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Research Article

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COMPARATIVE EFFICACY OF NEEM OIL DERIVATIVES WITH IMIDACLOPRID AGAINST OKRA JASSID, *AMRASCA BIGUTTULA BIGUTTULA* (ISHIDA)

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ABSTRACT

The present research study was conducted at the experimental field condition of Pakistan Agricultural Research Council, Southern Zone Agricultural Research Centre, University of Karachi, to compare the field performance of different neem oil derivatives doses with Imidacloprid, sprayed on okra crop against the jassid population. The experiments were carried out RCBD with the application of four treatments, including three different concentrations of neem oils at (2%, 1.5%, and 1%) with the comparison of Imidacloprid pesticide and control. Neem oil was selected as a natural pesticide against jassid population reduction on okra crop. All the treatments were sprayed twice and data were recorded before 24^{h} of pre-treatment and post-treatment at 24^{h}, 48^{h}, 72^{h}, and 144^{h}, respectively. The overall maximum reduction % after the application of Imidacloprid against the jassid population was calculated (61.51%) in 1st spray and (58.25%) 2nd spray, followed by (43.01%), (39.75%) at 2%, consequent to (32.50%), (29.75%), at 1.5% and (25.55%), (24.52%) at 1%, respectively. The maximum efficacy in neem oil concentration was recorded at 2% followed by 1.5%, and 1% but all neem oil concentrations including Imidacloprid observed effective from the 1st day up to the 6th post-spray days. All neem oil concentrations after 24^{h}, 48^{h}, 72^{h,} and 144^{h} of post-spray found significantly different at ($P< 0.05$). The application of neem oil, 2% caused the phytotoxicity reduction in okra plants. Thus, it is recommended that the bio-pesticide should be applied at 1.5% neem oil concentration against the jassid pest population.

Keywords: Efficacy, Imidacloprid, Jassid, Neem oil, Okra

INTRODUCTION

The origin of okra crop is said to be Ethiopia during the 12th century BC, spread from North Africa, Arabian countries, and India (Nzikou *et al.*, 2006). *Abelmoschus esculentus* belongs to the family malavaceae, frequently called as, ladies finger, guibeiro, guino-gombo, widely grown and utilized in different parts of the world (Naveed *et al*., 2009). Okra are used for thickening gravies and soup, mostly for cooking vegetables but also sliced and fried (Saifullah & Rabbani, 2009). This vegetable is the source of iron (1.5mg/100g), calcium (90mg/100g), vitamin C (30mg/mg), and minerals like magnesium and potassium (Biswas *et al*., 2009). The okra mucilage increases the inhibition of sugar absorption, cell glucose trapping and anti-diabetic activity (Chukwuma *et al*., 2018).

In Pakistan, okra crop is widely cultivated and grown an area about 14.465 thousand hectares with 109.239 thousand Tonnes production annually, only in Sindh, okra crop is cultivated on an area of 4.678 thousands hectares with 21.588 thousand tonnes annual production (Andras *et al*., 2005). Here several varieties of okra grown and each variety can be recognized due to pod quality, color, and height (Oyelade *et al*., 2003). The okra crop has been severely harmed by many species of insect pest species, the nymph and adult of these pests suck cell sap and transmit toxic saliva into the tissues ultimately plant lost their vitality and cause reduction up to 35% in yield production (Chowdhury *et al*., 2012).

Farmers are mostly using synthetic toxic insecticides for pest control that cause many problems like development of resistance in insect pest species and their resurgence creates food, water, soil, environmental pollution, destruction of beneficial fauna and flora and adverse human health issues (Akoto *et al*., 2015). Diseases like, nausea, headache, reproductive even cancer disorders occurs due to wide contact of insecticides (Bassil *et al.*, 2007), immuno-

toxicity, impaired development, endocrine and birth abnormalities may occur due to long-term exposure to insecticides (Berrada *et al*., 2010). The best approaches for controlling insect pest species is the application of bio-pesticides which are safe and eco-friendly with antifeedant, repellant power, reduce sterility, fitness, growth, cause restriction in oviposition of insect pests (Copping and Menn, 2000). For jassid, management the neem oil act as an eco-friendly option, contains biologically active ingredients, and hits the harmonic system of the insect pests (Akramuzzaman *et al*., 2018).

