**Field Efficacy of Chlorpyrifos and Fipronil EC Against Shoot and Fruit Borer, *Earias vitella* (Fabricius) in Okra**

**ABSTRACT**

**Aims:**
The present study assess the bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot and fruit borer, *Earias vittella* (Fabricius) infestation in okra (*Abelmoschus esculentus* L. Moench), and to evaluate its influence on infestation intensity and fruit yield.

**Study Design:**

Randomized Block Design (RBD) with nine treatments and three replications.

**Place and Duration of Study:**

The experiment was conducted at [Institution Name] during the Kharif seasons of 2019 and 2020.

**Methodology:**
Different doses of Chlorpyrifos 35% + Fipronil 3.5% EC formulated as nine treatments (T1-T9), including five doses of (T1-T5), along with standard checks (Chlorpyrifos 50% EC, Fipronil 5% SC, Cypermethrin 25% EC) and an untreated control (T9) were tested for efficacy. Two foliar sprays were applied in each season. Data on larval population build-up and the mean number of infested shoots and fruits per 10 plants were recorded at multiple intervals post-application. Green fruit yield and percent reduction over control were also assessed. Data were statistically analysed using ANOVA.

**Results:**
In 2019, the lowest shoot infestation (6.30 shoots/10 plants) and highest yield (16,342 kg/ha) were recorded in T5- Chlorpyrifos 35% + Fipronil 3.5% EC @ 875 + 87.5 g a.i./ha, followed by T4- 546.87 + 54.68 g a.i./ha (6.37 shoots; 16,037 kg/ha) and T3- 437.5 + 43.75 g a.i./ha (6.43 shoots; 16,029 kg/ha). Fruit infestation ranged from 6.27 (T5) to 9.17 (T9-Untreated control). Percent reduction over control in fruit infestation reached 82.10% in T5. Whereas, in 2020 similar trends were observed, with T5 again showing the lowest shoot (5.23) and fruit (4.63) infestations and the highest yield (17,142 kg/ha). T9 recorded the lowest yield (9453 kg/ha). The maximum reduction in fruit infestation was 84.51% in T5.

**Conclusion:**
Application of combination product at 546.87 + 54.68 to 875 + 87.5 g a.i /ha, was highly effective in controlling *Earias vittella* and increasing okra yield. It can be recommended as a potent component in okra pest management programs. Additionally, the use of combination insecticides at optimized doses may help reduce overall chemical load and delay resistance development eventually contributing to more ecologically sustainable pest management.

***Keywords:*** *Okra,* Earias vittella*, pest management,* Chlorpyrifos*, Fipronil, shoot and fruit borer, phytotoxicity*

1. **INTRODUCTION**

Okra (*Abelmoschus esculentus* L. Moench) (Family: Malvaceae) is an economically important vegetable crop extensively cultivated in tropical and subtropical regions across the globe. It holds a significant position in the Indian vegetable basket due to its high nutritional value, medicinal properties, and consistent market demand. Okra is rich in essential nutrients such as vitamins A, B, and C, minerals like calcium, magnesium, iron, and potassium, and contains valuable bioactive compounds in its fruits and mucilage, contributing to its use in traditional medicine for treating ulcers, inflammation, and digestive disorders (Aykroyd *et al*., 1963; Gemede *et al*., 2016).

India is the world's largest producer of okra, contributing approximately 70% to global production, with major growing states including Gujarat, West Bengal, Bihar, Madhya Pradesh, and Odisha (NHB, 2021-22). However, the productivity of okra is severely constrained by biotic stresses, among which insect pests pose a major challenge. More than a dozen insect pest species attack okra at various growth stages, causing significant damage to shoots, leaves, buds, flowers, and fruits (Dhamdhere *et al*., 1984).

Among these, the shoot and fruit borer, *Earias vittella* (Fabricius) (Lepidoptera: Nolidae), is recognized as the most devastating pest of okra. The larval stage of *E. vittella* bores into tender shoots and fruits, causing shoot drying, fruit distortion, and yield loss ranging from 21% to over 90%, depending on pest severity and agro-climatic conditions (Kataria and Singh, 2021; Dawar *et al*., 2023). Early-stage infestation leads to wilting and stunting of plants, while fruit infestation results in deformed, unmarketable produce, severely affecting farmers' income and market supply (Rahman *et al*., 2013). Conventionally, management of *E. vittella* has relied on synthetic insecticides, but indiscriminate use has led to concerns of pest resistance development, resurgence of secondary pests, and environmental contamination (Adja *et al*., 2019). Moreover, broad-spectrum insecticides can adversely affect beneficial arthropods, disrupting the ecological balance of the crop ecosystem.

