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Research Article

ENTOMOCIDAL POTENTIAL OF BOTANICAL EXTRACTS AGAINST JASSID (*AMARASCA BIGUTTULA BIGUTTULA*) IN OKRA *ABELMOSCHUS ESCULENTUS* L.

Romana Naveed[1], Muhammad Ali[*1], Muhammad Ashfaq[2], Muhammad Mamoon-ur- Rashid[3], Asif Latif[4] Gul Shafae[1]

[1] *Department of Entomology, Faculty of Agricultural Sciences, University of the Punjab, Lahore, Pakistan.*
[2] *Department of Plant Breeding and Genetics, Faculty of Agricultural Sciences, University of the Punjab, Lahore, Pakistan.*
[3] *Department of Entomology, Faculty of Agriculture, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan.*
[4] *Department of Horticulture Faculty of Agriculture, Gomal University Dera Ismail Khan, Khyber Pakhtunkhwa, Pakistan.*
Corresponding author: **ali.iags@pu.edu.pk*

Abstract

Okra a verdant vegetable, is a member of the Malvacae family. Many insect pests attack okra crop but jassid (*Amrasca biguttula biguttula*) is one of the most devastating sucking pests causing significant losses. Laboratory and field investigations were carried out to find out the efficacy of biopesticides against the jassid, on okra crop at the Faculty of Agricultural Sciences, University of Punjab, Lahore. *A. Esculentus* seeds were sown in a randomized complete block design with four replications in March 2023. Treatments applied were T_0 (control), T_1 *Citrullus colocynthisis* extract), T_2 (*Datura stramonium stramonium* extract), T_3 (*Eucalyptus globulus* extract), T_4 (*Ferula* as*safoetida* extract), T_5 (*Nicotiana tabacum* extract), and T_6 (Detergent) as the least hazardous chemical for comparison. A 20% v/v concentration of each treatment was applied as the pest population peaked. Pre-treatment observations were made 24 hours before the application of biopesticides, while post-treatment observations were made at 24, 48, and 72-hour intervals, as well as after one week and ten days. The results showed that all the bio-pesticides reduced the jassid population by up to one-week intervals under laboratory and field conditions. Under field conditions, the *N. tabacum* extracts reduced the per leaf population up to 78%) followed by *F.* as*safoetida* (77%), *C. colocynthisis* (63%), *E. globulus* (51%), *D. stramonium* (42%) and Detergent (25%). In the contrary, no significant differences were observed among *N. tabacum* extract, *F.* as*safoetida*, and *C. colocynthisis* extracts after 72 hours. It is concluded that bio-pesticides derived from *N. tabacum*, *F.* as*safoetida*, and *C. colocynthis* are highly effective to combat the jassid infestation.

Keywords: Okra, Sucking pests, Jassid, *Amrasca biguttula biguttula*, ETL, Plant extracts.
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1. INTRODUCTION

Abelmoschus esculentus, also known as bhindi, okra, and lady finger has dietary importance among vegetable crops commercially and as a garden crop (Hathi et al., 2022; Saifullah and Rabbani, 2009). Tropical Africa is the origin of the Abelmoschus species, which belongs to the Malvaceae family. Pakistan ranked fifth among the top producers of okra, contributing 1.3% to global output (Saleem et al., 2020). In Pakistan, okra cultivation accounts for 1.2% of all vegetable production. Punjab leads all other provinces in okra production, contributing 57.3%, followed by Baluchistan at 15.5% and KPK and Sindh at 13.9% and 13.3% (Khokhar, 2014). Okra is primarily grown in the summer on sandy loam soil with a pH range of 6–7 an ideal temperature of about 30–