The neem oil components are broken down by microbes in the soil, there is no negative effect Azadirachtin application on non-targeted species including; pollinators, predators, parasitoids, birds, and their derivatives leave no toxic effect to pollute the environment (Ahmed *et al*., 2007). Including botanical insecticides, temperature fluctuations also effect on the life cycle of the insect pest species (Mastoi *et al*., 2023). The predators act as potential role in the reduction population of *A. biguttula biguttula* and variety of cotton insect pest species (Bhugro *et al*., 2022). IPM stable eco-friendly techniques are the best tool for the upcoming (Mangrio *et al*., 2020). Keeping in view; such type of research was performed to examine the efficacy of neem oil at different concentrations with the comparison of Imidacloprid against the population reduction of jassid in okra crop at Karachi, Sindh-Pakistan.

MATERIALS AND METHODS

Experimental area: Present research was carried out field condition at PARC- Southern Zone Agricultural Research Centre experimental area, located at the University of Karachi during July-August, 2022 to examine the comparative efficacy of different neem oil concentrations versus Imidacloprid against the population reduction of jassid in okra crop.

Experimental design: Through RCBD the experiment was performed with four treatments (2%, 1.5%, 1%,) concentrations of neem oils, Imidacloprid, and control. The plot size for each replication was maintained at (10x10 ft) 100 square feet. Each treatment was replicated twice and data of the jassid population was counted before 24^h of the spray and 24^h, 48^h, 72^h, and 144^h of post-spray. For counting the pre and post-treatment population of the jassid, *A. biguttula biguttula* (Ishida) in each replication five plants were selected randomly and jassid population density was recorded from the top, middle and bottom parts of the plant leaves. The neem oil concentrations and insecticide, Imidacloprid were applied with the help of a knapsack sprayer with 16 liters capacity. All agronomic practices were carried out in the whole experimental plot uniformly. The analysis of variance was done through the application of 8.1 statistics software version. Through the LSD test at 5% probability level, the mean values were compared. (Handerson and Tilton, 1955) the formula was used for the actual population reduction of jassid caused by different neem oil concentrations and Imidacloprid. Whereas; Ta, shows the population in the treatment plot in post-spray, Cb, the population in the control plot before spray, Ca, the population in the control plot after-spray, and Tb, the population in the treatment plot before spray, respectively.

$$\text{Corrected \%} = (1 - Ta \times Cb/Ca \times Tb) \times 100$$

Preparation and calculation of different doses of neem oil concentrations: The total four treatments, Imidacloprid, T1, neem oil C1 1%, T2, neem oil C2 1.5%, T3, neem oil C3 2% T4, and control were applied. Different doses of neem oil concentrations were calculated by using the V1×C1= V2× C2 formula. Before adding neem oil into the spray tank, the calculated quantity of neem oil was diluted in about half liter of lukewarm water for making the proper mixture. Moreover, one tablespoon of detergent (washing powder) was added to the spray tank for creating good emulsion.

RESULTS

Toxicant efficacy of Imidacloprid against population reduction % of Jassid: Imidacloprid insecticide found with maximum efficacy power against jassid population calculated at (78%) after 24^h followed by (65%) after 48^h (54%) after 72^h, and (49%) after 144^h, in 1^{st} spray. While as; in 2^{nd} spray population of the insect pest was reduced by (74%), (62%), (51%), and (46%) after 24^h, 48^h, 72^h, and 144^h, respectively. In both sprays, the given insecticide proved with maximum efficacy during 2^{nd} day followed by 3^{rd}, 4^{th} and 6^{th} days. Before, the application of insecticide, mean pest population was recorded in the control plat at (2.85), (3.00), (3.51), (3.72), and (3.75), in the first replication. In the second replication in the control plot, the jassid mean population recorded (2.88), (3.05), (4.81), (5.55), and (6.22), after 24^h, 48^h, 72^h, and 144^h, respectively. ANOVA shows the significant difference in the time duration of the jassid population % after post-treatment in both scheduled sprays at ($P < 0.05$) when the insecticide Imidacloprid was applied under the field cultivated okra crop at the experimental area the further justification given in (Figure. 1).

