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Effect of Novel Insecticides on Sucking Pests and Pink Bollworm in Cotton Plants under Field Conditions

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

The study investigated that the effectiveness of various novel insecticides for controlling sucking pests and pink bollworm in cotton cultivation over a three-year period. The treatments were evaluated based on their impact on aphids, jassids, thrips, whiteflies and pink bollworm populations**.** During 2018-19, 2019-20 and 2020-21 years, among the tested novel insecticides, Fipronil + Imidacloprid @ 100g/ha has recorded lowest population of thrips, jassids. Similarly, Fipronil+ Acetamiprid @ 1000 ml/ha has recorded lowest aphid population whereas incidence of pink bollworm was least in Lamdacyhalothrin + Chlorantraniliprole @ 200 ml/ha.

Keywords: Novel insecticides; sucking pests; pink bollworm and cotton.

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1. INTRODUCTION

Cotton remains the dominant fiber in the textile industry and is commonly referred to as the "king" of fibers. It is widely used in apparel production, accounting for approximately half of all textiles. Cotton's profitability and extensive cultivation make it the most prevalent non-food crop globally. The top cotton-producing countries in the 2022-23 period were China (59.80 lakh tonnes), India (52.00 lakh tonnes), the USA (31.96 lakh tonnes), and Brazil (29.46 lakh tonnes). These four countries contribute around 71% of the world's cotton production from approximately 64% of the global cotton-growing area [1].

In the 2022-23 period, India's cotton production is estimated at 337.23 lakh bales, each weighing 170 kg. This is attributed to cultivation across 130.49 lakh hectares, yielding a productivity of 439 kg lint per hectare. Comparing to the previous year, cotton cultivation area expanded by 5.5%, leading to an 8.4% increase in overall production. Productivity saw a slight rise from 428 to 439 kg per hectare. Gujarat, Maharashtra, and Telangana have become key players in cotton cultivation and production from 2018-19 to 2022-23. On average, Maharashtra covered 43.78 lakh hectares, producing 79.54 lakh bales. Gujarat's area was 24.84 lakh hectares, contributing 76.67 lakh bales. Telangana's cultivation over 20.47 lakh hectares yielded 53.59 lakh bales [2].

In present investigation, combinations of 10 insecticides were compared against sucking pests like aphids, jassids, thrips and whiteflies. Fipronil + Imidacloprid and Fipronil+ Acetamiprid are widely used insecticides that belong to the neonicotinoid and phenyl pyrazole chemical classes, respectively. These chemicals are known for their effectiveness in controlling a broad spectrum of insects, including sucking pests.

2. MATERIALS AND METHODS

The experiment were conducted at the Agricultural Research Station (ARS) in Adilabad to assess the efficacy of novel insecticides in controlling sucking pests and pink bollworm on cotton crops. The trials spanned three seasons and the selected cotton hybrid was RCH-659. The crops were spaced with 90 cm between rows and 60 cm between individual plants within rows. Each plot measured 5 x 5 m and there were three replications for each treatment. Throughout the field, standard agronomic practices recommended for *kharif* crops were implemented.

The primary objective was to evaluate the effectiveness of the novel insecticides against both sucking pests and pink bollworm in real field conditions. To achieve this, the sucking pest population was monitored on ten randomly chosen plants. In each plant, three leaves (top, middle, and bottom) were examined. The initial sucking pest population assessment was conducted a day before the first spray (DBS), followed by subsequent assessments at 1, 3, 7, and 10 days after spraying (DAS). Similarly, observations were made for pink bollworm infestations. Five plants were randomly selected and tagged in each treatment and replication. Standard procedures were followed to accurately count the pink bollworms. Pre-spray counts were recorded, and then the post-spray counts were taken at 3, 7, and 10 days after each round of spraying. In accordance with previously established thresholds for pink bollworm damage [3], two sprayings were carried out during the trial. All insecticides were applied as a foliar spray with a power-operated knapsack sprayer.