35°C and relative humidity levels between 65 and 85% (Adilakshmi et al., 20008; Akanbi et al., 2010). Okra's biodiesel potential and tolerance to diverse climates make it a popular agricultural crop, due to culinary demand, health benefits and commercial use. (Ahmed et al., 2021). Okra is largely water (90%) and includes 7% carbs, 2% protein, 3% dietary fibre and essential vitamins A and C (Rajani et al., 2022). Its historical uses encompass treating wounds, pneumonia, ulcers, and diabetes using different plant parts (Agerin et al., 2002). In Pakistan, okra crop was grown on an area of 15713 hectares having a total production of 120637 tons (FAOSTAT, 2018). The low yield in contrast to other okra-growing countries is attributed to some biotic and abiotic variables (Hussain and Mukhtar, 2019; Ram, et al., 2022). One of the key elements that have an impact on Pakistan's okra output is pest attacks. The chewing and sucking pests are among the destructive pests. About 72 species have been reported for attacks on Bhindi, including Amarasca biguttula, Bemisia tabaci, Earias vittella, Helicoverpa armigera, Aphis gossypii, and Tetranychus cinnabarinus, etc (Rahman et al., 2012). Jassid, whitefly, thrips, and aphids are the four diverse types of sucking insect pests that affect the Malvaceae family member plant (okra) in Pakistan (Anonymous, 1993). Jassid is a multi-voracious insect that damages a variety of crops, earning it the nickname "the Devastator". It has the potential to diminish plant height by 49.8%, the number of leaves by 45%, and yield by 63.41%. Jassid infestations in okra can result in considerable yield losses, slowed growth, and lower crop quality (Smith et al., 2019). Damage signs of a jassid attack include leaf wilting, reddening of the leaf margins, downward curling of the leaves, and crumbled and broken leaf margins (Chandrasekaran et al., 2021).

Pesticides are used by farmers to control pests in roughly 90% of cases (Prayogo et al., 2005). When all other methods failed to protect the crop from the main targeted pest, chemical control of insect pests became essential (Raza and Afzal, 2000). The indiscriminate use of these artificial substances leads to several issues (Malik et al., 2015). Their sloppy usage caused food contamination (Mitra et al., 1999), the extinction of natural enemies' biodiversity (Sekhon and Verma, 1985), the spread of secondary pests (Praveen et al., 2001), and the disruption of food webs in the environment (Krishnamurthy, 1999), promotes the growth of resistance and revival problems (Dash et al., 2022). People started calling for sustainable agriculture and a safe environment as a result of their increased awareness of the risks associated with pesticide usage (Bolzonella et al., 2019). To control the jassid population, efficient management techniques that are beneficial to the environment should be used as alternative to synthetic, persistent, and non-selective pesticides. (Ghosh and Chakraborty, 2015).

Biopesticides like plant extracts hold a key position in integrated pest management based on assessments of their safety for predators, parasitoids, and pesticidal efficacy (Rao et al., 1999). Plant extracts can effectively manage a variety of sucking insect pests, such as aphids, spider mites, jassids, and whiteflies (Bhutto et al., 2017). Biopesticides are gaining popularity as sustainable alternatives because of their targeted efficacy, biodegradability, and minimal impact on non-target organisms (Gopal et al., 2016; Isman, 2020; Gupta et al., 2020; Johnson and Davis, 2021). The Jassid population's (adults and nymphs) can be decreased by employing the plant material (Natarajan et al., 2000; Rosaiah, 2001). The seeds of the Azadirachta indica, Ferula assafoetida, Nicotiana tabacum, Calotropis procera, Allium sativum, Chrysanthemum cineraria folium, Cymbopogon citratus, Ecogold, Alata soap and red chilli peppers showed pest reduction or oviposition deterrence effect (Paul and Sarkar, 2023; Lalruatsangi, 2022; Jan et al., 2022; Gul et al., 2021; Kunbhar

et al., 2018; Ali et al., 2017; Ghosh et al., 2015; Shabozoi et al., 2011; Mochiah et al., 2011; Radwan et al., 2000). Nicotiana tabacum (nicotine), Ferula assafoetida and eucalyptus scent repel jassids, Gum arabic's stick jassids, extracts or powdered Datura stramonium leaves and the soapy solution can smother and kill jassids (Koul, 2004; Dubey et al., 2012; Ahmed et al., 2013; Kumar et al., 2014; Mazumder et al., 2017). Bio-pesticides based on entomopathogenic nematodes (EPNs) effectively combat Jassids (Yasir et al., 2022).