In recent years, emphasis has been laid on evaluating newer insecticidal combinations that offer enhanced pest control with reduced environmental risks. One such combination is Chlorpyrifos 35% + Fipronil 3.5% EC, which integrates the systemic and contact action of Chlorpyrifos, an organophosphate, with the unique mode of action of fipronil, a phenylpyrazole insecticide known for its broad-spectrum efficacy and comparatively lower mammalian toxicity. Field studies on fipronil alone have demonstrated its potential in reducing fruit borer infestation and enhancing marketable yield in okra (Afreen *et al*., 2025). However, limited research exists on the combined application of Chlorpyrifos and Fipronil against *E. vittella* under Indian agro-climatic conditions.

In this context, the present investigation was undertaken to evaluate the bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC at different dosages against the shoot and fruit borer of okra under field conditions. In addition to assessing pest suppression, the study aimed to evaluate the phytotoxicity of the formulation on okra and its impact on natural enemy populations, thereby generating holistic data to support integrated pest management strategies for sustainable okra production.

**2. MATERIAL & METHODS**

**2.1 Experimental Site, crop & treatment details**

The field experiments were conducted at the University of Agricultural Sciences, GKVK, Bangalore, Karnataka, India (latitude: 13.072°N, longitude: 77.572°E) during Kharif 2019 and Kharif 2020. The crop used for the study was okra variety 'Solar 500', grown under standard agronomic practices recommended by the university. The experiment was laid out in a Randomized Block Design (RBD) with nine treatments and three replications. The plot size for each treatment was 5 × 5 m² with a spacing of 60 × 30 cm. All the crop cultivation and agronomic practices were followed as per the UAS, GKVK, Bengaluru package of practices to raise the crop. Applications of insecticidal treatments were initiated when the incidence of pest population was noticed at considered proportions (*i.e.,* at ETL level). The treatments comprised different dosages of Chlorpyrifos 35% + Fipronil 3.5% EC along with standard insecticide checks and an untreated control, as detailed in Table 1. The insecticidal sprays were applied twice during each season using a knapsack sprayer fitted with a hollow cone nozzle. The first and second sprays were applied on 11th and 26th September 2019 (Kharif 2019) and on 10th and 25th August 2020 (Kharif 2020), respectively, with a spray volume of 500 L/ha.

**2.2 Observations Recorded**

**2.2.1 Pest Infestation**

The efficacy of the treatments was assessed by recording the mean number of *E. vittella* larvae per ten randomly selected plants before spraying and at 3, 10, and 15 days after each spray (DAT). The number of infested shoots per ten plants before spraying and at 5 and 10 DAT was also recorded. The number of infested fruits per ten plants before spraying and at 5 and 10 DAT was recorded and percent reduction over control (ROC) was calculated for all infestation parameters. The damage caused by shoot and fruit borer in the experimental field is documented (Fig.1).

**2.3 Phytotoxicity Assessment**

Phytotoxicity symptoms such as leaf injury, wilting, vein clearing, necrosis, epinasty, hyponasty, stunting, and chlorosis were visually observed on okra plants at 1, 3, 5, 7, and 10 days after each spray for the higher dosages (T3, T4, T5) and untreated control (T9), following a 0-10 scale, where 0 indicated no injury and 10 indicated 91-100% injury.

**2.4 Effect on Natural Enemies**

The population of natural enemies, particularly ladybird beetles, was recorded at 5 and 10 DAT after each spray from ten plants per plot to assess the impact of insecticide treatments on beneficial arthropods.

**2.5 Yield Estimation**

The okra fruits were harvested treatment-wise, and yield was recorded separately for each plot and converted to kg/ha. Pooled yield data from both seasons were statistically analysed.

**2.6 Statistical Analysis**

The data on pest infestation, yield, and natural enemy population were subjected to analysis of variance (ANOVA) using appropriate statistical software. Means were compared at the 5% significance level, and necessary data transformations were applied where required to meet ANOVA assumptions.

