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Field and laboratory evaluation of some insecticides for the management of cotton jassid

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Abstract

The cotton variety CB14 was cultivated in the experimental plots and the effect of the insecticides, namely Actos 1.8EC, Asatap 75SP, Tundra 20SP, Talstar 2.5EC, Confidor 70WG, Spike 25WG, Siren 25.9%EC, Ripcord 10EC, and Panel 50SC in comparison to untreated plots were evaluated for jassid (*Amrasca devastans*) inhibition. Among the insecticides, Panel 50SC treated plots exhibited the highest plant height (123.0 ± 0.8cm), number of branches (13.5 ± 0.4a), number of leaves (66.4 ± 0.4a), sympodia (9.4 ± 0.2a), plant weight (281.5 ± 1.0 g), boll weight (14.0 ± 0.3 g) along with diameter (3.8 ± 0.3 cm) and length (5.8±0.0 cm) of the bolls, GOT (36.2±0.3), lint index (8.0±0.3) values. Panel 50SC revealed the lowest abundance of jassid, at 1, 3, and 7 days after treatments were 0.6±0.7, 1.0±0.5 and 1.6±0.4 per shoot, respectively. The laboratory-based mortality test revealed that after 24, 48 and 72 hours, Panel 50SC had the highest mortality rates (23.3 ± 1.6%, 46.6 ± 4.4% and 60.0 ± 5.0%, for each case). The study showed the highest yield under Panel 50SC (1.4 ± 0.9 t/ha) followed by Confidor 70WG (1.2 ± 0.7 t/ha), Spike 25Wg (1.2 ± 0.4 t/ha) and Actos 1.8EC (0.9 ± 0.7 t/ha).

Keywords: Agronomic traits, *Amrasca devastans*, cotton, insecticide, mortality

Introduction

In Bangladesh, the production area (in acres) for summer cotton, winter cotton, and Shimul cotton in 2022-2023 yielded 113.04, 5.68, and 0.068 kg of cotton per fruit-bearing tree, respectively. The corresponding production was 1988.77, 64365.88, and 30517.82 metric tonnes per acre (BBS 2023). The most damaging sucking insect pests of cotton are said to be jassid, which feed on the terminal and other sections of cotton plants, as well as the sap that is typically found on the underside of leaves, which is called phloem tissue. Jassids cause symptoms of hopper burn by injecting toxins into the plants through their saliva (Raj 2003). Plants are completely desiccated as a result of their severe infestation (Narayan and Singh 1994).

Ruder *et al*. (1991) found that diafenthiuron selectively blocks the coupling site in a unique time-dependent way, unlike other pesticides. Its structural similarity to dicyclohexyl carbodiimide suggests that CGA 140408 inhibits mitochondrial respiration by reducing energy intake. Udikeri *et al*. (2007), who obtained higher seed yield of cotton by protecting the crop from early sucking pest infestation by treating the seeds with Chlothianidin 600 FS (Poncho) at 9.0 ml kg1 seed. Dobbs *et al*. (2006) reported that imidacloprid (Gaucho) seed treatments produced significantly higher lint yield of cotton than untreated control. Hossain *et al*. (2012) showed that the differences among the GOT (Ginning Out Turn) of different treatments were statistically significant and observed GOT ranged from ~36% to ~38%. Gaucho 70 WS had successful effect of GOT up rise with increased dosages in CB3 variety and the control treatment revealed the lowest GOT%. Maienfisch *et al*. (2001) described imidacloprid as a neonicotinoid insecticide with gut and contact activity. After seed treatment, it exhibits systemic and residual toxicity in crops, disrupting the nervous system of insect herbivores. Zhang *et al*. (2011) highlighted its effectiveness against a wide range of sucking insect pests.

The study aimed to evaluate the impact of various insecticides on the abundance of jassid and their influence on cotton production and its agronomic traits. Additionally, it sought to compare the mortality effects of the tested insecticides on jassid populations.

