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FIELD EVALUATION OF SOME CHEMICAL PESTICIDES IN CONTROLLING THE GREEN PEACH APHID (MYZUS PERSICAE SULZER) (HEMIPTERA: APHIDIDAE) ON EGGPLANT CROP IN AL-‘ALAM DISTRICT

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Abstract
The experiment explores how the various pesticides are effective in the control of aphid adults and nymphs of the M. persica variety, in particular. These findings indicated that the Closer pesticide resulted in the greatest decrease in the numbers of nymphs, reached the average counts of 6.31 and 5.98 nymphs/in 2 after one - three days respectively with the respective mortality rates of 47.81 and 48.7. Contrarily, Pento pesticide had more counts of nymphs whereas plant extract Azadirachtin had a longer-lasting control effect as it registered a mortality rate of 63.42 with 21 days. Adult aphid population also reacted with significant response toward treatment with Closer having the lowest response (0.8 to 0.07 aphids/in 2) at all the time points and showing high level of effectiveness of Closer in comparison with water and Acetamprid treatments. The results emphasise the intricacies of aphid management, meaning that even though the utilisation of chemical pesticides offers quick outcomes, its effectiveness can decrease when using it frequently because of various aspects, including insect resistance and life cycle interactions. This paper shows that there is a necessity to develop comprehensive pest management approaches, which should take both the chemical and biological approach to achieving effective management of aphid populations.

Introduction

Eggplant (Solanum melongena L.) is a well-known vegetable crop used in Iraq, particularly in the farm under protection due to its nutritional value such as carbohydrates, proteins, minerals, and good caloric value (Al-Muhammadi et al., 1989).The eggplant is susceptible to various pest and disease infestations, and one of the most significant insect pests that affects the crop at all growth stages, requiring continuous control, is the green peach aphid (Myzus persicae Sulzer), which has a broad host range exceeding 400 plant species globally. It causes direct damage by feeding on plant sap and plays a significant role in transmitting numerous economically important plant viruses. This aphid species alone can transmit more than 70 types of plant viruses. Aphids, in general, increase their damage potential as they live on plants in colonies that encompass all life stages, and their rapid reproduction cycle allows for up to 20 generations per year in the central region of Iraq (Al-Kalash, 2022). This makes them difficult to control, often requiring the use of chemical pesticides. However, environmental risks and the development of pesticide resistance in aphid populations (Aaron, 2013) have led researchers to seek safer, more

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sustainable control methods. The objective of this study was to:

- Protect eggplant crops from Myzus persicae, which causes significant losses and transmits viral diseases.
- Explore the use of newer pesticides that do not show resistance in the aphid population.

Materials and Methods

3.1 Table (1) Pesticides Used in the Study

The study utilized three chemical pesticides, which are listed below:

Trade Name	Active Ingredient	Recommended Dose	Manufacturer	Country of Origin	Remarks
SC Closer	Isoclast	40 ml / 100 L of water	Dow AgroSciences	Canada	Specialized for sucking pests
Pento EC	Pifenthrin	50 ml / 100 L of water	Wellood	India	Insecticide for sucking pests
Decis Expert EC	Deltamethrin	15-20 ml / 100 L of water	Bayer	Germany	Specialized for sucking pests
SICONEEM 10000 PPM EC	Azadirachtin 1%	125 ml / 100 L of water	The Scientific Fertilizer Company	India	Botanical insecticide

2.2 Field Study:

The study was conducted on eggplant fields of the Barcelona variety, grown inside plastic tunnels in Al-'Alam District, from February to May.

2.3 Experimental Treatments:

The following treatments were applied:

- **Control 1**: Water spray only
- **Control 2**: Acetamprid pesticide spray (commonly used by farmers in Iraq)
- **Closer**: 15 ml / 100 L of water
- **Pento**: 50 ml / 100 L of water
- **Azadirachtin**: 125 ml / 100 L of water

2.4 Aphid Density Measurement:

To estimate the population density of the Dorea aphid, three plants were randomly selected and marked from each treatment. The population density of the aphid stages (adults and nymphs) was assessed one day before spraying by counting the adult insects at the beginning of darkness using a white LED flashlight. The insect is at this stage resting and it is not moving much. The plant leaf was held and flipped very attentively without causing intense vibrations that will cause the winged adult insects to fly away.