Table 1. List of chemicals used in experiment

Treatments	Dose / ha
T_1: Acephate + Imidacloprid	1000 g
T_2: Bufrofezin + Acephate	1250 g
T_3: Fipronil + Acetamiprid	1000 ml
T_4: Profenophos + Cypermethrin	1000 ml
T_5: Chlorophyriphos + Cypermethrin	1000 ml
T_6: Thiomethoxam + Lambda cyhalothrin	200 ml
T_7: Lambda cyhalothrin +Chlorantriniliprole	200 ml
T_8: Fipronil + Imidacloprid	100 g
T_9: Betacyfluthrin + Imidacloprid	625 ml
T_{10}: Monocrotophos + Acephate (farmer practice)	800 ml + 1000 gm

The percentage damage in green fruiting bodies was worked out using the following formula:

$$\%\ Pink\ bollworm\ damage = \frac{Damaged\ bolls}{Total\ bolls}\ X\ 100$$

The data thus obtained from field experiments were analyzed statistically by ANOVA at 5 per cent level of significance.

3. RESULTS AND DISCUSSION

The data from Table 2 and Fig. 1 show that among the treatments tested, using Fipronil + Imidacloprid at a rate of 100 g/ha resulted in the lowest aphid population, with 5.45 aphids observed. The next effective treatment was Fipronil + Acetamiprid, which recorded an aphid population of 5.83, following closely behind Fipronil + Imidacloprid. On the other hand, Profenophos + Cypermethrin had the highest aphid population at 9.06, indicating it was less successful in controlling aphids. Additionally, both Chlorpyrifos + Cypermethrin and Thiomethoxam + Lambda cyhalothrin treatments showed similar results, with comparable aphid populations of 8.16.

In case of jassids, Fipronil + Imidacloprid demonstrated the lowest jassids population among the all the treatments, with a value of 5.45. Thereafter Fipronil + Acetamiprid recorded the next best favourable results after Fipronil + Imidacloprid 100 g/ha, recording a jassids population of 5.83. In contrast, Profenophos + Cypermethrin recorded the highest jassid population with 2.68 among the all the treatments. Following this, treatment Chlorophyriphos + Cypermethrin with 2.57 recorded jassids population.

Regarding thrips, the lowest population was observed in the case of Fipronil + Imidacloprid with a value of 7.20. Following this trend, yielded the next most favourable results after Fipronil + Acetamiprid, recorded thrips population of 7.56. In contrast, the treatment Profenophos + Cypermethrin exhibited the highest thrips population at 10.13 among all the treatments. Subsequently, the Chlorophyriphos + Cypermethrin treatment recorded a thrips population of 9.93.

When considering whiteflies, the lowest whiteflies population was observed in the case of Fipronil + Acetamiprid, which was also true for Fipronil + Acetamiprid, with a value of 5.38. Continuing this pattern, Fipronil + Imidacloprid recorded the next most favourable results after Fipronil + Imidacloprid, reporting a thrips population of 5.95. In contrast, the treatment Profenophos + Cypermethrin displayed the highest whiteflies population among all the treatments, recording a value of 9.25. Subsequently, the Chlorophyriphos + Cypermethrin treatment exhibited a population of whiteflies 9.14.

In case of pink bollworm, Monocrotophos + Acephate (farmer practice) recorded the higher pest populations among all the treatments, with 22.83% damage. Subsequently, the Chlorophyriphos + Cypermethrin treatment showed 9.14 % damage. Following this pattern, Lambda cyhalothrin + Chlorantriniliprole with 6.50% recorded the lowest damage among the all the treatments.

Fipronil + Imidacloprid and Fipronil + Acetamiprid consistently showcased lower pest populations, making them relatively more effective against the pests considered. It's evident that the choice of treatment greatly influences pest control outcomes, and a balanced approach considering both efficacy and potential environmental impacts is crucial for sustainable pest management in cotton cultivation.

