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Effects of a local isolation of the entomopathogenic fungi, *beauveria bassiana*, neem oil extract, and some okra varieties on infestation by the okra leafhopper *Amrasca Biguttula Biguttula* in Iraq

Dr. Hameed H Mohammed Al Karboli[1], Mayes N Al Hamadany[2]
[1] Professor, Department of Forensic Science, Al-Turath University, Baghdad, Iraq
[2] Plant Protection Directorate, Ministry of Agriculture, Abu-Graib, Baghdad, Iraq
Corresponding Author: Dr. Hameed H Mohammed Al Karboli

Abstract
The okra leafhopper *Amrasca biguttula biguttula* is an economically important pest of okra (*Abelmoschus esculentus*) in Iraq. Integrated management using entomopathogenic fungi, botanical insecticides, and host plant resistance offers sustainable control options. The study, therefore, aimed to investigate the effectiveness of a local isolate of *Beauveria bassiana, spinosad neem oil extract and some local varieties of okra in controlling* the okra leafhopper insect under Laboratory and field conditions. The experiment was laid out into randomized complete block design (RCBD) with three replicates. Field spraying results showed a significant advantage for the neem oil and Spinosad bio-pesticide treatments over the *B. bassiana* isolate after 48 hours, reaching 81.27%, 80.77%, and 39.20%, respectively. No significant differences were found in the relative efficiency of these treatments after several days, reaching 96.37%, 95.03%, and 98.39%, respectively. These treatments then began to gradually decrease, reaching 73.80% for the *B. bassiana* isolate, which differs significantly from the neem oil and Spinosad treatments (90.5% and 84.55%, respectively). Laboratory and field tests demonstrated the significant advantage of the neem oil treatment, with its relative efficiency ranging between 70.83% and 90.45% between the laboratory and field tests. The results also showed significant differences in the number of okra plant pods produced. with neem oil and the *B. bassiana* isolate being the most effective in increasing the number of okra pods. The number of plant pods was three times that of the control treatment, reaching to 10.00 and 11.9 pods compared to 3.33 pods/3 plants in the control treatment.

Keywords: Okra leaf hopper, Beauveria bassisna, Neem oil extract, Okra Varieties, Amrasca biguttula biguttula, Iraq, Beauveria bassiana, neem oil, okra, Iraq

Introduction

Okra, belonging to the Malvaceae family (*Abelmoschus esculentus*), is a summer vegetable widely cultivated in tropical regions and the Middle East (Burkil, 1997) [13]. It is highly sought after in several Asian and African countries, including Afghanistan, Bangladesh, India, and Pakistan. It is also grown in the United States, Egypt, Turkey, Iran, Iraq, Nigeria, and Ghana (Iqbal *et al*., 2012) [26]. Okra is cultivated throughout Iraq.

Local varieties are popular with consumers, such as Batra, Ptera, and Husseinawyia. Some foreign varieties are also grown in Iraq, but they are less common than local varieties, such as Italian, Clemson, Perkins, and Canlis (Al-Khafaji and Al-Mukhtar, 1989) [8]. Several researchers have indicated that okra is attacked by 72 types of insect pests, the most important of which are sucking pests, including the cotton aphid, *Aphis gossipii* (glover), the leafhopper (*A. biguttula*), and the whitefly *Bemisia tabaci* (Gennadias). These major pests cause approximately 17.46% yield loss (Rao & Rajendran, 2003; Harischandra *et al*., 2012; Rehman *et al*., 2015; Ahmad *et al*., 2015). Al-Azzawi *et al*. (1990), and Mohamed, *et al*. (2012) [5, 6, 18, 29, 32, 33] reported that there, 13 insects attack plants of the Malvaceae family, including okra in Iraq, Among the most important pests affecting okra are the spiny bollworm (*Earias insulana*), the strawberry mite (*Tetranychus turkestani*), the whitefly (*Bemesia tabaci*), and the cotton leafhopper (*Empoasca decadens*), which causes limited damage. No specific leafhopper species were mentioned at that time.