Materials and methods

The study was conducted in the field and laboratory facilities of the Department of Entomology at Gazipur Agricultural University (GAU), situated in Gazipur, Bangladesh, from September 2023 to April 2024. The cotton variety was cultivated in a randomized complete block design following three replications. The experimental plots were sized 5.40 m x 4.50 m, with a spacing between blocks of 1.5 m, plots 1.0 m, plants 25 cm, and a row distance of 60 cm, respectively. Nine insecticidal treatments at recommended concentrations of 2 ml/L, 1 ml/L, 0.5 ml/L, 2 ml/L, 2 ml/L, 0.2 ml/L, 2 ml/L, 2.1 ml/L, and 2.3 ml/L were applied. Each inspection involved selecting a random sample of plants, counting and recording the number of jassids from the top three leaves. Enumeration of the population done using an aspirator and a magnifying glass (FD 75, Ballon Brand, China). For the mortality test, 15 jassids in each petri dish were dipped in the prepared solution and then dried. The bolls were processed using a laboratory electric gin with a single roller. IBM SPSS 30.0.0, used for mean and standard error value of agronomic features and other descriptive parameters.

Results and discussion

Table 1 presents an overview of the insecticides used for their respective mechanisms in cotton plants. These mechanisms involve neurotoxic effects that move across the laminae of the host plant during the diafenthiurin-derived selection process. When mixed with water, diafenthiurin transforms into carbodiimide, which inhibits energy production and disrupts pest residence. For plant sodium channel distortion, we use cyclomethrin and bifenthrin, acephate and chloropyrifos for acetylcholine neurotransmitter activity, imidacloprid and abamectin for paralysing activity, and thiamethoxam 25% with acetamiprid 20% for binding activity in central nerval pulses.

The effects of various insecticides on the abundance of jassids on cotton plants after 1 day, 3 days, and 7 days application were significantly different which is presented in Table 2. After 1 day of treatment, control showed the highest insect abundance (12.4±2.1), significantly higher than all other treatments. Ripcord 10EC (3.4±1.8) and Siren 25.9% EC (2.4±0.4) followed, showing intermediate effectiveness. In contrast, Panel 50 SC (0.6±0.7) had the lowest insect abundance, indicating superior immediate control efficacy. By 3DAT, the Control continued to maintain the highest insect population (12.0±0.5), significantly different from all treatments. Tundra 20SP (6.4±1.2) and Siren 25.9% EC (6.6±1.2) had higher insect populations compared to others, while Talstar 2.5EC (1.0±0.6) and Panel 50SC (1.0±0.5) exhibited the lowest. At 7DAT, the Control still exhibited the highest abundance (17.6±3.7), while Talstar 2.5EC (4.0±2.5) and Actos 1.8EC (2.6±0.4) showed the lowest insect populations.

Untreated fields had significantly higher populations of whiteflies, jassids, and aphids compared to insecticide-treated fields. Similar trends were observed in our study (Amin *et al*. 2008; Sarwar and Sattar, 2016).

Table 1. Different insecticides used in the experiment

Active ingredient	Trade name	Mode of action	Recommended dose (ppm)
Abamectin	Actos 1.8 EC	Systemic	2000
Acephate	Asatap 75 SP	Contact	1000
Acetamiprid 20%	Tundra 20SP	Systemic	500
Bifenthrin	Talstar 5EC	Contact	2000
Imidaclorpid	Confidor 70WG	Systemic	2000
Thiamethoxam 25%	Spike 25WG	Systemic	200
Chloropyrifos	Siren 25.9% EC	Systemic	2000
Cypermethrin	Ripcord 10EC	Contact and stomach	2100
Diafenthiurin	Pannel 50SC	Systemic and contact	1000

Table 2. Effect of different insecticides on the abundance of jassid on cotton plants at 1, 3 and 7 days after treatment

Insecticidal Treatment	Abundance (number/shoot) at different days after treatment (DAT)		
	1DAT	3DAT	7DAT
Actos 1.8EC	1.4±0.4d	1.6±0.8d	2.6±0.4de
Asatap 75SP	4.4±1.7b	5.0±1.5c	7.4±1.2bc
Tundra 20SP	3.4±1.8bc	6.4±1.2bc	5.4±2.4c
Talstar 2.5EC	0.6±0.5e	1.0±0.6de	4.0±2.5d
Confidor 70WG	1.4±0.8d	1.4±1.4de	5.0±4.0bc
Spike 25 WG	3.4±0.8bc	1.6±0.3de	6.0±2.6bc
Siren 25.9% EC	2.4±0.4c	6.6±1.2b	8.6±2.7bc
Ripcord 10EC	3.4±1.8bc	6.0±2.0bc	9.6±3.7b
Panel 50SC	0.6±0.7e	1.0±0.5e	1.6±0.4e
Control	12.4±2.1a	12.0±0.5a	17.6±2.1a

Data expressed as mean ± SD. Means not sharing a common letter within the same column is seemed significantly different according to Tukey's posthoc test at a significant level of $P \leq 0.05$.