The treatments varied in their effectiveness against different pests of cotton, Fipronil + Imidacloprid and Fipronil + Acetamiprid consistently demonstrated favourable results in terms of pest population control. Profenophos + Cypermethrin often resulted in higher pest populations, showcasing the importance of selecting treatments tailored to specific pest challenges for optimal pest management outcomes.

In the plots treated with Lambda cyhalothrin + Chlorantraniliprole, the highest yield obtained was 2446 kg/ha. This was followed by the plot treated with Chlorpyrifos + Cypermethrin, which yielded 2250 kg/ha. The findings of this study indicate that pink bollworm has a significant impact on yield parameters.

In situations involving sucking pests, the treatment of Fipronil + Imidacloprid resulted in a yield of 2244 kg/ha, while the treatment of Fipronil + Acetamiprid yielded 2181 kg/ha. This finding is similar with Rohini and Prasad [4] reported that in case of cotton leafhopper, fipronil 5 SC @ 2 ml/L and imidacloprid 17.8 SL @ 0.4 ml/L were found to be promising. Kalyan et al. (2012) concluded fipronil 5 SC @ 40 g *a.i.*/ha,

Table 2. Effect of novel insecticides on sucking pests and pink bollworm in cotton plants (Three years pooled)

Treatments	Dose / ha	Three years pooled					Yield (kg/ha)
		Aphids (No./Leaf)	Jassids (No./Leaf)	Thrips (No./Leaf)	Whitefly (No./Leaf)	Pink bollworm (%)	
T_1: Acephate + Imidacloprid	1000 g	6.92 (2.81)	2.13 (1.77)	8.48 (3.08)	7.05 (2.83)	15.83	1908
T_2: Bufrofezin + Acephate	1250 g	7.28 (2.87)	2.18 (1.78)	8.53 (3.08)	7.64 (2.94)	18.94	2074
T_3: Fipronil + Acetamiprid	1000 ml	5.83 (2.61)	1.83 (1.68)	7.56 (2.92)	5.95 (2.63)	15.05	2181
T_4: Profenophos + Cypermethrin	1000 ml	9.06 (3.17)	2.68 (1.92)	10.13 (3.33)	9.25 (3.20)	22.83	2151
T_5: Chlorophyriphos + Cypermethrin	1000 ml	8.61 (3.10)	2.57 (1.89)	9.93 (3.31)	9.14 (3.18)	13.88	2250
T_6: Thiomethoxam + Lambda cyhalothrin	200 ml	8.16 (3.03)	2.44 (1.85)	9.70 (3.27)	8.88 (3.14)	12.44	2092
T_7: Lambda cyhalothrin +Chlorantriniliprole	200 ml	7.70 (2.95)	2.38 (1.84)	9.36 (3.22)	8.52 (3.08)	6.50	2446
T_8: Fipronil + Imidacloprid	100 g	5.45 (2.54)	1.66 (1.63)	7.20 (2.86)	5.38 (2.52)	16.26	2244
T_9: Betacyfluthrin + Imidacloprid	625 ml	7.47 (2.91)	2.30 (1.82)	8.81 (3.13)	8.26 (3.04)	19.50	1838
T_{10}: Monocrotophos + Acephate (farmer practice)	800 ml + 1000 gm	6.70 (2.77)	2.04 (1.74)	7.98 (2.99)	6.85 (2.80)	23.11	1547
SE(d) ±	-	0.66	0.20	0.79	0.70	1.76	189.16
CD at 5 %	-	1.40	0.42	1.67	1.47	3.73	400.48

**Mean of three replications; Figures in the parenthesis are square root transformed values; DAS: Days after Spraying; ROC: Reduction over control; SE(d) ± Standard Error Deviation*