Among all insect pests, the Jassid (*Amrasca devastans*) is considered as major and serious pest of okra throughout the world (Dhandapani *et al*., 2003, Singh *et al*., 2013) [32, 37]. Both adults and nymph jassid stages suck the cell sap from the ventral surface of plant leaves. During severe infestation, jassid inject toxic chemicals (toxin) to the crop, which cause curling and stunting of crop (Ramzan *et al*., 2020 [35]; Singh *et al*., 2008). Severe jassid attack can lead to 54.04% yield loss. Several management strategies have been adopted to control this notorious pest throughout the world. Among all adopted methods, chemical control is mostly used as principle strategy against insect pest due to quick action toward the target insect pests. However, the chemical method has proved harmful for many non-targeted fauna (Hassan *et al*., 2007), in addition to its negative impact on the environment (Malik *et al*., 2015) [16]. Furthermore, the intensive application of the same group of insecticides against the target pest can enhance the development of resistance to the chemicals used (Murtaza *et al*., 2019; Rajput, 2004).

The leafhopper (*A. biguttula*) is a significant and difficult-to-control pest, a polyphagous pest affecting many important agricultural crops such as okra, tomatoes, cotton, eggplant, potatoes, sunflowers, castor beans, and others (Agsaoay and Briones, 2012) [4]. Menseh (2016) reported its infestation of approximately 20 species across primary and secondary hosts which can cause substantial yield losses. The jassid, is a devastating sucking pest of okra. Both nymphs and adults inject toxic saliva into the leaves, leading to “hopper burn”—symptoms characterized by yellowing, curling, and eventually necrosis. Research indicates that leafhopper infestation can cause 40% to 54% yield loss if left unmanaged (Ramzan *et al*., 2020; Singh *et al*., 2008).

Kumar and Singh (2002) [22] screened 22 okra varieties for leafhopper, and these varieties showed varying degrees of infestation The most significant physical defense is trichome density (leaf hairs). High density on the leaf lamina, midrib, and veins is negatively correlated with leafhopper population. Trichomes physically hinder the leafhopper's ability to feed and oviposit. Iqbal *et al*. (2008) [23] screened 30 okra hybrids to assess their susceptibility to leafhopper *A. biguttula*. The results showed three hybrids that were highly susceptible, three moderately susceptible, and three resistant, with infestation rates ranging from 5% to 18. Beyond physical hairs, Resistance cultivars contain higher levels of tannins of tannins and phenols which acts as chemical deterrents.

Beauveria bassiana is an entomopathogenic fungus (EPF) that acts through contact. Conidia attach to the insect cuticle, germinate, and penetrate the hemocoel, leading to white muscardine disease. Literature emphasizes that local isolates often regional environment. outperform commercial strains because they are better adapted to the specific humidity and temperature of the region (Zimmermann, 2007 [41]; Sajid *et al.*2013; Jaydeep Halder, *et al*. 2021 [19]).

Neem oil (*Azadirachta indica)* is the most widely cited botanical for leafhopper control due to its multifaceted mode of action. It acts as an antifeedant, repellent, and growth regulator. Research suggests that 2% to 5% concentrations are most effective. For instance, neem oil at 5% can reduce jassid populations to fewer than 5 hoppers per plant, significantly outperforming untreated controls (Mahmood *et al*. 2014; Saji, *et al.*2021).

Control methods for the leafhopper *(A. biguttula*) rely heavily on chemical pesticides. However, harmful effects such as insect resistance, secondary pest outbreaks, and environmental contamination are common. The use of pesticides during the harvest stage, after the main problem has already been addressed, is particularly problematic given that harvesting occurs approximately three times a week, leading to harmful pesticide residues on the pods (Dhairyashilu *et al*. 2025).

Therefore, this study seeks to develop safer State that it is infested by several insect pests, with the leafhopper *Amrasca biguttula biguttula* being a major one causing significant yield loss, While this pest is known globally, its presence and impact in Iraq were only recently documented, with *A. biguttula biguttula* being identified as a new record on okra in the region (Al-Hamadany and Al-Karboli 2017) [9]. Biological control strategies, utilizing entomopathogenic fungi such as *Beauveria bassiana* and botanical extracts like Neem oil, offer eco-friendly alternatives to synthetic insecticides. Studies have explored the efficacy of these agents against sucking pests. This study was conducted to evaluate the effects of a locally isolated *Beauveria bassiana*, Neem oil extract, and selected okra varieties, both individually and in combination, on the infestation of the okra leaf hopper, *Amrasca biguttula biguttula* in Iraq.