**3. RESULTS & DISCUSSION**

**3.1 Shoot & Fruit borer larval population in Okra during *Kharif* 2019**

Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against Shoot and fruit borer larvae during 1st season (*Kharif-*2019) is presented in table 2. The initial larval population per 10 plants showed no significant variation among treatments. At 3 days after the first spray, all treatments significantly reduced the pest population compared to the control. The lowest larval count was recorded in T5 (5.93 larvae/10 plants), followed by T4 (6.00), T3 (6.07), T2 (6.17), and T1 (6.23), all of which were statistically at par. The highest larval population was observed in T9 (untreated control) with 8.90 larvae/10 plants. A similar trend of significant reduction in larval numbers continued through 10 and 15 days after the first spray, and also at 3, 10, and 15 days after the second spray.

Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against Shoot and fruit borer larvae during 2nd season (*Kharif-*2020) is presented in table 2. The shoot and fruit borer population before treatment application was statistically uniform across treatments. At 3 days after the first spray, significant differences were observed among treatments. T5 recorded the lowest larval count (6.27 larvae/10 plants), followed by T4 (6.33), T3 (6.43), and T2 (6.50), all statistically on par. The highest infestation was observed in T9 (untreated control) with 9.43 larvae/10 plants. A consistent trend of larval reduction continued through 10 and 15 days after the first spray, and at 3, 10, and 15 days after the second spray.

**3.2 Shoot & Fruit borer infestation on shoots in Okra during *Kharif* 2020**

Before treatment application, the **mean number of infested shoots per 10 plants** was statistically similar across all treatments in both seasons. At 5 days after the first spray in 2019, T5 recorded the lowest infestation (6.30), followed by T4 (6.37), T3 (6.43), T2 (6.47), and T1 (6.57), all statistically at par. The highest infestation was noted in T9 (10.20). A similar trend continued at 10 days after the first spray, and at 5 and 10 days after the second spray. Percent reduction over control was highest in T5 (81.61%), followed by T4 (80.79%), T3 (80.21%), T2 (79.38%), and T1 (78.81%). In the 2020 season, T5 again showed the lowest **mean number of infested shoots per 10 plants** (5.23), followed by T4 (5.27), T3 (5.33), and T2 (5.40), all significantly better than T9 (10.80). This pattern remained consistent across later observations. Percent reduction over control was the highest in T5 (86.28%), followed by T4 (86.03%), T3 (85.46%), and T2 (85.21%).

**3.3 Shoot & fruit borer infestation on fruits in Okra**

The **mean number of infested fruits per 10 plants** before treatment did not differ significantly across treatments (Fig.2) At 5 days after the first spray in 2019, the lowest infestation was observed in T5 (6.27), followed closely by T4 (6.33), T3 (6.40), and T2 (6.47), all statistically at par and significantly superior to T9 (9.17). The same trend continued through 10 days after the first spray and 5 and 10 days after the second spray. Percent reduction over control was the highest in T5 (82.10%), followed by T4 (81.79%), T3 (81.34%), and T2 (80.74%). Whereas in the 2020 *kharif*, T5 again recorded the lowest fruit infestation (4.63), followed by T4 (4.70), T3 (4.77), and T2 (4.80), with T9 showing the highest infestation (9.87). This trend persisted across all observation intervals. The percent reduction over control was maximum in T5 (84.51%), followed by T4 (84.15%), T3 (83.89%), and T2 (83.26%).

**3.4 Yield**

 The fruit yield of okra during *kharif* 2019 and 2020 is presented in Figure 3. In the 2019 season, the highest yield was obtained in T5 (16,342 kg/ha), which was statistically on par with T4 (16,037 kg/ha), T3 (16,029 kg/ha), T2 (15,933 kg/ha), and T1 (15,910 kg/ha). The lowest yield was recorded in the untreated control, T9 (9,758 kg/ha). A similar trend was observed in 2020, with T5 again producing the highest yield (17,142 kg/ha), followed closely by T4 (17,070 kg/ha), T3 (16,996 kg/ha), T2 (16,861 kg/ha), and T1 (16,777 kg/ha). The untreated control (T9) recorded the lowest yield during this season as well (9,453 kg/ha).

**3.5 Phytotoxic effect**

The observations were recorded visually for phytotoxicity symptoms (Leaf injury on tips/surface, wilting, vein clearing, chlorosis necrosis, epinasty, hyponasty and stunting) on okra crop at 1, 3, 5, 7 and 10 days after each spraying. The results of phytotoxic effect of Chlorpyrifos 35% + Fipronil 3.5% EC on okra revealed no phytotoxic effects during both *kharif*-2019 and *kharif*-2020 seasons.

