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COMPARATIVE EFFICACY OF VARIOUS DOSAGES OF KURTUMA (*CITRULLUS COLOCYNTHIS*) AND AKK (*CALOTROPIS GIGANTEA*) AS BIO-PESTICIDES FOR PINK BOLLWORM (*PECTINOPHORA GOSSYPIELLA*) CONTROL IN COTTON CROPS UNDER ARID CONDITIONS

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ABSTRACT

In 2022, experiments were carried out at the Adaptive Research Farm in Karor District Layyah, Punjab, Pakistan, as well as on a farmer's field in Tehsil Karor District Layyah. The focus was on assessing the effectiveness of different doses of Elatorium and Akk, both bio-pesticides, against the pink bollworm affecting cotton (*Gossypium hirsutum* L) crops in arid conditions. The study employed a Randomized Complete Block Design (RCBD) with four treatments: T1. Elatorium @ 10% solution, T2. Elatorium @ 20% solution, T3. Akk @ 10% solution, and T4. Akk @ 20% solution, each replicated three times. The highest yield recorded was 1639.4 kgha-1 in T2 (Elatorium @ 20% solution), which was significantly superior to all other treatments. hese findings suggest that integrating bio-pesticides like Elatorium and Akk into pest management strategies can effectively combat the pink bollworm, reduce dependency on synthetic chemicals, and promote sustainable agricultural practices in arid regions.

Keywords: Cotton, *Pectinophora gossypiella*, Pesticides, Arid zone, Pakistan

INTRODUCTION

Cotton stands as a cornerstone natural fiber in the global textile industry, playing a pivotal role in numerous economies worldwide, notably in countries like Pakistan (Aiken, 2006). Beyond its direct textile applications, cotton seeds contribute significantly to various sectors, constituting approximately 80% of Pakistan's oilseed production (Rehman et al., 2019). However, despite its economic importance, cotton cultivation faces formidable challenges, exacerbated by factors such as adverse weather conditions and pest infestations.

In the 2022-23 season, Pakistan witnessed a notable 10.7% surge in cotton cultivation, yet this achievement was overshadowed by a distressing 41.0% decline in production due to devastating floods primarily affecting regions like Sindh and Baluchistan (Economic Survey of Pakistan, 2022-2023). Among the myriad challenges confronting cotton production, insect pests pose a particularly formidable threat, with the pink bollworm emerging as a prominent menace in recent years (Ghosh, 2001).

The pink bollworm, scientifically known as *Pectinophora gossypiella*, has established itself as one of the most destructive pests targeting cotton crops. Conventional insecticidal methods have struggled to effectively control its proliferation (Lykouressis *et al.*, 2005). Feeding on cotton bolls, damaging seeds, and ultimately reducing yields, pink bollworms inflict significant economic losses on cotton growers, rendering affected bolls unmarketable and exacerbating the already precarious economic conditions (Tabashnik *et al.*, 2008; Pusztai and Carey, 2011).

In Pakistan alone, the annual losses attributed to pink bollworm infestations are estimated to be around one million bales, underscoring the urgency of finding sustainable pest management solutions (Ahmed, 2013). The overreliance on chemical insecticides has not only strained economic resources but has also led to environmental degradation and the emergence of pesticide resistance among pest populations (Ayaz *et al.*, 2020; Dhurua and Gujar, 2011).

However, amidst these challenges, there exists a ray of hope in the form of botanical extracts with inherent insecticidal properties. These extracts offer an environmentally friendly alternative to conventional chemical insecticides and hold promise for application in organic farming practices (Isman, 2006). Moreover, the accessibility of natural plants from which these bio-pesticides are derived makes them a feasible and cost-effective solution for farmers across Pakistan's agricultural landscape (Khuhro *et al.*, 2014).

Recognizing the imperative to address the menace of pink bollworm infestations, mitigate economic losses in cotton production, and explore sustainable pest management strategies, our research endeavors to evaluate the efficacy of botanical extracts in controlling pink bollworm populations on cotton crops. Through rigorous experimentation and analysis, we seek to contribute to the advancement of sustainable agricultural practices and the resilience of cotton farming communities against pest-related adversities.