Materials and methods

1. Varieties Used in the Study

Three varieties were used in this study: the two local varieties Petra and Husseinawiya, which are very popular with consumers and are widely cultivated in most regions of Iraq, in addition to the foreign variety Americana, as follows:1- Petra variety - This is a well-known variety in central Iraq. It is a late-maturing variety, and the pods do not harden quickly. The harvest takes (65-70) days. The plant is tall, and the harvest period is long. (Al-Khafaji and Al-Mukhtar,1989) [8]

2. **Hausseinawiya variety:** This is a common local variety
3. **Americana variety:** This is a foreign variety that is not common in Iraq. It is green in color, unpopular with consumers, and the plants of this variety have dense hairs, which may affect farmers during the harvesting process.

Testing the susceptibility okra cultivars to leafhopper infestation

The field for the variety trial, was divided into three replicates, each containing three rows/replicate of the trial varieties. Following a randomized complete block design (RCBD), the seeds of the Petra, Husseinawiya, and Americana varieties were sown on April 1, 2016. After germination, Thinning was carried out to one plant per hill. All agricultural practices and crop management, including fertilization, irrigation, and weeding, were implemented according to the recommendations for cultivating this crop, as outlined by Al-Khafaji and Al-Mukhtar (1989) [8]. Approximately seven weeks after planting, the population density of okra leafhoppers on okra plants was estimated by taking three leaves from three plants at each of the different levels: lower, middle, and upper. These leaves were placed in labeled nylon bags and transported to the laboratory to count the number of leafhopper nymphs per leaf. Sampling took place throughout the season, starting on May 19, 2016, at regular intervals, and continued for approximately one month until June 21, 2016.

A sweeping net was used to estimate the number of adult leafhoppers on plants of different cultivars. Five sweeps were taken per cultivar. The net was passed over plants in one of the experimental rows, chosen randomly for each cultivar, with a length of 3 meter, The contents of the net in each replicate were emptied into labeled nylon bags and transported to the laboratory. The bags were then placed in the freezer for a few minutes to immobilize the leafhoppers and facilitate counting the number of leafhoppers in each.

The effect of *B. bassiana* isolate and neem oil in Laboratory

The okra leafhopper for this experiment was reared on Petra okra plants grown in small pots with a diameter of 15 cm and a capacity of 750 g of soil. Okra seeds were sown in a soil mixture placed inside these pots, which were then placed inside wooden cages covered with mulch, measuring (1 x 1 x 1) m. After 45 days from germination, these plants were infected with the okra leafhopper by releasing an average of (50) adults into each cage. These adults were left for 24 hours to lay eggs on the okra plants. After that, these cages were removed, all adults were removed from the okra plants, and then the plants were re-covered with cages. These pots were monitored inside the cages until the leafhopper nymphs appeared and reached the adult stage. Then, (10) adults were transferred to glass dishes measuring (3 x 15) cm, in which filter paper was placed along with okra leaves taken from plants kept inside cages to ensure they were not infected with the leafhopper, at a rate of 3 treatment /replicates in a completely randomized design

(CRD), okra leaves placed in glass dishes were sprayed with an aqueous suspension of *Beauveria bassiana* fungus (1 x 10^8 spores/ml) and neem oil at a rate of 20 ml /L of water. The control treatment was sprayed with distilled water only. These dishes were left open until dry, then 10 adult okra leafhoppers were transferred from leaves to each of the experimental dishes. The dishes were placed in a room at 25°C and 85% humidity and were monitored. The number of live adults was counted after 6, 12, 24, and 48 hours and after 3, 5, and 7 days. The relative efficiency of these treatments was calculated using Abbott's equation (1925) [2]:

$$\boldsymbol{corrected}\ \% = \left(1 - \frac{\text{n in T after treatment}}{\text{n in Co after treatment}}\right) * 100$$

Where: n = Insect population, T = treated, Co = control

The Effect of the of *B. bassiana*, Spinosad and Neem Oil in the Field

This experiment was conducted on the Petra cultivar at a rate of 3 rows, 3 m long, for each of the three experimental replicates and for each of the experimental treatments: Neem Oil, the Bio-Insecticide Spinosad, and the *B. bassiana* fungal preparation as a suspension, and a control treatment. One row was left untreated as an isolation distance between experimental replicates, for a total of 12 rows in the experiment, using a completely randomized block design (CRBD).

The spraying was carried out on 23/6/2016 using a small 10-liter sprayer, according to the proportions and recommendations for each of the experimental treatments, as follows:

1. **Neem oil:** Produced by Russell IPM in the United Kingdom, used at a rate of 20 ml /liter of water.
2. **Spinosad:** Produced by Dow Agro Sciences, USA, active ingredient (12.5%), used at a rate of 0.25 ml/liter of water.
3. ***B. bassiana* preparation:** Obtained from the Organic Agriculture Center/Ministry of Agriculture. The fungus suspension was used at a concentration of (1 x 10 ^{8}) spores per liter.