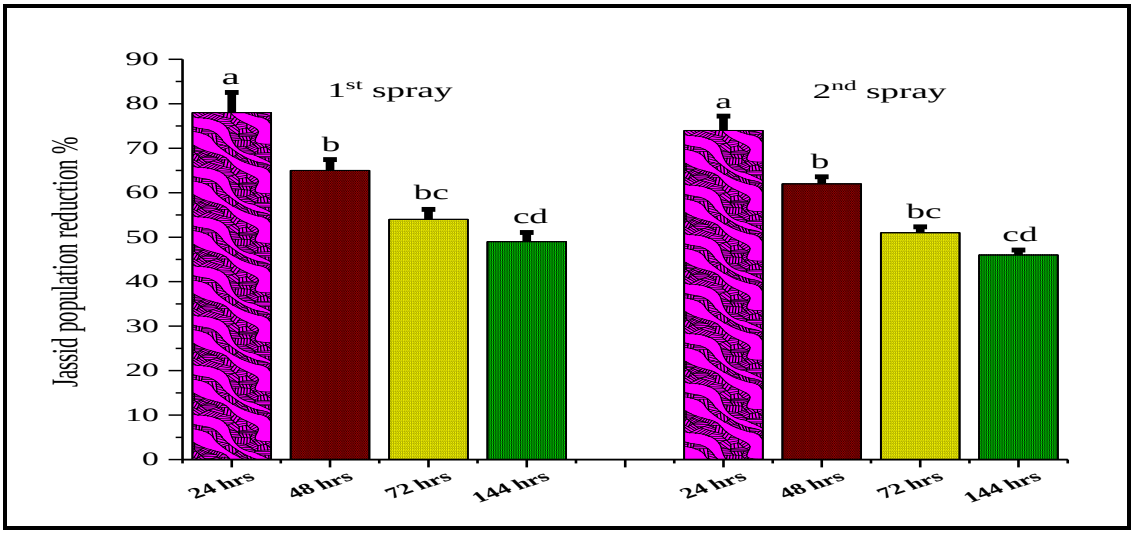

Figure. 1. Efficacy of Imidacloprid against population reduction % of Jassid during, 2022

Toxicant efficacy of 2% neem oil concentration against population reduction % of Jassid: The pre-data of the pest insect was taken in the control plot in both replications and found gradually increased. After the application of a given concentration of the botanical pesticide, the population reduction of the jassid was recorded (54%), (44%), (39%), and (35%) in 1st spray. Similarly, in 2nd spray, the population reduction of the pest counted (56%), (41%), (33%), and (29%), after 42h, 48h, 72h, and 144h, respectively. Results of the experiment revealed that at 2% neem oil concentration the maximum population of the pest significantly reduced on 2nd day followed by other post-spray days. The efficacy of neem oil concentration after 24h of spray considerably increased with maximum reduction of %. While the efficacy of neem oil concentrations gradually reduced after 144h of post-spray, respectively. The ANOVA found significant difference in pest population reduction % in time duration after post-treatment of both sprays at ($P< 0.05$) after the application of 2% neem oil concentration at okra field condition as shown in (Figure. 2).