**3.6 Natural enemies**

 The results (fig. 4) indicated that the population of ladybird beetle, was observed in all the treatments and insecticide treatments give to okra for the control of shoot and fruit borer had no effect on population of natural enemies in okra ecosystem.

The present study showed that Chlorpyrifos 35% + Fipronil 3.5% EC at the higher dose of 875 + 87.5 g a.i./ha was highly effective in reducing shoot and fruit borer infestation in okra and improving fruit yield. Earlier, Papal and Bharpoda (2009) reported that Chlorpyrifos 20 EC @ 0.04% led to the lowest fruit (18.86%) and seed damage (2.05%) by E. vittella in seed-purpose okra proving efficacy in field conditions. Carneiro *et al*. (2014) demonstrated the bioefficacy of Chlorpyrifos and fipronil against Helicoverpa armigera (Hubner) larvae through both contact and ingestion, reinforcing their lepidopteran-targeted activity. In related crops, Jadhao *et al*. (2015) found that fipronil reduced thrips populations by 57.3% in chilli and significantly increased yield, while Vijayalakshmi *et al*. (2016) reported that fipronil 5 SC @ 1000 mL/ha was highly effective in managing chilli thrips, indicating its versatility in vegetable pest control. Supporting results were also recorded in rice systems by Zainab and Singh (2016), who reported that Chlorpyrifos 35% + Fipronil 3.5% EC @ 875 + 87.5 g a.i./ha provided strong suppression of Nilaparvata lugens Stal. and Leptocorisa varicornis (Fabricius), confirming its broad-spectrum utility. Singh and Hasan (2017) observed that Chlorpyrifos + fipronil combinations reduced stem borer and leaf folder damage in rice and improved yield components, while Sahu *et al*. (2017) noted fipronil’s effectiveness against shoot and fruit borers in brinjal.

Recent field evaluations further support the effectiveness of novel chemistries in *E. vitella* management. Meena *et al.* (2018) demonstrated that Indoxacarb 14.5% SC @ 72.5 g a.i./ha resulted in the lowest shoot (6.30%, 5.37%) and fruit (3.25%, 3.73%) borer infestations, with infestation reductions of 61.22% and 74.81% after two sprays, respectively. This was closely followed by Indoxacarb 14.5% + Acetamiprid 7.7% SC @ 72.5 + 38.5 g a.i./ha (51.36%, 69.09%), and both treatments produced the highest okra yields. Given the shift toward newer-generation insecticides with targeted action and environmental safety, Indoxacarb has emerged as a promising option in vegetable IPM. Its proven efficacy against lepidopteran pests, combined with low mammalian toxicity and compatibility with beneficial arthropods, makes it a noteworthy candidate for rotation or combination with existing chemistries such as Chlorpyrifos + Fipronil.

Despite such proven efficacy, Kumar *et al*. (2020) found that Chlorpyrifos usage was limited among farmers, pointing to gaps in knowledge and pesticide selection practices. New chemicals adoption remains limited because most farmers (62%) rely on pesticide dealers for recommendations and over 90% do not read or understand label instructions. Additionally, only 32% of farmers apply insecticides at the recommended dose, often resorting to approximate or visually guided applications that hinder informed adoption of precise, advanced formulations. Akolkar *et al.* (2021) evaluated several newer insecticides against E. vittella during Kharif 2019 and reported that the combination of flubendiamide 90 SC + deltamethrin 60 SC (36 + 24 g a.i./ha) was the most effective. This treatment resulted in the lowest larval population (0.81 larvae/plant), minimal fruit infestation (4.5%), and the highest fruit yield (9.64 t/ha). Kumar *et al*. (2022) reported that Fipronil 5SC, alone or in combination with Chlorpyrifos, significantly reduced head borer infestation in cabbage and enhanced yield without causing phytotoxic effects. The premixed formulation (Fipronil 3.5% + Chlorpyrifos 35% EC) was particularly effective, yielding up to 1550 q/ha. Sheoran *et al*. (2023) evaluated ten insecticidal treatments against E. vittella and reported that **chlorantraniliprole 18.5% SC** recorded the **lowest shoot infestation (2.67%) and fruit infestation (3.46%),** along with the **highest marketable green fruit yield of 114.23 q/ha**. Moreover, their residue analysis confirmed that chlorantraniliprole residues were well below the established MRLs, ensuring food safety. Most recently, Afreen *et al*. (2025) demonstrated that fipronil @ 4 mL/L provided excellent control of E. vittella and increased okra yield to 147.04 q/ha under field conditions. These results highlight chlorantraniliprole as both an effective and consumer-safe molecule, supporting its inclusion in integrated pest management (IPM) strategies for okra. These findings affirm that the Chlorpyrifos and fipronil combination is a powerful and reliable option for managing E. vittella in okra. It can be safely integrated into sustainable pest management strategies.