To evaluate the efficiency of these treatments, the number of leaf hoppers was counted 24 hours before and after treatment and then after 2, 3, 30 days from treatments. This was done by randomly cutting 3 leaves from the center of 3 okra plants (replicated) and placing them in labeled nylon bags. These bags were then transported to the laboratory and placed in the freezer for several minutes to immobilize the leafhoppers and facilitate counting them on the leaves of each treatment. The number of live leaf hopper nymphs was counted in each treatment, and the relative efficiency was estimated according to Henderson-Tilton formula (1955).

To estimate the efficiency of the effect of the different treatments on the okra yield, 3 plants /replicas from the experimental treatments were marked with red tape, and all small pods were removed from these marked plants. After two weeks, the number of okra pods in each of the marked experimental treatment plants was counted and compared with 3 marked plants for each of the control treatment without spraying. The number of pods and the percentage increase in the number of okra pods in each treatment were calculated.

Statistical Analysis

All field experiments were conducted using a Complete Randomized Block Design (CRBD) and a Randomized Block Design (CRD) for significance testing at a probability level of 0.05 (Al-Sahouki and Wahib, 1990) [10]. The AS 2001 software was used for statistical analysis of the data.

Results and Discussion

1. **Susceptibility of some okra varieties to okra leafhopper infestation**

Table (1) shows the number of okra leafhoppers on the Huseinawiya, Americana, and Petra varieties from the beginning of infestation in the field in mid-May until the last week of June 2016. Infestation began in small numbers on the three varieties about 45 days after planting on 17/ 5/ 2016, reaching 0.00 to 0.66 and 0.00 leafhopper / 5 sweeps on the three cultivars Huseinawiya, Petra and Americana respectively. There were no significant differences in the number of leafhoppers on the different varieties during this period. After three weeks, the number of leafhoppers gradually increased on all three varieties, with no significant differences between them. numbers reached 0.06, 2.33, and 2.33 for the three varieties, respectively. Then numbers increased significantly during the third reading on June 23, 2016. with clear significant differences between the three varieties, reaching 44, 18, and 4.33 leafhoppers /5 sweeps. The lowest numbers were on the Americana variety, and the highest on the local variety Huseinawiya, the reason for the lower numbers on the Americana variety may be due to the density of the hairs covering the underside of the leaves compared to the other two varieties, whose leaves have a lower density of hairs. The density of the hairs hinders the feeding and movement of the leafhoppers, making it a less favorable variety for leafhoppers, as most researchers have pointed out that the main factor determining the number of okra leafhoppers (*A. biguttula*) is the density of hairs on the leaves; the denser the hairs, the fewer the leafhoppers, and vice versa (Hooda *et al*. 1997; Kumar and Singh 2000; Iqbal *et al*. 2008; 2011 b; Javed 2016 [21, 23, 24, 27, 31] and Ramzon, 2020). Despite the low number of leafhoppers on the Americana variety, it is considered undesirable for consumers, and harvesting is difficult for farmers due to the abundance of hairs on the plant compared to the other two varieties, especially the Petra variety, which covers most of the okra cultivation in Iraq.

Table 1: Numbers of okra leafhoppers, *A. biguttula biguttulla* on okra varieties during the agricultural season 2016.

Sampling date	Okra Varieties			L.S.D
	Huseinawiya	petra	Americana	
17/5/2016	0.00	0.66	0.00	0.429*
3/6/2016	0.06	2.33	2.33	1.082*
23/6/2016	44	18	4.33	5.194*
Mean	14.687	7.00	2.22	3.272*
L.S.D	4.266*	2.0921*	1.755*	