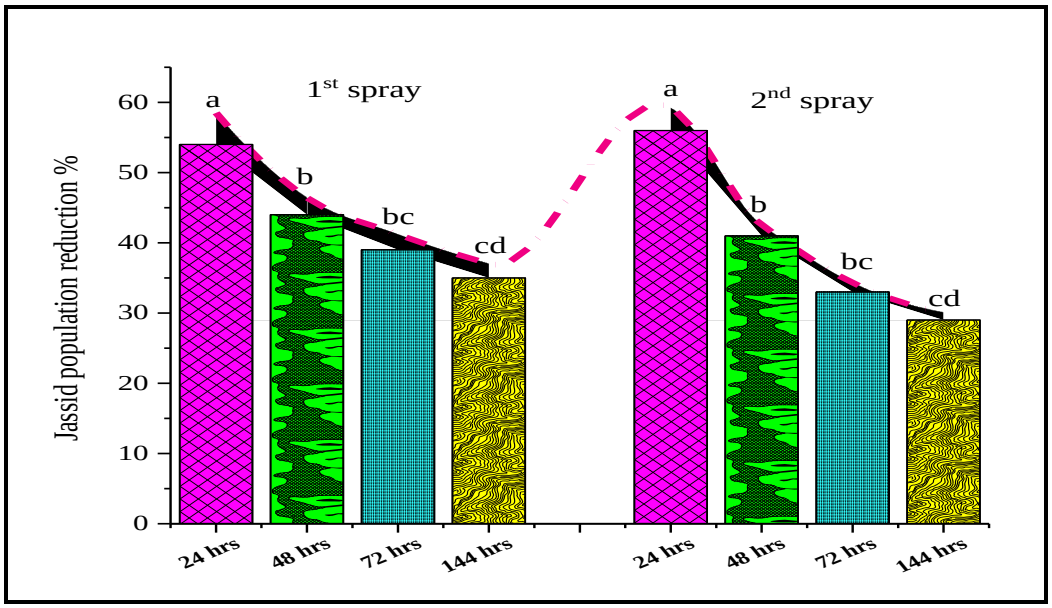

Figure. 2. Efficacy of neem oil 2% concentration against population reduction % of Jassid during, 2022

Toxicant efficacy of 1.5% neem oil concentrations against population reduction % of Jassid: In 1st spray, the 1.5% neem oil concentration against the population of the pest was recorded (36%), (33%), (28%), and (22%). Same way, the jassid population was reduced by (41%), (37%), (31%), and (21%), after 24h, 48h, 72h, and 144h, respectively. In both replications, the neem oil concentration significantly reduced the jassid population in treated plots. In the control plot, the population of the jassid gradually increased in both replications. After 24h of the first spray, 1.5% neem oil concentrations the jassid

population significantly reduced but gradually concentration reduced their efficacy after 144^{h} of the post-spray. After post-treatment in both scheduled sprays, significant difference was recorded in the jassid population reduction % at (P< 0.05) after the application of 1.5% neem oil concentration at field conditions further detail is given in (Figure. 3).

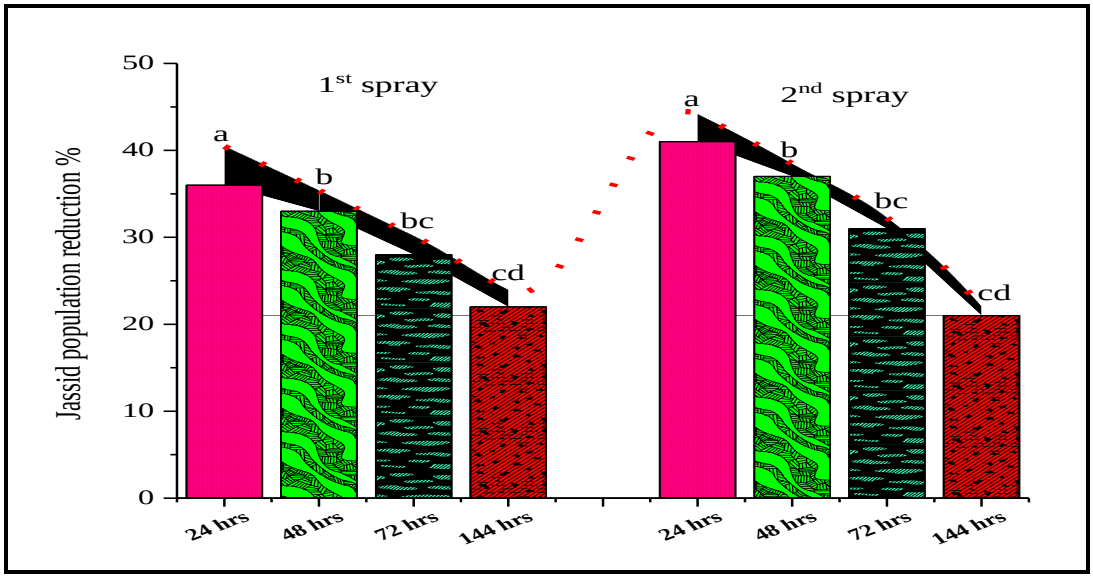

Figure 3. Efficacy of neem oil 1.5% concentration against reduction % of Jassid during, 2022

