per sprayThiamethoxam : 4000

Acetamiprid: 3000

Cypermethrin : 2000

Emamectin benzoate : 14000

Dimethoate : 3600

Spinosad : 19200

**Fig 1:** **Population of aphid under different insecticidal treatments**

**Fig 2: Fruit yield under different insecticidal treatments**

**REFERENCES**

1. Aarwe, R, Pachori, R, Sharma, AK, Kurmi, A and Rangare, NR. Efficacy and economics of different insecticides against *Earias vittella* (Fabricius) on okra (*Abelmoschus esculentus* L. Moench). Int. J. of Chem. Stud. 2017; 5(2): 429-432.
2. Anonymous. National Horticulture Board, <http://nhb.gov.in>. 2018-19.
3. Berwa, R, Sharma, AK, Pachori, R, Shukla, A, Aarwe, R and Bhowmik,, P. Efficacy of chemical and botanical insecticides against sucking insect pest complex on okra (*Abelmoschus esculentus* L. Moench). J. of Ent. and Zoo. Stud. 2017; 5(5): 1693-1697.
4. Berwa, R, Sharma, AK, Pachori, R, Shukla, A, Aarwe, R, Kurmi, A and Bhowmik, P. Assessment of different insecticides and economics against fruit damage by shoot and fruit borer of okra (*Abelmoschus* *esculentus* L. Moench). Int. J. of Chem. Stud. 2017; 5(6): 268-271.
5. Dhaka, SS, Rai, MK and Kumar, A. Relative efficacy of novel insecticides and biopesticides against *Earias vittella* (Fab.) in okra. Ann. of Pl. Prot. Sci. 2016; 24(2): 271-275.
6. Gummadidala, C and Kumar, A. Efficacy of selected insecticides and neem products against white fly (*Bemisia tabaci* (Gennadius)] of okra [*Abelmoschus esculentus* (L.) Moench]. J. of Ent. and Zoo. Stud. 2018; 6(4): 115-117.
7. Jayarao, B, Somasekhar, Khadar, AB, Bharathi, DT and Shaila, O. Efficacy of imidacloprid and thiamethoxam against leafhopper, *Amrasca biguttula biguttula* (Ishida) on okra. An Int. J. of Quart. and Life sci. 2016; 11(2): 911-914.
8. Kumar, P, Singh, DV, Sachan, SK, Singh, G, Singh, G and Prasad, Y. Efficacy of insecticide and biopesticids against aphids (*Aphis Gossypii* G.) on okra (*Abelmoschus Esculentus* L. Moench) crop. Ann. of Horti*.* 2015; 8(2): 190-193.
9. Mohanta, R, Nath, R and Mishra, A. Efficacy of some novel insecticides against vector white fly of yellow vein mosaic disease in okra (*Abelmoschus esculentus* L. Moench). Int. J. of Chem. Stud*.* 2020; 8(2): 2028-2033.
10. Pachole, SH, Thakur, S and Simon, S. Comparative bio-efficacy of selected chemical insecticides and biorationals against shoot and fruit borer [*Earias vittella* (Fabricius)] on okra [*Abelmoschus esculentus* (L.) Moench]. J. of Pharmacog. and Phytochem. 2017; 6(5): 1493-1495.
11. Pawar, SA., Zanwar, PR, Lokare, SG, Dongarjal, RP and Sonkamble, MM. Efficacy of newer insecticides against sucking pests of okra. Indian J. of Ent*.* 2016; 78(30): 257-259.
12. Rudra, N B and Saikia, DK. Evaluation of IPM for the management of insect pests of okra. Journal of Entomology and Zoology Stud. 2020; 8(4): 2197-2200.
13. Saha, R. Seasonal incidence and management of sucking pests of okra. M.Sc. (Ag). Thesis submitted to MPKV, Rahuri, Maharashtra; 2015.
14. Saha, R. Seasonal incidence and management of sucking pests of okra. M.Sc. (Ag). Thesis submitted to MPKV, Rahuri, Maharashtra. 2015.
15. Sarkar, ., Patra, S and Samanta, A. Evaluation of bio-pesticides against red cotton bug and fruit borer of okra. An Int. Quart. J. Life sci. 2015; 10(2): 601-604.
16. Satyanarayana, C and Arunakumara, KT. Bioefficacy of newer insecticide molecules against sucking insect pest complex in okra and their effect on predators. Pest Management in Horticultural Ecosyst. 2022;. 28(1): 100-106.
17. Sharma, RP and Verma, RK. Assessment of bio-pesticides against shoot and fruit borer *Earias vittella* (Fab.) of okra.Int. J. of Chem. Stud*.* 2019; 7(5): 2062-2066.
18. Singh, SK and Thakur, S. Comparative efficacy of some bio-rational and chemical insecticides against whitefly, *Bemisia tabaci* (Gennadius) on okra, *Abelmoschus esculentus* (L.) Moench. Int. J. Curr. Microbiol. Appl. Sci. 2018; 7(8): 4405-4411.
19. Sree, LE, Rajan, SJ, Reddy, MN, Sneha, MK, Rao, SCH. Conservation biological control: effect of bio-fertilizers and bio pesticides in organic ecological engineering field of okra (*Abelmoschus esculentus* (L.) Moench). Int. J Curr. Microbiol. App. Sci. 2019; 8(1): 548-555.