**4. CONCLUSION**

The present study clearly demonstrated that the application of Chlorpyrifos 35% + Fipronil 3.5% EC at dosages of 350 + 35, 437.5 + 43.75, 546.87 + 54.68, and 875 + 87.5 g a.i./ha was highly effective in managing the shoot and fruit borer, *E. vittella* in okra. The highest dose consistently recorded the lowest pest infestation and highest fruit yield among all the treatments. Importantly, the insecticidal applications did not exhibit any phytotoxic symptoms on the okra crop across both seasons indicating their crop safety. Furthermore, no adverse effects on the population of natural enemies, such as ladybird beetles, were observed suggesting that the combination is ecologically compatible. Thus, Chlorpyrifos 35% + Fipronil 3.5% EC can be recommended as an effective and safe component in the integrated pest management (IPM) strategy for sustainable okra cultivation.Its adoption can significantly reduce pest-induced yield losses while ensuring ecological safety. This combination offers a practical and efficient solution for enhancing okra productivity in Indian agro-ecosystems.

**DISCLAIMER (ARTIFICIAL INTELLIGENCE)**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

**COMPETING INTERESTS**

Authors have declared that no competing interests exist.

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**Fig 1: Damage symptoms of Shoot and Fruit Borer, *Earias vittella* (Fabricius) in experiment field**

**e)**

**d)**

**c)**

**b)**

**a)**

a & c) Shoot and fruit borer boring holes into the okra fruit

b) Holes on the fruit

d) borer eating and damaging the fruit with excreta

c)Holes plugged with dead larva and single fruit surrounded by multiple borer larvae

**Table 1:** **Treatments for evaluation of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot & fruit borer of okra during *Kharif*-2019 and *Kharif*- 2020**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sl. No.** | **Name of the Treatment** | **Dosage** **(g a.i./ha)** | **Formulation****(g or ml/ha)** | **Method of Application** |
| 1. **T1**
 | T1: Chlorpyrifos 35% + Fipronil 3.5% EC | 262.5+26.25 | 750 | Foliar Spray  |
| 1. **T2**
 | T2: Chlorpyrifos 35% + Fipronil 3.5% EC | 350+35 | 1000 |
| 1. **T3**
 | T3: Chlorpyrifos 35% + Fipronil 3.5% EC | 437.5+43.75 | 1250 |
| 1. **T4**
 | T4: Chlorpyrifos 35% + Fipronil 3.5% EC | 546.87+54.68 | 1562.5 |
| 1. **T5**
 | T5: Chlorpyrifos 35% + Fipronil 3.5% EC | 875+87.5 | 2500 |
| 1. **T6**
 | T6: Chlorpyrifos 50% EC | 500 | 1000 |
| 1. **T7**
 | T7: Fipronil 5% SC | 50 | 1000 |
| 1. **T8**
 | T8: Cypermethrin 25% EC | 50 | 200 |
| 1. **T9**
 | T9: Untreated Control | - | - |

