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# Evaluation of Bio-Efficacy of Various Insecticides Against Pink Bollworm of Bt-Cotton

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## ABSTRACT

A field experiment was conducted to evaluate of bio-efficacy of insecticides against cotton pink bollworm with 10 treatments and three replicates at Entomological Research farm, College of Horticulture, Mandsaur, during *Kharif* 2020-21. Nine molecules *viz*; imidacloprid 70% WG @ 50 g *a.i.* / ha, emamectin benzoate 5% SG @ 200 g *a.i.* / ha, lambda cyhalothrin 4.9% CS @ 300 g *a.i.* / ha, thiamethoxam 25% WG @ 200 g *a.i.* / ha, imidacloprid 17.8% SL @ 200 g *a.i.* / ha, indoxacarb 14.5% SC @ 500 g *a.i.* / ha, flubendiamide 20% WG @ 250 g *a.i.* / ha, chlorpyrifos 50% + cypermethrin 5% EC @ 1250 g *a.i.* / ha, Beta-cyfluthrin 8.49% + imidacloprid 19.8% OD @ 1250 g *a.i.* / ha were evaluated. Treatment chlorpyrifos 50% + cypermethrin 5% EC 1250 g *a.i.* / ha was found effectiveness against cotton pink bollworm and followed by beta-cyfluthrin 8.49% + imidacloprid 19.8% OD1250 g *a.i.* / ha.

**Key Words:** Boll damage, Cotton, Fiber crop, Insecticides, Pink Boll Worm.

## INTRODUCTION

Cotton (*Gossypium sp.*) known as "white gold," is a member of the Malvaceae family (Dhawan et al, 2011), grown in India as a *Kharif* cash and fiber crop. Cotton is a globally important fiber crop that is grown in tropical and sub-tropical regions of more than 70 nations. Cotton seeds are primarily used to produce oil, cake as animal feed, linters, and hull. Cotton seed oil is used for edible purposes after hydrogenation, as well as in the manufacture of soap paints and varnishes, in the leather industry and as a lubricant. The pink bollworm (*Pectinophora gossypiella*) is a major pest of cotton that can cause significant damage to crops and reduce yields (Baraskar *et al,* 2019).

Cotton is a leading cash crop and the most widely used non-food crop in the world. China is the world's largest cotton producing country, followed by India, with an area of 120.69 lakh hectares, 362.18 lakh bales, and an average productivity of 510 kg/ha. In India, it is primarily grown in Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh, Punjab, Tamil Nadu, and Haryana. In Madhya Pradesh, cotton is grown on 6.16 lakh hectares, with a yield of 20 lakh bales and a productivity of 578 kg lint per ha mainly in the Nimar and Malwa Plateaus, specifically in the districts of Khargone, Khandwa, Indore, Dewas, Ujjain, Neemuch, Mandsaur and Barwani (Anonymous, 2020-21). Cotton requires more than 80 per cent of the pesticides to manage insects and pests. Pest control and farmer profit have suffered as a result of in discriminate pesticide use. Furthermore, approximately 10% of insecticides globally and 45.00% in India are used for insect pest management in cotton crops alone (Nagtilak, 2016).

The pest spectrum of the crop is quite complex, with approximately 1326 species of insects reported on the cotton crop from sowing to maturity in various cotton-growing regions around the world, with 162 insect pests identified in India. Insect infestations are known to reduce crop yields

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**Table 1. Treatment details.**

| Sr. No. | Treatment | Name of insecticide | Applied dose (g or ml/ha) |
|---|---|---|---|
| 1 | $T_1$ | Imidacloprid 70%WG | 50 |
| 2 | $T_2$ | Emamectin Benzoate 5% SG | 200 |
| 3 | $T_3$ | Lambda Cyhalothrin 4.9% CS | 300 |
| 4 | $T_4$ | Thiamethoxam 25% WG | 200 |
| 5 | $T_5$ | Imidacloprid 17.8% SL | 200 |
| 6 | $T_6$ | Indoxacarb 14.5% SC | 500 |
| 7 | $T_7$ | Flubendiamide 20% WG | 250 |
| 8 | $T_8$ | Chlorpyrifos 50% + Cypermethrin 5% EC | 1250 |
| 9 | $T_9$ | Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD | 1250 |
| 10 | $T_{10}$ | Untreated check | - |

by 56-60 percent (Meghna *et al,* 2018). Aphids [*Aphis gossypii*(Glover)], jassid [*Amrascabiguttulabiguttula* (Ishida)], thrips [*Scirtothripsdorsalis* (Hood)], whitefly [*Bemisia tabaci* (Gennadius)], mealy bugs [*Phenococcus spp*.] and bollworms are major pests of cotton crop (Ramesh *et al,* 2016). Besides this, American boll worm, pink boll worm and spotted boll worm are the major pests in India. Cotton yield loss was 46.5 per cent due to sucking pests alone, with the bollworm complex accounting for 44.5 per cent (Prabhavathi et al, 2018).There are various management practices that should be followed to help mitigate some of the environmental risks associated with growing of cotton (Gill and Bhatt, 2015)