Table 3 presents the percent mortality rate using different insecticides on cotton jassids. At 24 hours after treatment, the treatments displayed a wide range of efficacy in terms of jassid mortality. The highest mortality was observed in Panel 50SC with a mean mortality of 23.3 ± 1.6%, On the other hand, treatments like Control(3.3 ± 0.9%) showed the lowest mortality rate followed by Ripcord 10EC and Siren 25.9% EC (1.3 ± 0.3 and 1.3 ± 0.8) % respectively. After 48 hours of treatment, the results also showed significant differences. Panel 50SC showed highest mortality rate of 46.6 ± 4.4%. Ripcord 10EC and Siren 25.9% EC continued to show the lowest efficacy. After 72 hours of treatment Panel 50SC showed the highest sustained efficacy with a mortality rate of 60.0 ± 5.0%. Conversely, control with 5.6 ± 1.0e and treatments like Ripcord 10EC and Talstar 2.5EC exhibited lower mortality rates, at 36.0 ± 8.7% and 36.6 ± 3.3%, respectively.

This aligns with the findings of Karim *et al*. (2022), where specific insecticides like nitenpyram and dinotefuran were highlighted for their effectiveness. Endosulfan shows slightly higher efficacy based on the findings of Nasreen *et al.* (2005).

The Agronomic traits of CB14 cotton variety exposed to jassid management with different insecticides is presented in Table 4. Among the insecticide treatments, Panel 50SC resulted in the highest performance across several agronomic traits. Plants treated with Panel 50SC exhibited the greatest plant height (123.0 ± 0.8 cm), number of branches (13.5 ± 0.4), number of leaves (66.4 ± 0.4), and sympodia (9.4 ± 0.2), and exhibited the highest number of bolls per plant (34.9 ± 2.7a), plant weight (281.5 ± 1.0 g). These results suggest that Panel 50SC is highly effective in enhancing the overall growth and yield of the CB14 cotton variety. In comparison, Actos 1.8EC also showed notable performance, with significant measures in plant height (121.1 ± 0.6 cm), number of branches (13.2 ± 0.3). Confidor 70WG also performed well, ranking second in several parameters. It showed notable plant height (121.5 ± 0.6 cm), number of branches (13.1 ± 0.4), and number of leaves (66.0 ± 0.3). Additionally, it had a good plant weight (279.0 ± 0.8 g), On the other hand, Control plots, which did not receive any insecticide treatment, displayed the lowest values for most agronomic parameters. The control had the least plant height (118.0 ± 0.5 cm), branching plant (12.7 ± 0.4b), the control had the lowest number of bolls per plant (16.7 ± 1.5e).

Amin *et al*. (2017) found that agronomic traits like increased trichome density on cotton leaves was negatively correlated with the presence of sucking insects like jassids. Our results showed a clear distinction with Muhammad *et al*. (1997), in boll production between treated and untreated conditions.

Table 3. Mortality effect of different insecticides on cotton jassid in laboratory condition

Insecticide	Mortality rate (%) at different hours after treatment (HAT) Treatment		
	24HAT	48HAT	72HAT
Actos 1.8 EC	15± 3.1ab	26.0± 4.9bc	38.3± 7.2bc
Asatap 75SP	4.4 ± 4.4d	14.4 ± 2.9cd	46.6 ± 6.0ab
Tundra 20SP	3.6 ± 2.1d	10.0 ± 2.8d	37.6 ± 4.3bc
Talstar 2.5EC	7.6 ± 1.4bc	22.6 ± 6.7bc	36.6 ± 3.3cd
Confidor 70WG	20.3 ± 10.3a	37.6 ± 14.9ab	52.3 ± 15.2ab
Spike 25 WG	14.3 ± 5.3ab	26.6 ± 6.6bc	39.3 ± 8.6bc
Siren25.9% EC	1.3 ± 0.8d	9.6 ± 2.1d	38.3 ± 9.2bc
Ripcord 10EC	1.3 ± 0.3d	6.6 ± 0.6d	36.0 ± 8.7cd
Panel 50SC	23.3 ± 1.6a	46.6 ± 4.4a	60.0 ± 5.0a
Control	0.3 ± 0.1e	3.3 ± 0.5e	5.6 ± 1.0e

Data expressed as mean ± SD. Means not sharing a common letter within the same column is seemed significantly different according to Tukey's posthoc test at a significant level of $P \leq 0.05$.