MATERIAL AND METHOD

Location: In 2022, experiments were conducted at two locations: the Adaptive Research Farm in Karor Zone Layyah and a farmer's field in Mauza Sargani, Tehsil Karor, District Layyah. The experimental design followed a Randomized Complete Block Design (RCBD) with three replications. Cotton cultivar NIAB-878 was planted at a seed rate of 25 kg/ha. Fertilizers containing nitrogen, phosphorus, and potassium (NPK) were applied according to recommended guidelines, and standard agronomic practices were followed throughout the crop's growth period.

Treatments: The trials consisted of four treatments including T1: Elatorium @ 10% solution, T2: Elatorium @ 20% solution, T3: Akk @ 10% solution, T4: Akk @ 20% solution. Each treatment was replicated three times. Treatments were applied following proper pest scouting of Pink Bollworm.

Parameters: Various growth parameters were recorded including Plant height (cm), Number of bolls per plant, Boll weight (gm), Yield (kg/ha).

Statistical Analysis: Data from each location was analyzed separately using analysis of variance (ANOVA) technique. The difference among treatment means was compared using the least significant difference test at a 5% probability level (Steel *et al.*, 1997).

RESULTS

Average Pest Population Before Spray: Data presented in Tables 1 and 2 at both locations showed statistically significant differences among all treatments regarding the average population of pink bollworm. Table 1 reveals that the minimum population of pests was observed in treatment T1 (6.66), where the biopesticide Elatorium was applied at a 10% solution, which is statistically similar to all other treatments: T2 (8.33), T3 (7.33), and T4 (7.66), where biopesticides Elatorium @ 20%, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Similarly, data presented in Table 2 showed a similar trend in pest population as observed in Table 1.

Pest Scouting After 72 Hours of Spray: Data presented in Tables 1 and 2 at both locations showed statistically nonsignificant differences among all treatments regarding the average population of pests. Table 1 indicates that the minimum population of pests was recorded in treatment T1 (4.0), where biopesticides Elatorium @ 10% solution was applied, which is statistically similar to all other treatments: T2 (4.66), T3 (4.0), and T4 (4.33), where biopesticides Elatorium @ 20% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Data presented in Table 2 showed a similar trend in results as observed in Table 1.

Pest Scouting After 7 Days of Spray: Data presented in Tables 1 and 2 at both locations showed statistically similar populations of pests among all treatments. Table 1 illustrates that the minimum population of pests was recorded in T1 (5.33), where biopesticides Elatorium @ 10% solution was applied, which is statistically similar to treatments T2 (7.33), T3 (6.0), and T4 (6.33), where Elatorium @ 20% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Data presented in Table 2 showed a similar trend of results as observed in Table 1.

Average Plant Height (cm): The data presented in Tables 1 and 2 showed significant differences among the treatments regarding the plant height (cm) of cotton in both locations. Table 1 shows that the maximum plant height (168.6) was recorded in T2, where biopesticides Elatorium @ 20% solution was applied, which is statistically significant compared to treatments T1 (159.0), T3 (155.19), and T4 (150.48), where Elatorium @ 10% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Similarly, data presented in Table 2 revealed that the maximum plant height (166.8) was recorded in T2, where biopesticides Elatorium @ 20% solution was applied, which is significantly similar to

treatments T1 (156.75), T3 (154.24), and T4 (149.85), where Elatorium @ 10% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively.

Table 1. Pest scouting and impact on growth parameters (Average of three replications) Location: ARF karor.

Treatments	P. Scouting			Average plant height (cm)	Average number of bolls	Average boll weight (g)	Average Yield ($kgha^{-1}$)
	before 24 hours	after 72 hours spray	after 7 days spray				
Elatorium 10% Solution	6.66 a	4.00 a	5.33 a	159.0 b	52.30 bc	2.73 b	1208.7 b
Elatorium 20% Solution	8.33 a	4.66 a	7.33 a	168.6 a	56.01 a	3.15 a	1639.4 a
Akk 10% Solution	7.33 a	4.00 a	6.00 a	155.19 c	49.63 c	2.64 b	1110.6 b
Akk 20% Solution	7.66 a	4.33 a	6.33 a	150.48 d	54.83 ab	3.03 a	1632.2 a

Average Number of Bolls per Plant: Data presented in Tables 1 and 2 at both locations showed statistically significant differences among the treatments regarding the average number of bolls per plant. The maximum number of bolls per plant was recorded in T2 (56.01), where biopesticides Elatorium @ 20% solution was applied, which is statistically significant compared to treatment T1 (52.30), T3 (49.63), and T4 (54.83), where Elatorium @ 10% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Data presented in Table 2 showed a similar trend of results as observed in Table 1. Similarly, data presented in Table 2 showed a similar trend of results as observed in Table 1.