Researchers such as Anithai and Nandihall (1981), Teli and Dalaya, (2008) [11] tested the susceptibility of seven okra varieties to infestation by the leafhopper (*A. biguttula*) and cotton (*Aphis gossypii*) after 45 and 60 days of planting in India. The results on hair counts showed that the number of leafhoppers and aphids is inversely proportional to the midrib and midrib thickness and directly proportional to the midrib thickness. In similar studies (Hooda *et al*., 1997) [21], 150 okra hybrids were tested for infection by the leafhopper (*A.biguttula biguttula*) based on nymph counts and the injury index. Two resistant hybrids, nine moderately resistants'', and two highly susceptible were found. The number of leafhopper nymphs on the resistant hybrids was lower compared to the other hybrids, and their development time was longer. Furthermore, the density and length of glandular hairs (trichomes), and the concentrations of sugar, silica, potassium, tannins, and phenols in the leaves of these hybrids were associated with their resistance to leafhopper (Javed *et al*., 2016) [27]. In studies conducted by Iqbal *et al*. (2011a) [25] on the relationship between the chemical composition of okra varieties and resistance to the okra leaf hopper (*A.biguttula biguttula*), it was found that the most important factor is the crude protein content of these varieties, which has a significant effect of 69% on the fluctuations in the number of leaf gloves. This is followed by fiber, which has an effect of 21%, in addition to the plant's content of nitrogen, lignin, sugars, phosphorus, copper, silica, and others.

This study, however confirmed previous studies that the resistance of okra hybrids to leafhopper infection depends on the density of hairs and glandular hairs, and the higher the density, the greater the resistance to leafhopper infestation.

The Effects of Neem Oil and *B. bassiana* in Laboratory

The results in Table 2 show the relative efficacy of the neem oil and the local isolate of the fungus *B. bassiana* against adult *A. biguttula biguttula* okra leaf hopper in laboratory, in which neem oil treatment was Significantly superior.

The treatment of neem oil and the *B. bassiana* during the first 48 hours after treatment showed that the relative efficacy of the two treatments after 6, 12, 24, and 48 hours was 36.66%, 50%, 50%, and 56.66 % for the neem oil preparation, which differs significantly from the relative efficacy of the fungus isolate, which was 0%, 0%, 20%, and 36.66%, respectively. It is observed that neem oil began to affect the adult leafhopper immediately after treatment, and its efficacy gradually increased over time, reaching more than 50% after 48 hours. The *B. bassiana* fungus isolate, however, showed no effect during the first 12 hours after treatment, and its effect began to appear after 24 hours, reaching a relative efficacy of 20%, which increased to 36.66% after 48 hours. The relative efficacy of both treatments continued to increase gradually after 3, 5, and 7 days, reaching 60%, 66.66%, and 70.83%, respectively. The relative efficiency of the two treatments, neem oil and *B. bassiana*, was 43.33%, 43.33%, and 69.22%, respectively.

After 7 days of treatment, the relative efficiency of the two treatments was observed to be equal. Significant differences were observed in the overall relative efficiency rates of neem oil and the fungus isolate, reaching 55.83% and 30.36% respectively, with a clear and significant advantage for the neem oil treatment. The differences in the relative efficiency of the two treatments are due to the different effects and mechanisms of action of each on the insects. When the fungus spores adhere to the insect's cuticle, they begin to germinate and penetrate the insect's body. This may take several days until the insect dies. Therefore, the fungus's effect appeared late, after 48 hours of treatment, and its relative efficiency remained low, at half of what the neem oil treatment achieved during the first 48 hours of treatment. Neem, on the other hand, affects insects in several ways, including having a repellent effect, in addition to its direct effect on the insect's central nervous system. This leads to loss of appetite and growth cessation, and it also has an action similar to molting hormones, and thus its effect is expected to be faster than that of *B. bassiana* (Naqvi, 1996; Iqbal *et al.*2011a) [24, 30].

Table 2: The relative efficacy of the neem oil and *B. bassiana* against okra leafhopper, *A. biguttula biguttulla* in laboratory

	Number of okra leafhoppers							
Time Treatmentent	**6 hours**	**12 hours**	**24 hours**	**48 hours**	**3 day**	**5 day**	**7 day**	**mean**
Neem	36.66	50	50	56.66	60	66.66	70.83	55.83
B.bassiana	0	0	20	36.66	43.33	43.33	69.22	30.36

The effect of neem oil, Spinosad, and *B. bassiana* on leafhopper in the field

The results shown in Table (3) demonstrate the relative efficiency of neem oil, the biopesticide Spinosad, and the local isolate of the fungus *B. bassiana* in controlling the okra leafhopper *A. biguttula biguttula* in the field. The relative efficiency of these treatments two days after treatment reached 81.27%, 80.77%, and 39.20%, with the neem oil and Spinosad treatments significantly superior to the *B. bassiana* isolate. After seven days of treatment, no significant differences in the relative efficiency of the treatments were observed, with results being similar at 96.37%, 95.03%, and 98.39%, respectively. After 30 days of treatment, the relative efficiency of these treatments began to gradually decrease, especially the Spinosad treatment, which reached 77.86%, which significantly different from the neem oil and *B. bassiana* treatments Which amounted to, 72.93% and 83.96%, respectively. Thus It can be concluded that the use of these three treatments were highly effective against the okra leaf hopper, and these results were consistent with those of the laboratory experiment, showing the superiority of neem oil in both the laboratory and field. Its efficacy ranged from 55.83% to 90.45%, followed by the biopesticide Spinosad at 84.55%. The least effective treatment was the fungal isolate *B. bassiana,* with efficacy varying between the laboratory and field.