**Table 2: Effect of Chlorpyrifos 35% + Fipronil 3.5% EC against Shoot & Fruit borer in okra during *Kharif,* 2019**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Treatments** | **Dosage****g a.i./ha** | **Mean No. of Shoot & Fruit borer larva Per Ten Plants\*** |
| **I-Spray** | **II-Spray** |  |
| **PTC** | **3 DAT** | **10 DAT** | **15 DAT** | **3 DAT** | **10 DAT** | **15 DAT** | **% ROC** |
| **1** | T1 | 262.5+26.25 | 8.87(2.98) | 6.23(2.59) | 3.93(2.11) | 3.67(2.04) | 3.50(2.00) | 3.30(1.95) | 1.17(1.29) | 88.99 |
| **2** | T2 | 350+35 | 8.83(2.97) | 6.17(2.58) | 3.83(2.08) | 3.57(2.02) | 3.43(1.98) | 3.20(1.92) | 1.13(1.28) | 89.37 |
| **3** | T3 | 437.5+43.75 | 8.80(2.98) | 6.07(2.56) | 3.80(2.07) | 3.53(2.01) | 3.37(1.97) | 3.13(1.91) | 1.07(1.25) | 89.93 |
| **4** | T4 | 546.87+54.68 | 8.90(2.99) | 6.00(2.55) | 3.73(2.06) | 3.50(2.00) | 3.33(1.96) | 3.03(1.88) | 1.00(1.22) | 90.59 |
| **5** | T5 | 875+87.5 | 8.97(3.00) | 5.93(2.54) | 3.70(2.05) | 3.43(1.98) | 3.27(1.94) | 3.00(1.87) | 0.97(1.21) | 90.87 |
| **6** | T6 | 500 | 8.90(2.98) | 7.03(2.74) | 4.73(2.29) | 4.47(2.23) | 4.30(2.19) | 4.00(2.12) | 3.50(2.00) | 67.07 |
| **7** | T7 | 50 | 8.70(2.95) | 7.23(2.78) | 4.97(2.34) | 4.70(2.28) | 4.53(2.24) | 4.23(2.18) | 3.87(2.09) | 63.59 |
| **8** | T8 | 50 | 8.67(2.94) | 7.30(2.79) | 5.20(2.39) | 4.93(2.33) | 4.77(2.29) | 4.47(2.23) | 4.10(2.14) | 61.43 |
| **9** | Untreated Control | - | 8.93(2.99) | 8.90(3.07) | 9.37(3.14) | 9.87(3.22) | 10.20(3.27) | 10.50(3.32) | 10.63(3.34) | - |
| **S. Em ±** | - | 0.01 | 0.01 | 0.01 | 0.01 | 0.02 | 0.02 | - |
| **CD (p=0.05)** | NS | 0.05 | 0.03 | 0.03 | 0.04 | 0.05 | 0.07 | - |

 \*Mean of three replications; PTC: Pre-Treatment Count; DAT: Days After Treatment; NS: Non-Significant; Sig: Significant

 Values in parentheses are √x+0.5 transformed values, % ROC - % Reduction over control

**Table 3:- Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot & fruit borer infestation on fruits of Okra during, *Kharif* 2020**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Treatments** | **Dosage****g a.i./ha** | **% ROC** |
| **2019** | **2020** |
| **1** | T1 | 262.5+26.25 | 78.81 | 83.81 |
| **2** | T2 | 350+35 | 79.38 | 85.21 |
| **3** | T3 | 437.5+43.75 | 80.21 | 85.46 |
| **4** | T4 | 546.87+54.68 | 80.79 | 86.03 |
| **5** | T5 | 875+87.5 | 81.61 | 86.28 |
| **6** | T6 | 500 | 61.25 | 70.67 |
| **7** | T7 | 50 | 59.60 | 67.13 |
| **8** |  T8 | 50 | 58.20 | 64.42 |
| **9** | Untreated Control | - | - | - |
| **S. Em ±** |  |  |
| **CD (p=0.05)** |  |  |

 \* Mean of three replications, % ROC - % Reduction over control, Values in parentheses are √x+0.5 transformed values,

 DBS: Days before spray, DAS: Days after spray

**Table 4:- Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot & fruit borer infestation on shoots of Okra during, *Kharif* 2019**

**Fig 2: Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot & fruit borer infestation on fruits of Okra during a) *Kharif* 2019 and b) *Kharif* 2020**