Bt-cotton is a genetically engineered crop. Cotton that has been genetically modified is referred to as transgenic cotton (Choudhary *et al,* 2016 and Gurjar *et al,* 2023). Bt-cotton contains a toxic protein-inducing gene from the soil bacterium *Bacillus thuringiensis*, allowing the crop to produce toxin, resulting in decreased bollworm infestation, reduced insecticide application, increased yield and improved 'Kapas' quality (Kaur *et al,* 2014). Bt-cotton has shown potential in the management of bollworm populations but these cotton hybrids have recently been found to be susceptible to pink boll worm. The continuous cultivation of Bt-cotton reduced bollworm infestation but increased the severity of sucking pest. A number of sprays of various insecticides are required to control pests. It is well known that the continuous and repeated application of various insecticides has resulted in a multiplication of insecticide resistance, but management of these insect pests is a continuous process (Sayyed *et al,* 2011).Keeping in view the present investigation is emphasized to test the new combination molecule with other insecticides against pink bollworm complex.

## MATERIALS AND METHODS

The field experiment was carried out at the Research farm, College of Horticulture, Mandsaur, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (M.P.) during *Kharif* season of 2021-2022. The College of Horticulture, Mandsaur is situated in Malwa plateau in Western part of Madhya Pradesh at $23.45^0$ to $24.13^0$ North latitude, $74.44^0$ to $75.18^0$ East longitudes and at an altitude of 435 meters above mean sea level. This region comesunder agro climatic zone No.10 of the State.The experiment was made in Randomized Block Design (RBD). The ten treatments were used in this experiment including an untreated control with three replications. A Popular Bt cotton hybrid Dhandev Gold was sown with a spacing of 0.5X0.5 $m^2$ and date of sowing 13/08/2021. The gross and net plot size for present experiment was 9 $m^2$ and 6.25 $m^2$ , respectively. Continuous two foliar applications of insecticides with knapsack sprayer fitted with a hollow cone nozzle at Economic Threshold Level (ETL) were applied. Spraying of insecticides was started at the

**Table 2. Bio efficacy of various insecticides on green boll damage against pink boll worm.**

| Treatment | Applied Dose g.*a.i.*/ha | Green boll damage % (Mean) | Reduction over untreated check (%) |
|---|---|---|---|
| $T_1$- Imidacloprid 70%WG | 50 | 12.49(20.68) | 61.78 |
| $T_2$- Emamectin Benzoate 5% SG | 200 | 11.99(20.25) | 63.31 |
| $T_3$- Lambda Cyhalothrin 4.9% CS | 300 | 12.73(20.90) | 61.05 |
| $T_4$-Thiamethoxam 25% WG | 200 | 10.99(19.79 ) | 67.85 |
| $T_5$- Imidacloprid 17.8% SL | 200 | 13.91(21.52) | 58.97 |
| $T_6$- Indoxacarb 14.5 % SC | 500 | 12.99(21.12) | 60.25 |
| $T_7$- Flubendiamide 20% WG | 250 | 10.78(19.02) | 67.01 |
| $T_8$- Chlorpyrifos 50% + Cypermethrin 5% EC | 1250 | 8.78(17.23) | 73.13 |
| $T_9$- Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD | 1250 | 9.74(18.18) | 70.20 |
| $T_{10}$-Untreated check | - | 33.58(35.82) | - |
| S Em± | - | 1.23 | - |
| CD at 5% | NS | 2.49 | - |
| CV% | - | 13.47 | - |

*Figures in parentheses transformed value*

ETL of insect pests. Pre-treatment, observation was taken one day before and post treatment observations were recorded 3, 7 and 10 days after first and second spray.

The observations on sucking insect pests population was taken on 5 plants per plot and 3 leaves per plant. Thrips population was counted on top 03 tender leaves of 05 plants per plot. The last observation of each spray was considered as pre-treatment observation for the next Spray. Green boll damage was counted based on number of healthy and damaged bolls on five randomly selected plants from each treatment before and post of 1$^{st}$ and 2$^{nd}$ sprays. Similarly, observations of open bolls and locules damage by pink bollworm were recorded at the harvest. The data obtained was subjected to statistical analysis after using appropriate transformations. The data obtained were tabulated and analyzed by the method of "Analysis of variance" as suggested by Fisher and Yates (1963).