2.5 Pesticide Application:

This spraying was done just before the sunset when the weather conditions were favourable in terms of temperature and calm wind, such that the pesticide was not carried to the other treatments and made interference. Each pesticide was sprayed separately, with careful attention to thoroughly covering the treated plants, particularly the underside of the leaves, as it is the preferred site for the insect's different stages to exist, feed, and reproduce.

Readings were taken 1, 3, 7, 14, 21, and 28 days after spraying. Data collection focused on the plants located at the center of the treatments, while edge plants were excluded to avoid potential influence from neighboring treatments.

The percentage of insect mortality was calculated for all experimental treatments, and the corrected mortality rate was determined using the **Henderson & Tilton formula** (Flemings & Ratnakaran, 1985) as follows:

$$\textbf{corrected mortality rate} = \{1 - (\frac{\text{ND in CO brfore Spray} * \text{ND in T after Spray}}{\text{ND in CO after Spray} * \text{ND in T before Spray}}) * 100\}$$

Where (ND) represents the population density of the insect. The corrected percentage mortality was then transformed into angles using angular transformation tables (Al-Rawi & Khalaf Allah, 2000).

ND = numerical density T = Treatment CO = Control

The treated plants were monitored daily with care to record any symptoms of phytotoxicity resulting from the spraying process with the applied materials.

3. Results and Discussion:

3.1 Effect on Aphid Nymphs:

The results in Table (2) indicated that the best outcomes were recorded for the Closer pesticide treatment one and three days after the application, with average nymph counts of 6.31 and 5.98 nymphs/ in², achieving mortality rates of 47.81% and 48.7%, and 48.08% and 46.4%, respectively, compared to the water and Acetamprid treatments, with significant differences from the mortality rates observed in the other treatments, according to the Duncan's multiple range test results.

Regarding the Pento pesticide, the average nymph counts after one and three days were 11.71 and 9.4, respectively. However, after 21 days of application, the plant extract Azadirachtin treatment excelled, recording the lowest average of 6.73 nymphs/ in², with the highest mortality rates of 63.42% and 32.6%, compared to the water and Acetamprid treatments, showing a significant difference from the averages of the other treatments' effects.

Table (2): Effect of Control Factors on Average Nymph Counts of the Aphid M. persica with Corrected Mortality Rates Compared to Water and the Acetamprid Pesticide, Sequentially.

Dates / Treatment	Average Nymph Counts and Corrected Mortality Rates						
	After 1 Day	After 3 Days	After 7 Days	After 14 Days	After 21 Days	After 28 Days	Average
Closer	**6.31 (a 47.81) (a 48.7)**	**5.98 (a 48.08) (a 46.4)**	**4.78 (b 68.86) (b 44)**	**7.93 (e 51.54) (e 10.7)**	**8.51 (c 54.77) (c 16.7)**	**9.13 (c 51.71) (c 30.1)**	**7.11 (a 54.1) (a 33.5)**
Pento	**11.71 (g 10.68) (g 12.3)**	**9.4 (i 24.73) (i 22.3)**	**8.33 (j 49.95) (j 10.1)**	**9.53 (l 46.28) (l 1.1)**	**10.82 (h 46.96) (i 2.4)**	**12.2 (f 40.49) (f 13.9)**	**10.33 (i 38.5) (i 11)**
Decis	**12.82 (h 5.95) (i 7.7)**	**11.63 (k 10.44) (l 7.6)**	**8.95 (m48.28) (m 7.1)**	**9.53 (h 48.34) (h 4.9)**	**9.75 (d 54.03) (d 15.4)**	**10.02 (a 52.99) (a 32)**	**10.45 (h 40.2) (h 13.4)**
Azadirachtin	**10.91 (h 6.03) (h 7.8)**	**9.09 (j 17.81) (j 15.2)**	**7.58 (l 48.58) (l 7.6)**	**8.2 (j 47.81) (j 3.9)**	**9.47 (g 47.58) (h 3.5)**	**11.48 (j 36.77) (j 8.5)**	**9.45 (l 36.5) (l 8)**

Note: Values followed by the same letter do not differ significantly. Each value represents the average of three replications.