Toxicant efficacy of 1% neem oil concentrations against population reduction % of Jassid: The pre-data of the insect pest population were recorded from the control plot in both replications. It was recorded that the pest population gradually increased in the control plot. After the application of recommended dose of neem oil concentration the jassid population reduction % was recorded (32%), (27%), (22%), and (17%) in 1st spray. In 2nd spray the pest population reduction increased (35%), (25%), (23%), and (19%), after 24^{h}, 48^{h}, 72^{h}, and 144^{h}, respectively. The 1% neem oil concentration proved to maximum population reduction % in earlier the post-spray. The findings of the study showed that 1% neem oil concentration remained effective from 1st up to 6th post-spray days. While as in both replication, the population of the jassid increased in the control plot. When the insect pest data was statistically analyzed after both post-sprays found with significant difference at (P< 0.05) among the post-treatment hours at field condition with the application of 1% neem oil concentration, and further validation is shown in Figure. 4)

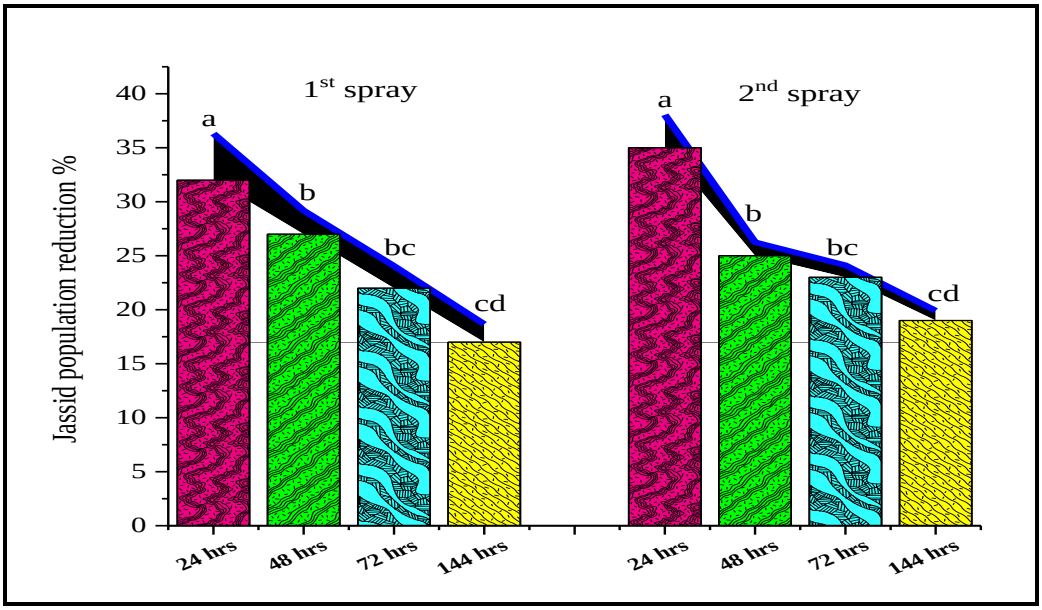

Figure. 4. Efficacy of neem oil 1% concentration against reduction % of Jassid during, 2022

Overall toxicity of Imidacloprid and neem oil concentrations against reduction % of Jassid: The overall toxicant effect of Imidacloprid against the jassid population reduction % was recorded (61.51%), and (58.25%) in both replications. The overall toxicity of 2% against jassid population reduction % counted (43.01%), and (39.75%) followed by 1.5% (29.75%), (32.51), and (24.52), (25.55%) at 1%, respectively. The efficacy of neem oil concentrations after 24^h of spray considerably increased and maximum reduction % in the jassid population occurred. The efficacy of neem oil concentrations was considerably reduced after 144^h of post-spray days. All neem oil concentrations remained statistically significant with each other after, 24^h, 48^h, 72^h, and 144^h of post-spray. The overall ANOVA was found with the significant difference in the jassid population in okra crop ($P<$ 0.05) in post-treatment in both sprays after the application of Imidacloprid and different neem oil concentrations detailed justification is given in (Figure. 5).