The current state of affairs demands the dissemination of knowledge on how to use herbal plants for okra to combat insect infestations. The increasing concerns about the toxic effects of chemical insecticides on human health and the environment demands the use of safer alternatives for the management of insect pests. This is why the study aims to identify an effective method of controlling jassid using biopesticides that can help protect both human health and the environment.

2. Materials and Methods

2.1. Location of experiment setup

The desi Okra was grown in the Faculty of Agricultural Sciences, University of the Punjab, Lahore, Punjab, Pakistan. The experimental farm was located at longitude (31.4790^{o} N) and latitude (74.2662^{o} E). The okra seed was acquired from the vegetable seed market in Lahore.

2.2. Laboratory experiment

For the laboratory experiment, the leaf of okra was collected from the field and treated with the plenty of water to remove dust particles. After that, the leaf was treated with the selected botanicals at 20% concentration, the leaf was placed in 9cm Petri dishes. After half and hour of the treatment of the okra leaf, 20 adult jassids were released in the tested arena. The mortality of the adults was recorded after 24, 48, and 72-hour intervals, as well as after one week and ten days. The corrected mortality was calculated by deducting the mortality in the control from the treatments mortality to find out the effect of tested botanical extracts.

2.3. Preparation of land

The field was ploughed with a power tiller and left for a few days to get optimal soil texture. Once the appropriate tilth was achieved for seed sowing, the experimental field was repeatedly ploughed and clods were crushed. The area was then divided by the experimental pattern after weeds, stubbles, and dead roots were removed from the soil. Raised edges were used on the experimental units to monitor the runoff of nutrients and water. The study was carried out using a Randomized Complete Block Design (RCBD) with three replicates for each treatment.

2.4. Cultural practices

On ridges, the sowing of hhealthy and homogenous seeds was carried out with a 50 cm R ×R and 22 cm P × P spacing. Early sowing with a seed rate of 10 kg/acre was carried out in April. The most effective tools were used throughout the growing season to carry out the necessary intercultural operations. Kept the field under tight observation to make this possible. Intercultural practices such as Gap filling, weeding, irrigation and drainage were done to promote germination, plant growth and increase production.

2.5. Preparation and Application of plant extracts

Biopesticides applied in the experiment include detergent and extracts of Ferula assafoetida, Nicotiana tabacum, Eucalyptus globulus, Citrullus colocynthis and Datura stramonium stramonium. All treatments were applied at 20% concentration. Soxhlet equipment was used to produce extracts using methanol as a solvent (Schwanninger et al., 2002). Dried fruits of Citrullus colocynthisis and seeds of Datura stramonium stramonium were well-grounded using a pestle and mortar. Detergent was used in liquid form and Ferula assafoetida in powder form. Dried leaves of Nicotiana tabacum, and Eucalyptus globulus were mashed using a pestle and mortar. All treatments were

applieded at a concentration of 20%. T0= Control, T1= C. colocynthis extract, T2= D. stramonium extract, T3= E. globulus extract, T4= F. assafoetida extract, T5= N. tabacum extract, T6= Detergent. The hand atomizer was employed to effectively apply the herbal spray, addressing the pest populations that were observed to reach at Economic Threshold Level (ETL). The crop received a single application of biopesticides.

2.6. Data Collection and Analysis

The mean Jassid population per leaf was calculated before and after application of botanical extracts. Jassid count was carried out on ten leaves in every experimental unit. The Jassid population was manually counted in the field. The percentage reduction in pest population was calculated using the formula;

% Reduction of population= (Initial pest population- final pest population / Initial pest population) × 100

Recorded Data was statistically analyzed using Statistics 8.1 Software. To compare mean values, recorded data were transformed into the average population. Means were differentiated using the LSD test (Gomez & Gomez, 1984) and ANOVA tables were created.