The low effect of the *B. bassiana* isolate in the field can be attributed to the lack of optimal humidity required by the fungus, or to the extremely high temperatures, which exceeded 45°C during the season. Therefore, based on these results, neem oil or the bio- pesticide Spinosad can be used to control the okra leafhopper, *A. biguttula biguttul*a, due to its high efficacy and safety for humans, the environment, and beneficial insects and organic agriculture, especially that okra were usually harvested (2-3) times per week, and if any insecticide were used during this period, the harvested pods cannot be used due to its high insecticidal residuals affects. Usually most chemical pesticides may require a safety period ranging between (2-3) weeks.

Table 3: The relative efficacy of the neem oil,spinosad and *B. bassiana* against okra leafhopper, *A. biguttula biguttulla* in the field.

Time Treatment	2 day	7 day	30 day	Mean
Neem	81.27	96.37	93.72	90.45
Spinosad	80.77	95.03	77.86	84.55
B. bassiana	39.20	98.39	83.96	73.85
L.S. D	16.49*	N.S 11.67	14.08*	14.58*

Effect of Spraying with Different Treatments on Okra Yield

The results shown in Table (4) indicate significant differences in the number of okra pods in the different treatments. The neem oil and *B. bassiana* treatments were superior to the biopesticide treatment in increasing the number of pods to three times that of the control treatment, which yielded 10 pods. The number of pods did not differ in the Spinosad treatment, as it was 4.88 pods compared to 3.33 in the control treatment. The increase in the number of okra pods in the neem oil and *B. bassiana* treatments is due to their relatively high efficacy against the okra leafhopper in the field, amounting to 90.45 and 73.85 (Table 3), which led to a reduction in the number of okra leafhoppers in the treated plants, and this was reflected in the yield of these plants.

A number of researchers have indicated the efficiency of neem preparations in controlling okra leafhoppers, Dhiloo *et al*. 2016 and Anitha & Nandihallie, 2008 [11, 15] reported that Neem oil has outperformed some plant extracts and fungicides in controlling okra leafhoppers. Solangi *et al*. (2013) [39] evaluated the effectiveness of some biopesticides for controlling the okra leafhopper, *A. biguttula biguttula*, using four treatments: tobacco leaf powder, neem oil, neem oil with some microorganisms, compared to a control treatment. The results showed that the last treatment was superior in reducing the leafhopper population by 78.47%, followed by the neem oil treatment at 76.5%.

The results obtained by(Harischchandra and Shekharappa 2009; Harisehandra*et al*. 2012 and Dhairyashil *et al*. (2025) by using some plant and fungal preparations to control sap-sucking insects that infest okra crops, including the leafhopper *A. biguttula biguttula*, confirmed the superiority of neem oil over the fungal preparation *B. basiana* in reducing the leafhopper *A. biguttula biguttula* was conducted to evaluated the efficacy of several plant preparations, the biopesticide Spinosad, and the fungal preparation *B. bassiana* compared to the chemical pesticide Imidacloprid. The results showed significant differences in the efficacy of these different treatments in reducing pest density. It was recommended that the plant extract of *Polygonum nummularia* and the biopesticide Spinosad may be included in an integrated pest management program for the leaf hopper, given their non-harmful effects on humans and the environment, and their use within an integrated pest management program for okra in organic farming.

Table 4: Effects of spraying with different treatments on the number of okra pods, Petra variety, during the agricultural season 2016.

Treatment	Mean Numbers of okra pods / 3 plant
Neem	10.00
Spinosad	4.88
B. bassiana	9.11
Control	3.33
L.S.D	3.759*

Thus It can be concluded that the use of these three treatments were highly effective against the okra leaf hopper, and these results were consistent with those of the laboratory experiment, showing the superiority of neem oil in both the laboratory and field. Its efficacy ranged from 55.83% to 90.45%, followed by the Spinosad at 84.55%. The least effective treatment was the fungal isolate *B. bassiana*, with efficacy varying between the laboratory and field.

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