## RESULTS AND DISCUSSION

The results found after insecticidal treatments were presented in Table 2 and 3 showed significantly superior of all the treatments over control in green boll damage, open boll and locule damage due to pink bollworm of cotton during experimentation.

## Green Boll Damage

Mean per cent green boll damageddue to pink bollworm of cotton varied between 8.78 to 13.91 % in various treatments.All the treatments showed significantly superior over untreated check (33.58 %) in reduction of the green boll damage during 1$^{st}$ and 2$^{nd}$ sprays. Among the tested insecticides, Chlorpyrifos 50% + Cypermethrin 5% EC (70.13) was showed highest effective in reduction of green boll damage over control and followed by the treatments Flubendiamide 20% WG and Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD which were at par with Thiamethoxam 25% WG, Emamectin Benzoate 5%

SG, Imidacloprid 70%WG and Lambda Cyhalothrin 4.9% CS all the treatments showed significantly superior over untreated control. Next best treatment was Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD with 70.20% reductions in green boll damage over untreated check. Kharbade and Wayal (2009) reported that on the basis of pink bollworm larvae per 20 infested green bolls, the percentage damaged green bolls and loculi, open bolls and locule damage and yield of seed cotton, λ-cyhalothrin 5 EC andchlorpyrifos 20 EC were the best treatments, followed by β-cyfluthrin 5 EC. Abudulai et al (2018) suggested that alternate applications of Chlorpyrifos +Cypermethrincan be recommended as a replacement for endosulfan for control of cotton pink bollworms and improvement of cotton yield.

**Open boll damage**

The overall percent of mean of two sprays revealed that least open boll damage was recorded in Chlorpyrifos 50%  + Cypermethrin 5% EC @ 1250 g *a.i.* / ha 5.26 % and next best treatments was Beta-cyfluthrin 8.49% + Imidacloprid19.8% OD@ 1250 g *a.i.* / ha 6.28% open boll damage. The present findings were in accordance with Abudulai *et al* (2018) suggested that (Chlorpyrifos + Cypermethrin) can be recommended for control of cotton open bollworm damage and improvement of cotton yield. Similarly, Gosavi *et al* (2020) found most effectiveness of imidacloprid 19.8% OD against pink bollworm and better improvement in yield. Further, spraying of imidacloprid 19.8% OD on 2nd and 6th day after crossing ETL of moth trap catches in pheromone trap and imidacloprid 19.8% OD showed most effective management of pink bollworm on Bt-cotton and found minimum open boll damage. Sabry (2013) suggested that chlorpyrifos 50% was the most effective pesticide against the pink bollworm larvae.

**Locule boll damage**

Significantly highest locule damage per cent was noted in untreated check (29.18%). Found the result that treatments,Chlorpyrifos 50% +Cypermethrin 5% EC @ 1250 g *a.i.*/ha (3.09%) showed maximum reduction in locule damage. Treatments Flubendiamide 20% WG and Emamectin Benzoate 5% SG and at par with Lambda Cyhalothrin 4.9% CS and Imidacloprid 70%WG. The next best treatment was Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD 4.09% reduction in locule damage over untreated check. The present findings were correlated with the results of Gosavi *et al* (2020) lambda-cyhalothrin 5 EC most effective against pink bollworm. Further, spraying of lamda-cyhalothrin 5 EC on 2nd and 6th day after crossing ETL of moth trap catches in pheromone trap showed most effective management of pink bollworm on Bt-cotton. Sabry (2013) suggested that lambda-cyhalothrin was the most effective pesticide against the pink bollworm larvae. Thilagam and Gopikrishnan (2020) and Divya *et al* (2020) revealed that, the application of Chlorpyrifos + Cypermethrinwas found superior over the other treatments with minimum locule boll damaged.

**Yield of Cotton**

The cotton yield showed significant difference in over untreated check. The highest seed cotton yield was collected with Chlorpyrifos 50%  +Cypermethrin 5% EC(22.45 q/ha) spray was at par with Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD (20.45 q/ha) spray. However, lowest yield was obtained in the Imidacloprid 17.8% SL (11.73 q/ha). The present findings on seed cotton yield corroborated with the results of Nemade *et al* (2017) revealed that highest seed cotton yield was observed with Cypermethrin 5% EC. Asif *et al* (2016) obtained maximum extrapolated yield (2.99 tons / ha) in Chlorpyrifos 50%  treated plots. Patel *et al* (2014) and Jakhar and Jat (2021) revealed that application Flubendiamide 20% WG showed best cotton yield and BC ratio. The above findings were in partial agreement with the present study as these studies did not include the combination of insecticides, but individual performance of insecticides in present study also exhibited better.