3. Results:

3.1. Laboratory Trial

All the tested botanical extracts were found effective when tested against okra jassids under laboratory conditions (Fig-1). The mortality of the jassids increased by increasing the exposure period of botanical extracts. Among the tested botanical extracts, the *N. tabacum* extracts were found most effective followed by *F. assafoetida,* and *C. colocynthis* extracts. The maximum (94.00, 86.00 and 83.00%, mortality was observed on leaves treated with *N. tabacum, F. assafoetida,* and *C. colocynthis* extracts at ten days after the treatment of okra leaves. The mortality of the jassids increased gradually from 24 hours after the application to seven days, however; a slight increase in the mortality was observed after ten days of the application of botanical extracts. Among the tested treatments, the detergent powder was found least effective and resulted in less than 50% mortality of the jassids at all the post-treatment intervals. It was followed by *D. stramonium* extracts resulting in more than 50% mortality after seven and ten days after treatment.

3.2. Field Trial

The findings in Figure (2) showed that the use of different bio-pesticides had a significant impact on jassid infestations on okra crops. Compared to the untreated control, the jassid population decreased in all treated plots. The percentage of reduction varied considerably between the evaluated products. The data collected after 24 hours of application revealed significant variations across the treatments. The largest reduction in the jassid population after 24 hours was observed on okra plants treated with N. tabacum extract (2.08/leaf) when compared with control. In contrast, when okra plants were treated with detergent, the maximum population of jassids (4.24/leaf) was observed. F. assafoetida, C. colocynthis, E. globulus and D. stramonium extract were also successful at controlling jassids, providing 2.41 and 3.08, 3.37 and 3.9 jassids per leaf, respectively.

It was also discovered that the trend of all bio-pesticides stayed the same at 48 hours after spraying. N. tabacum extract was most effective in reducing jassids (1.63/leaf), followed by F. assafoetida extract (2.02/leaf), C. colocynthis extract (2.34/leaf), E. globulus extracts (2.45/leaf), and D. stramonium extract (2.78/leaf), whereas; detergent increased pest population (4.03 per leaf). After 48 hours, there was a considerable reduction in population of jassids.

After 72 hours of spraying bio-pesticides, the percentage of jassids in all products decreased. However, N. tabacum extract surpassed the others, with a higher pest reduction (0.89/leaf). F. assafoetida (0.94/leaf). Opposing this, C. colocynthis (1.49/leaf), E. globulus (1.97/leaf), D.

stramonium (2.34/leaf) and detergent (2.99/leaf) lost their ability to keep the pest population below ETL. According to ETL. But N. tabacum extracts, which reduced jassid by a greater amount (0.86/leaf), were significantly more