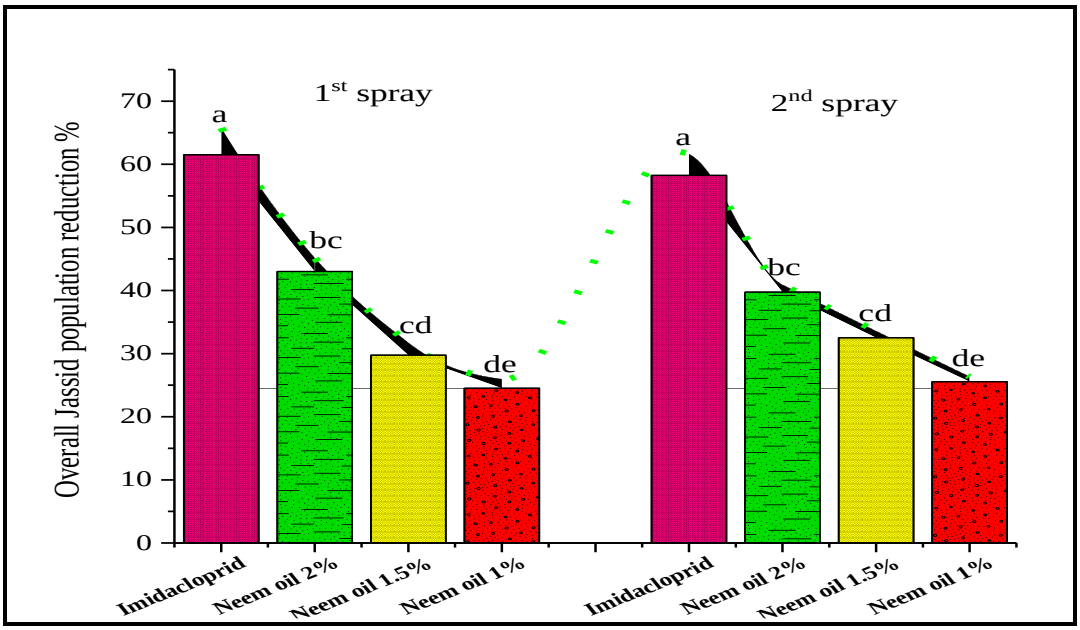

Figure. 5. Overall efficacy of Imidacloprid and neem oil concentrations against reduction % of Jassid during, 2022

Effect of Jassid attack and phototoxicity on okra plants during, 2022: The jassid is the devastator pest insect that massively hits okra crop and causes significant productivity damage even in favorable climatic conditions. Leaves of severely attacked plants turn yellow, and edges are also curled up, and this is the prominent feature of its attack (Pictures 1 & 2). Growth of severely attacked plants is stunted and severely attacked plants may even die. However, neem oil at 2% caused phytotoxicity in okra plants, hence cannot be recommended for pest control in okra crop (Picture 3 & 4).

Picture 1 & 2 Shows symptoms of phytotoxicity caused by 2% neem oil sprays on okra crop.

Pic-3 & 4 Showing curling and yellowing of leaves due to severe jassid attack on okra

DISCUSSION

The findings of the present research study with the great conformity with the published work of previous researchers. Our research study showed that Imidacloprid remained highly effective in reducing population (61.51%) in 1st spray against jassid and found effective up to six days of post-treatment.. It is with the work conformity of Usman *et al*., (2018), reported that Imidacloprid significantly suppressed the jassid population (79.43%) after 24h in cotton crop. In 2nd spry of Imidacloprid, pest reduction % was recorded (58.25%) as reported Iqbal *et al*., (2017), that Imidacloprid was found with high efficacy at 77.90%, followed by neem seed extract at 55.95% against jassid in okra crop after 1st spray. Mangrio and Sahito, (2022-23) applied five different insecticides against the *Papilio demoleus* larvae at field and laboratory conditions.