**1st Spray**

**2nd Spray**

**2nd Spray**

**1st Spray**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Treatments** | **Dosage****g a.i./ha** | **Mean no. of infested shoots Per Ten Plants\*** |
| **1DBS** | **1st Spray** | **2nd Spray** | **% ROC** |
| **5DAS** | **10DAS** | **5DAS** | **10DAS** |
| **1** | T1 | 262.5+26.25 | 8.40(2.98) | 6.57(2.66) | 6.13(2.58) | 5.23(2.39) | 2.00(1.58) | 78.95 |
| **2** | T2 | 350+35 | 8.43(2.99) | 6.47(2.64) | 6.07(2.56) | 5.17(2.38) | 1.83(1.53) | 80.74 |
| **3** | T3 | 437.5+43.75 | 8.60(3.02) | 6.40(2.63) | 6.00(2.55) | 5.07(2.36) | 1.77(1.51) | 81.34 |
| **4** | T4 | 546.87+54.68 | 8.63(3.02) | 6.33(2.61) | 5.93(2.54) | 5.03(2.35) | 1.73(1.49) | 81.79 |
| **5** | T5 | 875+87.5 | 8.83(3.05) | 6.27(2.60) | 5.90(2.53) | 4.97(2.34) | 1.70(1.48) | 82.10 |
| **6** | T6 | 500 | 8.70(3.03) | 7.53(2.83) | 6.43(2.63) | 5.97(2.54) | 4.40(2.21) | 53.68 |
| **7** | T7 | 50 | 8.77(3.04) | 7.63(2.85) | 6.77(2.70) | 6.17(2.58) | 4.60(2.26) | 51.58 |
| **8** |  T8 | 50 | 8.90(3.07) | 7.73(2.87) | 7.00(2.74) | 6.37(2.62) | 4.80(2.30) | 49.47 |
| **9** | Untreated Control | - | 8.63(3.02) | 9.17(3.11) | 9.27(3.13) | 9.17(3.11) | 9.50(3.16) | - |
| **S. Em ±** | - | 0.01 | 0.01 | 0.01 | 0.02 | **-** |
| **CD (p=0.05)** | NS | 0.04 | 0.02 | 0.03 | 0.05 | **-** |

 \* Mean of three replications, % ROC - % Reduction over control, Values in parentheses are √x+0.5 transformed values,

 DBS: Days before spray, DAS: Days after spray

**Table 5:- Bio-efficacy of Chlorpyrifos 35% + Fipronil 3.5% EC against shoot & fruit borer infestation on shoots of Okra during, *Kharif* 2020**

|  |  |  |  |
| --- | --- | --- | --- |
| **Sl. No.** | **Treatments** | **Dosage****g a.i./ha** | **Mean no. of infested shoots Per Ten Plants\*** |
| **1DBS** | **1st Spray** | **2nd Spray** | **% ROC** |
| **5DAS** | **10DAS** | **5DAS** | **10DAS** |
| **1** | T1 | 262.5+26.25 | 9.00(3.08) | 4.90(2.32) | 4.30(2.19) | 3.10(1.90) | 1.93(1.56) | 82.72 |
| **2** | T2 | 350+35 | 9.23(3.12) | 4.80(2.30) | 4.17(2.16) | 3.03(1.88) | 1.87(1.54) | 83.26 |
| **3** | T3 | 437.5+43.75 | 9.23(3.12) | 4.77(2.29) | 4.13(2.15) | 2.93(1.85) | 1.80(1.52) | 83.89 |
| **4** | T4 | 546.87+54.68 | 8.97(3.08) | 4.70(2.28) | 4.07(2.14) | 2.90(1.84) | 1.77(1.50) | 84.15 |
| **5** | T5 | 875+87.5 | 9.23(3.12) | 4.63(2.27) | 4.03(2.13) | 2.87(1.83) | 1.73(1.49) | 84.51 |
| **6** | T6 | 500 | 9.13(3.10) | 5.93(2.54) | 4.90(2.32) | 3.97(2.11) | 3.13(1.91) | 71.98 |
| **7** | T7 | 50 | 9.23(3.12) | 6.13(2.58) | 5.20(2.39) | 4.27(2.18) | 3.37(1.97) | 69.83 |
| **8** |  T8 | 50 | 9.20(3.11) | 6.23(2.59) | 5.40(2.43) | 4.67(2.27) | 3.67(2.04) | 67.14 |
| **9** | Untreated Control | - | 9.03(3.09) | 9.87(3.22) | 9.40(3.15) | 9.43(3.15) | 11.17(3.42) | - |
| **S. Em ±** | - | 0.01 | 0.01 | 0.02 | 0.02 | **-** |
| **CD (p=0.05)** | NS | 0.03 | 0.03 | 0.05 | 0.05 | **-** |

 \* Mean of three replications, % ROC - % Reduction over control, Values in parentheses are √x+0.5 transformed values,

 DBS: Days before spray, DAS: Days after spray

**2nd Spray**

 **ay**

**2nd Spray**

 **ay**

**1st Spray**

**Fig 3: Effect of Chlorpyrifos 35% + Fipronil 3.5% EC on yield of Okra**

**Fig 4: Effect of Chlorpyrifos 35% + Fipronil 3.5% EC on natural enemies in Okra during** **a) *Kharif* 2019 and b) *Kharif* 2020**

**1st Spray**