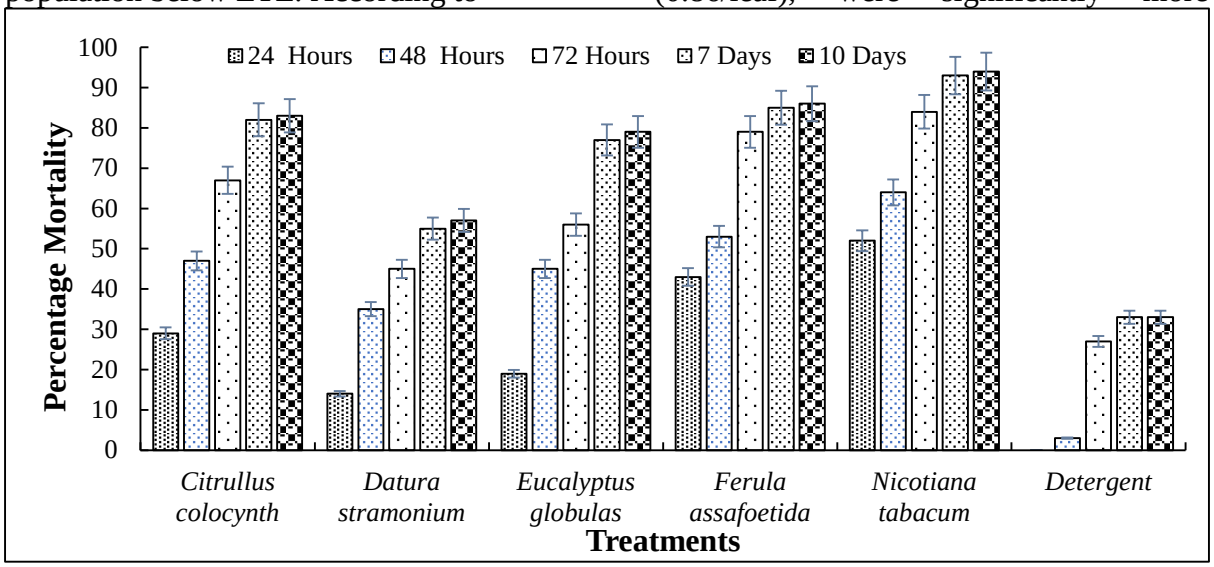

Figure 1. Effects of biopesticides on the mortality of jassids at various time intervals after application under laboratory conditions

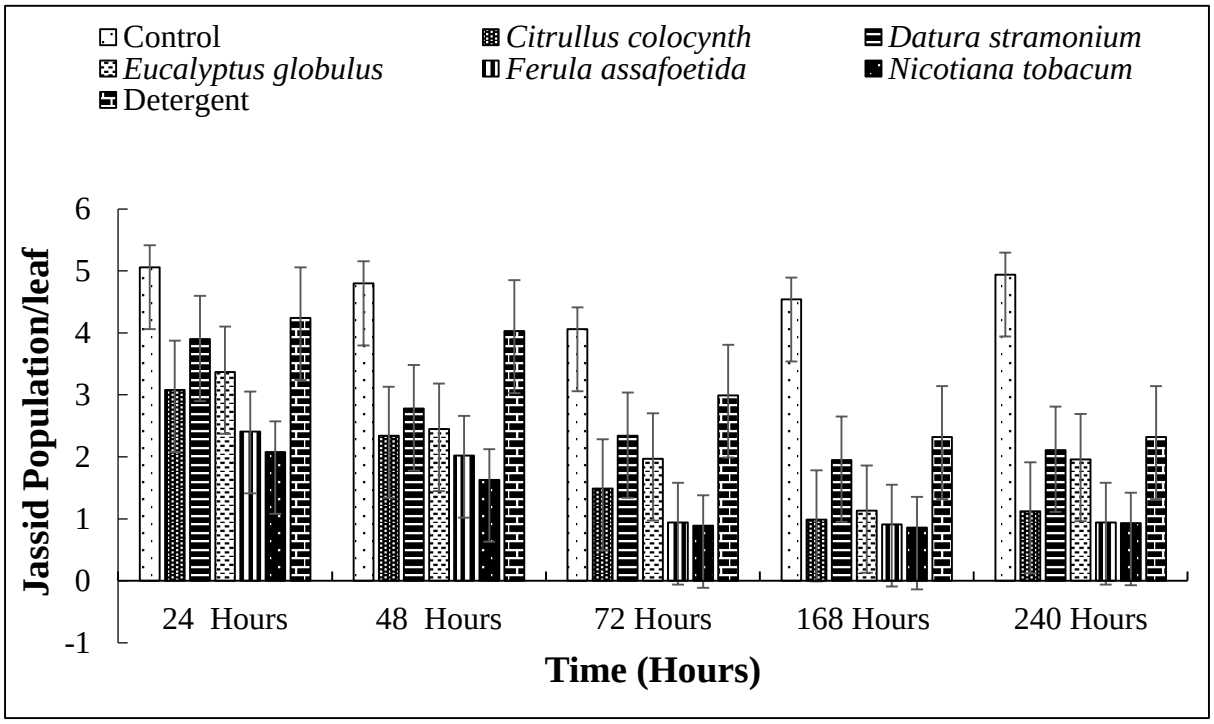

Figure 2. Effects of biopesticides on Jassids population at various time intervals after application under natural field conditions

statistical analysis, the differences in the reduction % between the biopesticides were highly significant.

