Evaluation of the efficacy of different Neocotinoid insecticides against cotton whitefly, *Bemisia tabaci* (Hemiptera : Aleyrodidae) on eggplant under greenhouse condition

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Abstract .This study was conducted to evaluate the efficacy of some neonicotinoid insecticides including , Actara 25 WDG (foliar and soil treatment), Confidor 200 SL, Calypso 480 SC, Polo, Confidor 5 G against cotton whitefly *Bemisia tabaci* on Eggplant (*Solanum melongena* L.) during the growing season of 2018. The results revealed that the highest population of the adults was concentrated on the upper leaves at the new growth of the plant, while the majority of nymphs were found on the middle leaves of the plant, and the females preferred to lay the eggs on the upper leaves because the highest proportion of eggs was found on the upper leaves. The foliar application of Actara and confidor were significantly effective against the whiteflies after one day of treatment. While the soil treatments of the Actara and Confidor showed the least efficiency at one day after the treatment; all treatments except Polo were significantly superior over control in decreasing the population of the nymphs at the day 14 after the treatment. Polo did not show any efficiency in the reduction of the number of live nymphs. The data on efficacy of the tested neonicotinoid insecticides against the *B. tabaci* on the eggplant under the greenhouse showed different efficiency according to the treatment method. At one day after the application, foliar spraying of Actara and Calypso were the most efficient; and the efficacy of all tested insecticides increased up to the day 14 after application, and foliar treatment of Actara gave the highest efficacy after 14 days.

1. Introduction

Eggplant (*Solanum melongena* L.) is one of the most important vegetable crops in Iraq, which was cultivated on 25705 dunams with the productivity of 380.000 tons [1]. Eggplant crop cultivations are mostly concentrated on the Baghdad and middle Euphrates provinces [2], that are attacked by many pests, but the cotton whitefly *Bemisia tabaci* (Gennadius) are the most destructive insect pests; which is a polyphagous infesting a large number of vegetable plants, crops and ornamental plants, and infest
more than 500 plants belonging to 74 plant families [3; 4]. Adult and nymphal stages suck the plant sap and deposit the honeydew providing appropriate conditions for fungi growth inhibiting the photosynthesis, and the heavy infestation reduces yield and quality due to the transmission of plant disease [5;6].

Chemical pesticides have been widely used in the control of \textit{B. tabaci} causing many problems, such as the rapid development of the resistance to several pesticides, organic phosphorus, carbamates, and pyrethroids [7]; alternatively, growth regulators and new insecticide groups with novel mode of action were used to break the resistance that acquired in the whitefly pest. Additionally, it has been indicated [8] that pesticide Polo, which inhibits the production of energy in the mitochondria, and the combination of insecticides Applaud and Evesct proved most effective against the population density of \textit{B. tabaci} on the tomato plant. Also, it was found that insecticide Karate integrated on the polymer (poly-electrolyte) has reduced the population density of pest [9]. Also, it was recorded [10] that applying Pymetrozine on the 4 to 6 leaf-tomato plant protected from TYLCV infection due to the prevention of \textit{B. tabaci} feeding. The study aims to evaluate the efficacy of the foliar spray application of Neoconotenoid insecticides against \textit{B. tabaci} infesting eggplants.

2.Materials and Methods
The distribution of \textit{Bemisia tabaci} in the plant and evaluate the efficacy of pesticides on the population density of \textit{B. tabaci} on eggplants in greenhouses were studied during the growing season 2018/2019; the experiment was carried out at the agricultural research station of the College of Agriculture, Kerbala University/ Husseinia, Kerbala.