Table 4. Agronomic traits of CB14 cotton variety exposed to jassid management with different insecticides

Insecticides	Traits of a plant					
	Height(cm)	Branches	Leaves	Sympodia	Weight (g)	Boll/plant
Actos 1.8EC	121.1±0.6ab	13.2 ± 0.3a	65.8±0.5ab	9.3 ± 0.2a	278.5± 0.8a	33.1±4.2ab
Asatap 75SP	120.0±0.5ab	13.0±0.4ab	65.5±0.4ab	9.0 ±0.1a	277.0±0.9ab	32.5±1.8cd
Tundra 20SP	119.8±0.4ab	12.9±0.3ab	65.3±0.5ab	9.1 ±0.2a	276.5±1.0ab	32.3±2.4cd
Talstar 2.5EC	122.2 ± 0.7a	12.8 ± 0.3b	66.2±0.4ab	9.2 ±0.1a	280.2± 0.9a	32.9 ± 2.1c
Confidor 70WG	121.5 ± 0.6a	13.1 ± 0.4a	66.0±0.3ab	9.3 ± 0.2a	279.0± 0.8a	33.7±2.6ab
Spike 25 WG	118.5 ± 0.5b	13.4 ± 0.4a	64.8±0.6b	9.1 ±0.1a	275.0± 0.7b	33.0 ± 2.0b
Siren25.9% EC	122.8 ± 0.7a	12.6 ± 0.3b	66.1±0.4a	9.3 ± 0.2a	280.8 ± 0.9a	32.1±1.9cd
Ripcord 10EC	119.2±0.4ab	13.3 ± 0.3a	65.0±0.5ab	9.0 ±0.1a	276.2±0.8ab	32.1 ± 1.6d
Panel 50SC	123.0 ± 0.8a	13.5 ± 0.4a	66.4±0.4a	9.4 ± 0.2a	281.5 ± 1.0a	34.9 ± 2.7a
Control	118.0 ± 0.5b	12.7 ± 0.4b	64.6±0.5b	9.0 ±0.1a	274.5 ± 0.8b	16.7 ± 1.5e

Data expressed as mean ± SD. Means not sharing a common letter within the same column is seemed significantly different according to Tukey's posthoc test at a significant level of $P \leq 0.05$.

Traits of CB14 cotton bolls exposed to jassid management with different insecticides is presented in Table 5. Number of locule was highest for Panel 50 SC (4.4 ± 0.2a), which was statistically similar with Siren 25.9% EC, Tundra 20SP, Actos 1.8EC, Asatap 75SP. While, control (3.6 ± 0.2b) showed the lowest locule(number). Panel 50SC exhibited the highest boll length (5.8 ± 0.0 cm) and the largest diameter (3.8 ± 0.3 cm). Confidor 70WG (5.4 ± 0.0 cm) and Actos 1.8EC (5.3 ± 0.1 cm) also showed relatively high boll lengths. The control treatment had the shortest boll length (4.2 ± 0.3 cm). In terms of boll diameter, Panel 50SC (3.8 ± 0.3a) showed highest diameters, which was followed by confidor 70WG (3.7 ± 0.3a), Actos 1.8EC (3.6 ± 0.2 cm), and Talstar 2.5EC (3.5 ± 0.2 cm). While the control and treatments like Tundra 20SP and Ripcord 10EC had smaller diameters. Boll weight was highest for Panel 50 SC (14.0 ± 0.3a) and lowest for control (13.3 ± 0.2ab) treatment.

According to Amin *et al*. 2016, sucking insects like jassids, aphids infestation and application of insecticide

Table 5. Traits of CB14 cotton bolls exposed to jassid management with different insecticides