Our research findings showed the efficacy of neem oil concentrations considerably increased after 24h and reduced after 144h of post-spray. At 2% neem oil concentration jassid population reduced at (43.01%) in 1st spray, this is with the work similarity of Dhiloo *et al*., (2016), who reported that neem oil at 3% and 1% reduced jassid population at (78.86%) and (53.08 1%) respectively in eggplant. In 2nd spray at the same concentration pest population gradually reduced (39.75%) this is the work similarity of Charleston *et al*., (2005), who documented the deterrent, antifeedant, toxic effects of the neem seed extracts, and neem oil in the laboratory against the population of jassid and found that neem oil at 2%-3% and neem seed extract 3% effectively reduced the jassid population. At 1.5% of neem oil concentration, the reduction % population of the insect pest counted (29.75%) in 1st spray as reported Ahmed *et al.*, (2007), that maximum mortality (44.44%) in Shisham defoliator larvae occurred with 2.0% and 3.0% neem oil after 48h and 56.11% with 3.0% concentration after 72h. In 2nd replication, the population was reduced (32.51%) as discussed Shahzad *et al*., (2016) that neem extract remained in second position after Imidacloprid in reducing the white fly population in Brinjal and reducing the white fly population from 5.63% per plant to 1.03% per plant.

At 1% of neem oil concentration, the jassid population recorded (24.52%) in 1st spray with more or less work similarity Khan *et al.,* (2013), studied the efficacy of neem oil and datura against the population of white fly, thrips, and jassid in cotton crop and found that both products significantly reduced their population at different intervals. Our finding is more or less similar work of Mangrio *et al*., (2023), applied five different insecticides against *Earias vittella* and *Pectinophora gossypiella* in cotton crop and abamectin proved with high efficacy power against both cotton borer species. (Sahito *et al*., (2017) applied acetamiprid, pyriproxyfen, diafenthiuron, acephate, but nitenpyram prove with better control against *A. biguttela biguttela* under cotton filed condition at the same district.

In 2nd spray the population reduced by (25.55%) these findings have been supported by Hafeez-u-Rehman *et al.,* (2015), who documented that neem seed extract and neem oil at 2% and 3%, did not significantly reduce jassid and white fly populations after 24h of spray, however, these concentrations significantly reduced jassid and white fly populations after 48h and 72h of spray. Aslam and Naqvi, (2000) also found that neem products and dimethoate effectively reduced jassid, aphid, thrips, whitefly, and sucking insects pest in cotton crop. From same district Sahito *et al*., (2018) reported first time *Arescon enocki* endo-parasite with best control against *A. biguttula biguttula* in cotton crop filed. The findings of the present study showed that different neem oil concentrations significantly reduce the jassid population after 24h of spray, however, these concentrations expressed maximum efficacy against the jassid population. Moreover, Khattak *et al.,* (2006), documented that neem seed water extract at 1% and 2% and neem oil at 1% did not significantly reduce the white fly population after 24h of spray. Faiz *et al.,* (2012), reported that neem oil remained efficacious against jassid in cotton crop up to 7 days after spray.

CONCLUSION AND RECOMMENDATIONS

Okra fruit is profusely used as vegetable and due to being susceptible to many pests frequently sprayed

with chemical pesticides which pose severe risks to human health and the environment. Findings of this study it is recommended that neem oil at 1.5% equally proven as effective and cannot cause phototoxicity effect on the okra plant leaves hence, can be replaced with chemical pesticides for controlling sucking pests in okra. Neem oil at 2% caused phytotoxicity in okra plants, hence cannot be recommended for pest control in okra.

AUTHORS CONTRIBUTION

B. Mal: is the main author of this research article who performed and conceived experiments. **W.M. Mangrio:** collected data and wrote the paper. **H.A. Sahito:** statistically analyzed data and point by point reviewed article. **A.A. Siddique:** arranged materials, tools. **S.N. Khuhro and F.A. Sahito** played support at any stage in this research work.

IMPACT STATEMENT

The okra crop possesses great economic importance and is being widely cultivated throughout the province of Sindh but is massively affected by the jassid population. The bio-pesticides should be applied against pest population reduction and for the security of quality and quantity of okra production.

DECLARATION AND COMPETING INTEREST

The authors confirm that there is no financial interest or personal relationship regarding any part of the work which is given in this research work.

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AVAILABILITY OF DATA AND MATERIALS

The findings and data of this research paper are available at the request of the corresponding author.

PUBLICATION CONSENT

The corresponding author accepts all the responsibilities for the release of this scientific work.

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