Table 2. Pest scouting and impact on growth parameters (Average of three replications) Location: Mauza Sargani Tehsil Karor District Layyah.

Treatments	P. Scouting			Avr. plant height (cm)	Average number of bolls	Average boll weight (g)	Average yield ($kgha^{-1}$)
	before 24 hours	after 72 hours spray	after 7 days spray				
Elatorium 10% Solution	5.33 a	4.66 a	6.66 a	156.75 b	50.35 bc	2.86 b	1813.8 b
Elatorium 20% Solution	7.33 a	4.66 a	8.66 a	166.8 a	54.89 a	3.31 a	2183.8 a
Akk 10% Solution	6.66 a	5.0 a	7.33 a	154.24 b	47.77 c	2.76 b	2013.8 a
Akk 20% Solution	7.0 a	5.33 a	7.66 a	149.85 c	52.79 ab	3.16 a	2177.2 a

Average Boll Weight (g): Data presented in Tables 1 and 2 at both locations show significant differences among the treatments regarding average boll weight. The maximum average boll weight was recorded in T2 (3.15), where biopesticides Elatorium @ 20% solution was applied, which is statistically significant compared to treatment T1 (2.73), T3 (2.64), and T4 (3.03), where Elatorium @ 10% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Data presented in Table 2 indicated a similar trend of results as observed in Table 1.

Average Yield (kg/ha): The data pertaining to cotton yield in Tables 1 and 2 at both locations showed significant differences among the treatments. The analysis of data regarding cotton yield, as indicated in Table 1, shows that the maximum yield was recorded in T2 (1639.4 kg/ha), where biopesticide Elatorium @ 20% solution was applied, which is significantly different from treatments T1 (1208.7 kg/ha), T3 (1110.6 kg/ha), and T4 (1632.2 kg/ha), where Elatorium @ 10% solution, AKK @ 10% solution, and AKK @ 20% solution were applied, respectively. Similarly, data presented in Table 2 showed a similar trend of results as observed in Table 1.

DISCUSSION

The results for both locations showed that the efficacy of different plant extracts and their doses against the population of pink bollworm varied significantly at different intervals. Initially, all treatments showed statistically similar pink bollworm populations. Treatment T1, using Elatorium 10% solution, had the lowest pest population, similar to other treatments. After 72 hours of spraying, no significant differences were observed among treatments at both locations. T1

remained the most effective, similar to other treatments. Seven days after spraying, all treatments exhibited statistically similar pink bollworm populations. Treatment T2, using Elatorium 20% solution, resulted in the tallest plants, significantly different from other treatments. T2 also had the highest number of bolls per plant, significantly different from the rest. Regarding boll weight, T2 with Elatorium 20% solution had the highest, significantly different from other treatments. The observed differences in yield and plant quality among cotton varieties were clearly influenced by the use of various plant extracts that effectively controlled pink bollworm in the cotton field, and similar findings were reported by numerous researchers who have also documented the positive impact of plant extracts on cotton crop health and yield (Phillips, 2005; Dutt, 2007; Bardin *et al.,* 2008; Rafiq *et al.,* 2012). The highest cotton yield was achieved in T2, where Elatorium 20% solution was applied, significantly differing from other treatments.

CONCLUSION

In conclusion, the study revealed that treatment T2, which incorporates Elatorium 20% solution, consistently demonstrated superior performance compared to other treatments across multiple parameters, including pest control, plant height, boll number, boll weight, and cotton yield. These findings strongly indicate that T2 stands out as the most effective treatment for optimizing cotton crop management.

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