Regarding the Azadirachtin formulation, Al-Rubaie et al. (2000) indicated that neem plant extract was more effective than Melia azedarach extract against the nymphs of the whitefly B. tabaci when used at a 10% concentration. The mortality rate achieved by the former was 100%, while the latter achieved 90% after 72 hours of treatment. Additionally, the mortality rate of aphid nymphs reached 93.7% when neem seed extract was used (Jayaraj et al., 1986).

Regarding the excellent outcomes of the chemical pesticide Closer, they are in synergy with the findings of Zewain et al. (2013) who indicated the efficacy of this pesticide in the 200 and 300 mL/ha dosage. It gave it high death percentage of whitefly nymphs during three days after the initial treatment. They added that spraying with Closer 300mL/ha offered more effective results such as against the nymphs within the seven-day protection of the day of treatment, even though the lowest results were recorded using a dose of 100mL/ha.

The diversity of pesticides and compounds which are to regulate the pest may give positive outcomes at the very start of their use. Nevertheless, overall, it is challenging and unreliable to control the insect using chemicals. One spray will not be trusted to effectively control the pests as the entire insect life cycle will be found on the underside of the leaf. In addition, the majority of pesticides are not applicable to every stage of pests. The small size of the insect, its great population density, more than one generation, and capacity to feed, mate, ovulate, and parthenogenetically reproduce, all these make it difficult to control. As the insect mostly dwells in the underside of leaves, it is hard to cover the whole plant in one spray, and thus the repeated sprays are required. Such frequent spraying results in the resistance of the pesticide in the pest.

It has been learnt that the insect has certain genetic aspects, which can make it resistant to pesticides. Such pesticides seem efficient at the first application, but as soon as they are applied over and over again, they have less efficiency since the insect is developing very fast with short life cycle, and it has more than one generation. Further, the sensitivity of nymphs reduces with age because of the hardening of body wall among the later instar nymphs. Newly hatched nymphs, on the contrary, contain less rigid body wall because the cuticle layer is thinner (Goodwin & Mercer, 1995). This decreased the thickness of the cuticle that enables an enhanced penetration of toxic chemicals that are applied in the control of pests which influences the food conversion of the treated nymphs. The effect is more rife on the nymphs at an early stage as they are more effective in converting food to its useful form hence having high toxicity by the control agents. These pesticides act by blocking feeding in nymphs causing massive death (Al-Emara, 2009).

3-2 Effect of Study Factors on Adult M. persica Aphids

Table (3) shows an average number of adult aphids following the application of study factors and corrected mortality rates of the same in relation to water and pesticide Acetamprid. The findings show that population density of the aphid was affected by all the factors used in the study albeit differently. The greatest decrease was observed in the case of Closer pesticide treatment, where the adult aphid count was 0.8, 0.37, 0.36, 0.26, 0.13 and 0.07 aphids per square inch, in comparison to the water treatment and Acetamprid treatment, respectively, on all the days. All other treatments determined by Duncan multiple range test showed great differences with these results range test.

Conversely, D-cis treatment led to minimum mean of adult aphids after 21 and 28 days, which were 0.4 and 0.34, respectively. Likewise, the pinto pesticide application had 0.32 and 0.29 on the same date.

The Azadirachtin extract had the highest average number of adult aphids on one and three days with the number standing at 1.14 and 1.07 respectively, in comparison with water and Acetamprid treatments which stood at 48.41 and 36.1 respectively.