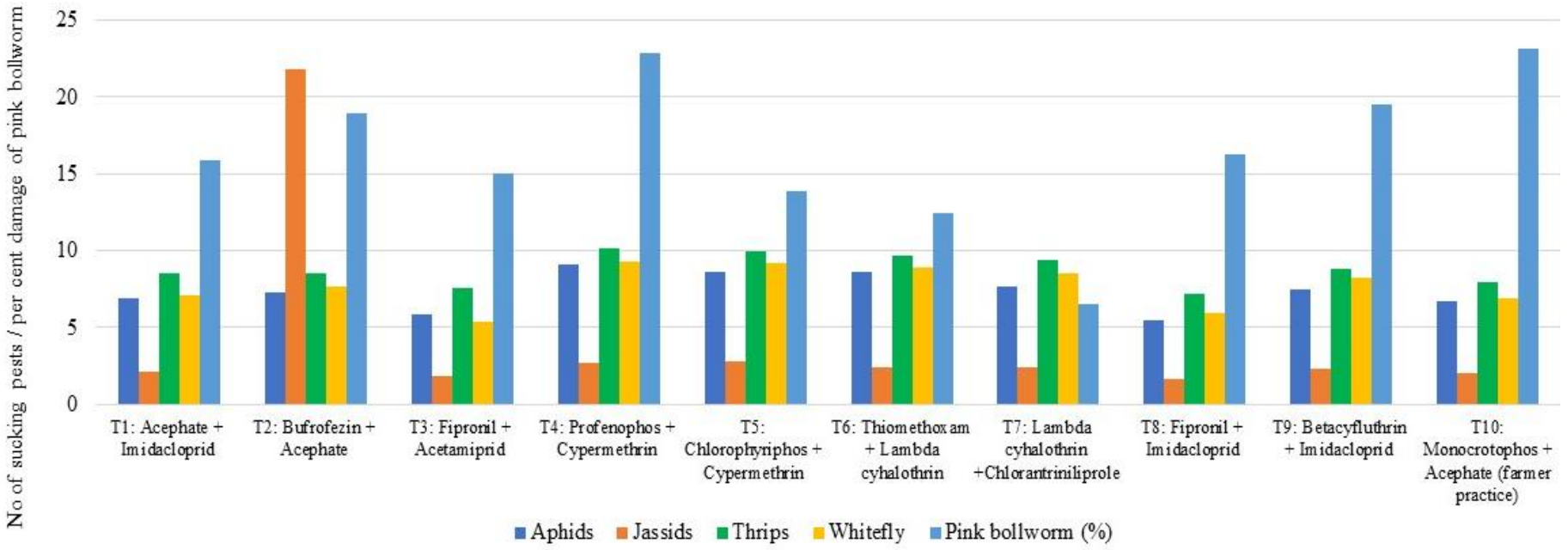

Fig. 1. The graphical distribution of novel insecticides for the control of sucking pests and pink bollworm in cotton

imidacloprid 70 WG @ 50 g *a.i.*/ha. Baraskar and Paradkar [5] observed that Fipronil 5% SC was found effective against the major sucking pests like leafhopper of Bt-cotton crop.

These findings are at par with Singh et al. (2002) and Singh et al. [6] reported that fipronil @ 50 g a.i. ha^{-1} at fortnightly interval was found to be the best treatment against the leafhopper. Wadnerkar et al. [7] reported that treatment with fipronil 5% SC @ 50-75 g a.i. ha^{-1} was effective in lowering the population of thrips, aphids and jassid infesting cotton. Jadhav et al. [8] indicated that Fipronil 5% SC @100 g a.i. ha-1 resulted in 2.2 leafhoppers per leaf and 1.2 thrips per leaf at seven days after application. Present findings are in corroborative with Ghure et al. [9] and Gosalwad et al. [10] showed that the newer insecticides molecules *i.e* L ambda-cyhalothrin, emamectin benzoate [11].

4. CONCLUSION

Fipronil + Imidacloprid and Fipronil + Acetamiprid stood out as effective treatments for multiple pests, emphasizing the importance of tailored pest management strategies. The choice of treatment significantly influences pest control outcomes, underscoring the need for strategic decision-making to achieve optimal results in cotton cultivation.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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