## CONCLUSION

It was concluded that the treatment Beta-cyfluthrin 8.49% + imidacloprid 19.8% OD and Chlorpyrifos 50%  + Cypermethrin 5% EC resulted tin maximum reduction in green, open and locule damage in Bt-cotton and found maximum yield as compared to untreated check.

**Table 3. Bio efficacy of various insecticides on open boll damagedby pink bollworm (mean of three picking).**

| Treatment | Applied doses g.*a.i.*/ha | Open boll damage % (Mean) | Reduction over untreated check (%) |
|---|---|---|---|
| $T_1$- Imidacloprid 70%WG | 50 | 9.98 (18.26) | 69.76 |
| $T_2$- Emamectin Benzoate 5% SG | 200 | 9.17 (17.62) | 71.58 |
| $T_3$- Lambda Cyhalothrin 4.9% CS | 300 | 10.89 (18.69) | 68.52 |
| $T_4$-Thiamethoxam 25% WG | 200 | 8.74 (17.19) | 72.92 |
| $T_5$- Imidacloprid 17.8% SL | 200 | 10.46 (18.86) | 67.59 |
| $T_6$- Indoxacarb 14.5 % SC | 500 | 10.24 (18.66) | 68.27 |
| $T_7$- Flubendiamide 20% WG | 250 | 7.96 (16.38) | 75.33 |
| $T_8$- Chlorpyrifos 50% + Cypermethrin 5% EC | 1250 | 5.26 (11.21) | 79.55 |
| $T_9$-Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD | 1250 | 6.28 (13.63) | 77.50 |
| $T_{10}$-Untreated check | - | 34.88 (36.60) | - |
| S Em± | - | 0.74 | - |
| CD at 5% | NS | 2.16 | - |
| CV% | - | 10.96 | - |

*Figures in parentheses transformed values*

**Table 4. Bio efficacy of various insecticides on open boll damaged by pink bollworm (mean of three picking).**

| Treatment | Applied Dose g.*a.i.*/ha | Locule boll damage % (Mean) | Reduction over untreated check (%) |
|---|---|---|---|
| $T_1$- Imidacloprid 70%WG | 50 | 5.99 (14.75) | 81.25 |
| $T_2$- Emamectin Benzoate 5% SG | 200 | 5.05 (13.10) | 81.91 |
| $T_3$- Lambda Cyhalothrin 4.9% CS | 300 | 6.01 (14.89) | 80.45 |
| $T_4$-Thiamethoxam 25% WG | 200 | 5.19 (13.16) | 82.77 |
| $T_5$- Imidacloprid 17.8% SL | 200 | 6.64 (14.93) | 77.96 |
| $T_6$- Indoxacarb 14.5 % SC | 500 | 6.23 (14.45) | 79.32 |
| $T_7$- Flubendiamide 20% WG | 250 | 4.64 (12.43) | 84.60 |
| $T_8$- Chlorpyrifos 50% + Cypermethrin 5% EC | 1250 | 3.09 (11.66) | 86.43 |
| $T_9$- Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD | 1250 | 4.09 (12.09) | 86.43 |
| $T_{10}$-Untreated check | - | 29.18 (30.28) | - |
| S Em± | - | 0.52 | - |
| CD at 5% | NS | 1.56 | - |
| CV% | - | 7.82 | - |

**Table 5. Yield of various insecticides against pink boll worm.**

| Treatment | Applied Dose g.*a.i.*/ha | Yield (q/ha) |
|---|---|---|
| $T_1$- Imidacloprid 70%WG | 50 | 15.89 |
| $T_2$- Emamectin Benzoate 5% SG | 200 | 15.55 |
| $T_3$- Lambda Cyhalothrin 4.9% CS | 300 | 13.25 |
| $T_4$-Thiamethoxam 25% WG | 200 | 17.85 |
| $T_5$- Imidacloprid 17.8% SL | 200 | 11.73 |
| $T_6$- Indoxacarb 14.5 % SC | 500 | 13.09 |
| $T_7$- Flubendiamide 20% WG | 250 | 19.11 |
| $T_8$- Chlorpyrifos 50% + Cypermethrin 5% EC | 1250 | 22.36 |
| $T_9$- Beta-cyfluthrin 8.49% + Imidacloprid 19.8% OD | 1250 | 20.45 |
| $T_{10}$-Untreated check | - | 9.85 |
| S Em± | - | 0.94 |
| CD at 5% | NS | 2.79 |
| CV% | - | 11.46 |

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