Insecticides	Traits of a boll			
	Locule (number)	Length (cm)	Diameter (cm)	Weight (g)
Actos 1.8EC	4.0 ± 0.2a	5.3±0.1ab	3.6 ± 0.2ab	13.7 ± 0.3ab
Asatap 75SP	4.0 ± 0.1a	4.7±0.2bc	3.2 ± 0.1ab	13.6 ± 0.2ab
Tundra 20SP	4.1 ± 0.2a	4.7±0.0bc	3.1 ± 0.1b	13.5 ± 0.3ab
Talstar 2.5EC	4.2 ± 0.1ab	4.8±0.1b	3.5 ± 0.2ab	13.9 ± 0.3a
Confidor 70WG	4.3 ± 0.2ab	5.4±0.0ab	3.7 ± 0.3a	13.8 ± 0.3a
Spike 25 WG	3.7 ± 0.2a	5.3±0.0ab	3.4 ± 0.2ab	13.4 ± 0.3ab
Siren 25.9% EC	4.3 ± 0.2b	4.5±0.3bc	3.3 ± 0.2ab	13.9 ± 0.3a
Ripcord 10EC	3.9 ± 0.2a	4.4±0.2c	3.2 ± 0.1ab	13.5 ± 0.2ab
Panel 50SC	4.4 ± 0.2b	5.8±0.0a	3.8 ± 0.3a	14.0 ± 0.3a
Control	3.6 ± 0.2a	4.2±0.3d	2.7 ± 0.1c	13.3 ± 0.2ab

Data expressed as mean ± SD. Means not sharing a common letter within the same column is seemed significantly different according to Tukey's posthoc test at a significant level of $P \leq 0.05$.

Table 6. Yield and quality traits of CB14 cotton variety exposed to jassid management with different insecticides

Insecticide	Yield (t/ha)	Quality	
		GOT (%)	Lint index
Actos 1.8EC	0.9 ± 0.7ab	34.1±0.3b	7.3±0.1ab
Asatap 75SP	0.7 ± 0.3de	31.8±0.7bc	6.2±0.2bc
Tundra 20SP	0.7 ± 0.7de	30.4±0.4c	5.2±0.2cd
Talstar 2.5EC	0.9± 0.3ab	32.6±0.3bc	6.9±0.2ab
Confidor 70WG	1.2 ± 0.7ab	35.2±0.2ab	7.4±0.1ab
Spike 25 WG	1.2 ± 0.4ab	33.3±0.4bc	7.1±0.2ab
Siren 25.9% EC	0.7 ± 0.0de	26.2±0.6d	3.8±0.2e
Ripcord 10EC	0.6 ± 0.5e	25.6±0.8d	3.6±0.2e
Panel 50SC	1.4 ± 0.9a	36.2±0.3a	8.0±0.3a
Control	0.3 ± 0.9f	11.9±1.0e	2.5±0.2e

Data expressed as mean ± SD. Means not sharing a common letter within the same column is seemed significantly different according to Tukey's posthoc test at a significant level of $P \leq 0.05$.

reduced protein, starch content which turn into reduction to traits of boll, boll per plant, locule number, ginning out term.

Yield and quality traits obtained from CB14 cotton variety when cultivated under different insecticide treatments is presented in Table 6 and showed significant differences. Panel 50SC achieved the highest yield of 1.4 ± 0.9 tons/ha. Confidor 70WG and Actos 1.8EC both had high yields of 1.2 ± 0.7 and 0.9 ± 0.7 tons/ha, respectively. Ripcord 10EC yielded 0.6 ± 0.5 tons/ha significantly lower than the other treatments, except for the control. Control produced the lowest yield at 0.3 ± 0.8 tons/ha, labeled f, which is significantly different from all other treatments. Panel 50SC achieved the highest GOT at 36.2% and the highest lint index of 8.0. Asatap 75SP and Tundra 20SP yield showed lower GOT percentages and lint indices. The Control treatment shows the lowest values for both GOT (11.9%) and lint index (2.5).

Our study confirms that untreated fields produce significantly lower yields compared to those treated

with insecticides, a pattern also observed by Sarwar and Sattar (2016). They reported a sharp reduction in yield for untreated fields, with notable improvements in fields treated with monocrotophos and endosulfan. Our study also supports the GOT range of Hossain *et al*. (2012) where the range was <40%.

Conclusion

From the above-analyzed results, it can be concluded that trade name Panel 50SC with the lowest jassid counts, the highest mortality rates, and the best cotton yield metrics can be beneficial for cotton growers. Confidor 70WG and Actos 1.8EC also performed well, with high efficacy in mortality and yield traits, while Talstar 2.5EC and Spike 25 WG showed moderate results. Asatap 75SP and Tundra 20SP were less effective, and Siren 25.9% EC and Ripcord 10EC displayed minimal impact, particularly in controlling jassid counts and improving GOT. The control consistently had the poorest outcomes, highlighting the benefits of insecticidal treatments.

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