Table (3): The Effect of Control Factors on the Average Number of Adult M. persica Aphids with Corrected Mortality Rate Compared to Water and Acetamprid, Respectively.

Dates / Treatment	Averages of Adult Aphid Counts and Corrected Mortality Rates						
	After 1 Day	After 3 Days	After 7 Days	After 14 Days	After 21 Days	After 28 Days	Average
Closer	**0.82 (c 69.14) (c 56.1)**	**0.37 (b 78.72) (b 77.2)**	**0.36 (c 71.44) (c 76.6)**	**0.26 (d 85.26) (d 75.3)**	**0.13 (b 93.36) (b 87.4)**	**0.07 (b 97.48) (b 92.5)**	**0.34 (c 83.2) (c 74.7)**
Pento	**2.31 (m 32.42) (m 4)**	**1.61 (l 27.88) (l 22.9)**	**1.52 (m 6.27) (m 23.2)**	**0.74 (l 67.4) (l 45.3)**	**0.32 (g 87.3) (g 76)**	**0.29 (j 91.89) (j 76)**	**1.13 (m 56.7) (m 34.6)**
Decis	**1.3 (h 57.78) (h 40)**	**1.1 (i 45.41) (i 41.7)**	**0.93 (i 36.33) (i 47.8)**	**0.52 (j 74.57) (j 57.3)**	**0.4 (i 82.37) (i 66.7)**	**0.34 (l 89.44) (l 68.7)**	**0.77 (h 67.4) (h 50.8)**
Azadirachtin	**1.41 (k 48.41) (k 26.7)**	**1.07 (j 40.18) (j 36.1)**	**1.01 (k 22.11) (k 36.2)**	**0.56 (k 69.15) (k 48.3)**	**0.32 (h 84.11) (h 70)**	**0.32 (m 88.8) (m 66.8)**	**0.78 (k 62.6) (k 43.6)**

Note: Values followed by the same letter do not differ significantly. Each value represents the average of three replications.

The study findings concur with those of Zewain et al. (2018) when comparing the efficacies of Closer insecticide at the concentration of 3.5, 7, 10, and 14 ml/30 litres of water versus the efficacies of Radiant 240SC insecticide at the concentration of 15 ml/30 liters of water against the Dubas bug. It was found with excellent control effects on nymph and adult Dubas bug at different concentrations of Closer after 35 days of treatment which had a corrected control efficiency of 89.3% when 3.5 ml/30 liters of water was applied and with 7, 10, and 14 ml/ 30 liters of water yielding a range of 93.3- 94.6% in the same period. In the meantime, Radiant 240SC 15 ml/30 liters had an efficiency of 91.5. According to a research conducted by Lut (1996) there was also the possibility of some special insecticides to be used in controlling aphids without any appreciable impact on the predator Geocoris pallens (Stal).

Abdalla et al. (2010) reported that neem seed extract at concentrations of 6% and 12% caused significant mortality in sucking insect pests (whitefly and jassid) compared to the control. Additionally, the population density of Bemisia tabaci (Genn.) was reduced in a field experiment using the aqueous extract of the neem plant (Serra and Schmuttere, 1993).

Kaabi (2005) mentioned that adult mortality might occur due to the inability of nymphs to develop into complete adults, instead remaining in the stationary stage with a gradually darkening, non-glossy appearance before dying. Plant extracts were also discovered to play a huge role in nutritional conversion efficiency of the whitefly (Kaabi, 2005).

Palumbo (2009) employed the chemical insecticide (Spiramesifen) that inhibits the lipid biosynthesis in insects and mites, and mentioned that it worked within the course of four weeks in the experiment.

This was attributed to its properties, which resemble those of insect growth regulators (IGRs), known for their extended killing efficacy that affects the next generation of treated insects. This insecticide, therefore, does not only affect the insects that it encounters, but it also affects the fertility of the insect population.

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