The plants were sprayed with insecticides (Table 1) using a handheld sprayer. The treatments included four foliar pesticides and two soil treatment, while the control treatment was sprayed with water only. Randomly, the samples were collected 1 day before the treatment, 1, 3, 7 and 14 days post treatment. The sample consisted of 30 leaves (lower, middle and upper) taken from 10 plants; after each sampling event, the leaves were transferred to the laboratory for counting the number of eggs, nymphs, and adult of \textit{B. tabaci} on three patches of 1 cm² on each leaf using double magnifying glass (60 times). The efficacy of the insecticides was calculated according to Tilton and Henderson equation (11). The factorial trials were designed according to the RCBD design. The data were analyzed and the mean was compared with the least significant difference (LSD) at 0.05.

\[
\text{Corrected efficacy} \% = \left(1 - \frac{\text{(N) in (Co.) after treatment} \times \text{(N) in (T) before treatment}}{\text{(N) in (Co.) before treatment} \times \text{(N) in (T) after treatment}}\right) \times 100
\]

\(N = \text{Insect population}, \ T = \text{treatment}, \ Co. = \text{control}\)
Table 1. Pesticides used in the foliar and soil application against the whiteflies on eggplant.

| Trade Name      | Active ingredient | Dosage rate   | Company  | Application |
|-----------------|-------------------|---------------|----------|-------------|
| Actara 25 WDG   | Thiamethoxam      | 40 gr. / 100 L. | Syngenta | Foliar      |
| Confidor 200 SL | Imidacloprid      | 100 ml. / 100 L. | Bayer    | Foliar      |
| Calypso 480 SC  | Thiacloprid       | 35 ml. / 100 L. | Bayer    | Foliar      |
| Polo 500 SC     | Diazinon          | 65 ml. / 100 L. | Syngenta | Foliar      |
| Actara 25 WDG   | Thiamethoxam      | 200 gr. / 2500 m² | Syngenta | Soil        |
| Confidor 5 G    | Imidacloprid      | 14 kg. / 2500 m² | Bayer    | Soil        |

3. Results and discussion

The results of the Figure 1 showed that 53.47% of the adults of *B. tabaci* were found on the upper leaves at the new growth of the plant, while 27.80% of adults were on the middle leaves, and the lowest proportion of the distribution of adult was on the lower leaves (22.66%). Whereas the majority of nymphs were concentrated on the middle leaves of the plant, with an average of 59.87%, followed by 29.33% and 13.8% on the upper and lower leaves respectively. The highest proportion of eggs (77.16%) was found on the upper leaves, and the proportion of distribution of eggs on the middle leaves was 17.39%, while the lowest proportion was on the lowest leaves of 13.75%.

![Figure 1](image_url)  
**Figure 1.** The percentage of the distribution of the whitefly stages on the eggplant leaves.

Evaluation of the efficacy of some Neocontinoid insecticides on the nymph stages of *B. tabaci*. Data of table (2) indicated that the foliar application of Actara and confidor were significantly effective against *B. tabaci* after one day of treatment. The number of live nymphs was 12.4 and 13.3/ cm² of leaves respectively, followed by Calypso which decreased the number of live individuals with an average of 14.5 nymphs / cm² of leaves at 1 day after the treatment; Calypso did not differ statistically than the foliar application of Actara and Confidor. The treatments of the Actara and Confidor showed the least efficiency at one day after the treatment when used in soil treatment; they decreased the population of the nymphs with an average of 17.3 and 18.1 nymphs/ cm² of leaves respectively compared to the control treatment (24.4 nymphs/ cm² of leaves). The data revealed that Actara and
Confidor soil treatments were proved highly effective treatments against the population of the nymphs, which decreased to 2.3 and 3.9 nymph / cm² of leaves respectively at day 14 after the application. Whereas Polo (22.4 nymphs/ cm² of leaves) did not show any efficiency in reduction of the number of live nymphs that did not differ statistically from the control treatment (30.8 nymphs/ cm² leaves).