The efficiency of all four bio-pesticides decreased after one week of application compared to the first 72 hours, but they still managed to keep insect populations below effective than F. assafoetida (0.91/leaf) and C. colocynthis extract (0.99/leaf). On the other hand, the population of jassids on E. globulus (1.13/leaf) treated plants was found near ETL. D. stramonium (1.95/leaf) and detergent (2.32/leaf) were found to be insufficient in bringing the jassid

population below ETL. The reduction of jassid was shown to differ significantly between treatments.

The data showed that a small decrease in the population of jassids was seen at 240 hours following the application of plant extracts as compared to 168 hours. Both the plots treated with N. tabacum and F. asafoetida extracts showed a small increase in the jassid population.

4. Discussion

Negative effects on crop growth, harvesting, and storage are observed in global food production, as about 50% of the entire crop is lost each year due to insect pest attack. Before using fresh veggies, the long-lasting impacts of the pesticides are also not considered. To combat the outbreak of various diseases, natural resources with some insecticidal qualities are being studied for this purpose. It is suggested to use safe botanical pesticides to control agricultural pests that are less effective against natural enemies and environmentally friendly (Noonari et al., 2016). The current study aimed to investigate the beneficial effects of several plant materials against the okra jassid. In this investigation, Nicotiana tabacum extract, which caused maximum mortality (78%) under natural field conditions was found to be the most efficient in treating the jassid (Amrasca spp.).

Different biopesticides are being utilised to control pests in crops having economic importance in the interest of sustainable agriculture. As more than 2400 plant species have been found to have anti-pathogenic and insecticidal capabilities, biopesticides are a growing trend right now (Karunamoorthi, 2012). The results of the Jan and Al-Shuraym (2022) study indicate that plant-derived extracts have a promising future as alternative pest management techniques since they effectively control insects while also having positive environmental impacts. The biopesticides, in a similar vein, showed only minor efficiency against the target pest and were kept below the threshold of economic harm (Solangi et al., 2015). The current study's findings are aligned with those of Mahmood and Eijaz (2014).

Results revealed that Nicotiana tabacum extract killed 99.57% jassid population, followed by Ferula assafoetida 59.89% while detergent reduced 59.64% after 7 days of treatment. The population of jassid decreases with an increase in exposure to biopesticides. The maximum reduction was noted after 7 days after application. The results are in complete conformity with the findings of Kunbhar et al. (2018). They reported that natural pesticides can lessen the number of aphids, whiteflies, jassids, and thrips. Nicotiana tabacum boosted whitefly and jassid mortality, and Citrullus colocynthis also showed considerable pest mortality. Similarly, neem extracts 96.08%, Nicotiana tabacum extract 95.63%, Citrullus colocynthis extract 86.17%, and Datura stramonium 70.94% exhibited the most efficacy against the jassid population, while dhatura had the lowest efficacy (Ursani et al., 2014). Similarly, Bhandari et al. (2022) documented that all the tested botanical extracts viz. Azadirachta indica), Cannabis sativa and Jholmol extracts caused significant reduction in the population of okra jassids under field conditions. In India, the neem extracts caused 60% reduction in the infestation of jassids by using A. indica extracts under field conditions (Ahmad, 2020). Our results confirm that Nicotiana tabacum extract carries strong insecticidal properties against jassid under field conditions.

The concept of biorational management must be strengthened by further scientific research that thoroughly analyses both its advantages and disadvantages. Without sufficient understanding, replacing synthetic chemicals willfully could endanger the market viability of biorationals. Decisions about whether biopesticides can effectively contribute to future pest management methods or need further improvement can be made by carefully evaluating these results.

5. Conclusion

The present investigation has confirmed that Nicotiana tabacum extract exhibited the maximum effectiveness against jassids after 168 hours of application, with Ferula assafoetida also showing promising outcomes. The adoption of N. tabacum is highly recommended as a proficient approach for managing jassid populations. This biopesticide provides a robust method for jassid control, concurrently promoting environmental preservation and human health, in contrast to conventional pesticides in okra farming.

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