Table 2. Efficacy of Neocontinoid insecticides against nymph stages of *B. tabaci*.

| Insecticide | Average of nymphs (nymphs/ cm²) | Mean |
|-------------|---------------------------------|------|
|             | Before the treatment            |      |
|             | 1 day  | 3 day  | 7 day  | 14 day  |      |
| *Actara     | 28.3   | 12.4   | 14.1   | 11.2    | 6.1  | 10.9 |
| *Confidor   | 23.7   | 13.3   | 13.7   | 11.1    | 7.3  | 11.3 |
| *Calypso    | 21.9   | 14.5   | 12.2   | 10.2    | 6.3  | 10.8 |
| *Polo       | 23.2   | 22.4   | 17.5   | 17.2    | 17.8 | 18.7 |
| **Actara    | 25.2   | 17.3   | 12.5   | 5.7     | 2.3  | 9.4  |
| **Confidor  | 27.8   | 18.1   | 12.8   | 6.2     | 3.9  | 10.2 |
| Control     | 24.7   | 24.4   | 23.6   | 24.7    | 30.8 | 25.8 |
| mean        | 24.97  | 17.48  | 15.22  | 12.32   | 10.46|      |

L.S.D. time intervals = 1.69, L.S.D. insecticides = 2.47, interaction=4.94

* Foliar application

** Soil treatment

The data of efficacy of the tested insecticides against *B. tabaci* on the eggplant under the greenhouse showed different efficiency according to the treatment method (Table 3). After 1 day after the application, foliar treatment of Actara and Calypso were the most efficient with the efficacy of 79.24% and 76.11%, respectively, followed by the soil treatment of Actara with the rate of 36.81%; whereas Polo had the lowest efficacy. The efficacy of insecticides increased up to day 14 after the application for all insecticide, and foliar treatment of Actara gave the highest efficacy of 89.06%.

Table 3. The relative efficacy of some Neocontinoid insecticides against cotton whiteflies infesting eggplant in the greenhouses.

| Insecticide | Efficacy of the insecticides % | Mean |
|-------------|--------------------------------|------|
|             | After the treatment            |      |
|             | 1 day  | 3 day  | 7 day  | 14 day  |      |
| *Actara     | 71.81  | 74.12  | 81.97  | 89.06   | 79.24|
| *Confidor   | 48.16  | 55.31  | 61.11  | 63.93   | 57.12|
| *Calypso    | 68.13  | 72.29  | 77.81  | 86.22   | 76.11|
| *Polo       | 31.63  | 41.49  | 35.33  | 39.47   | 36.98|
| **Actara    | 39.78  | 56.77  | 79.67  | 80.33   | 64.13|
| **Confidor  | 28.27  | 49.33  | 63.98  | 77.13   | 54.67|
| mean        | 47.96  | 58.21  | 66.64  | 72.69   |      |

L.S.D. time intervals = 4.97, L.S.D. insecticides = 6.39, interaction=14.81

* foliar application

** soil treatment
The finding of this study showed the high efficacy of the Neocontinoids, Acatra, and Calypso which gave the best mortality after one day of the application; the high efficacy is related to the destructive effect of these insecticides on Nicotinic acetylcholine receptor (NAchR) receptors in the neurotransmitter fibers of the central and peripheral nervous system of the insect; the high-polarity Neocontinoids absorb rapidly and are transported to all parts of the plant; Neocontinoids have the ability of continuous transmission of nerve impulses, causing agitation, paralysis, and death of the insect (12, 13). The high efficacy of Actara is due to its long-term effect on the population of the whiteflies because it is dissolved slowly within the plant tissues (14). Actara, effects on sucking mouthparts especially whiteflies, causes rapid mortality on whiteflies within 24 hours (15). (16) found that Actara gave a high mortality rate of 87% against the whiteflies (Biotype B) on the cucumber when used in the spraying method with a concentration of 2 g/L water. (17) revealed to the efficiency of the soil and foliar treatment of Actara against whitefly on cotton. The effect lasted for five weeks. (18) confirmed that the Actara-soil treatment reduced the population of *Thrips Frankliniella schultze* on the tomato crop with high environmental benefits and a longer period of effectiveness compared to the spraying method.

4. Conclusion

Foliar spraying of Actara and Calypso were the most efficient at one day after application, and the foliar treatment of Actara gave the highest efficacy after 14 days, so Actara can be recommended in IPM program which can greatly reduce the population density of cotton whiteflies.

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