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Efficacy of some Insecticides and Alternatives against *Aphis gossypii* Glover in Tomato Crop and their Effect on Soil Fertility

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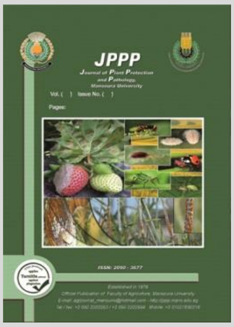

ABSTRACT

The main objective of present study was to evaluate the toxicity of Malathion 57% EC, Potegon 20% SP, K.Z oil, and Neem (*Azadirachta indica*) extract AgNPs for controlling the cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) and their effects on enzymes as indicators on soil fertility in tomato plants (*Lycopersicum esculentum*). The tested insecticides could be arranged in descending order according to their potency as follows: Malathion 57% EC > Potegon 20% SP > K.Z oil > Neem extract AgNPs. These compounds succeeded in controlling *A. gossypii*, where the means of reduction percentages of infestation were 79.92, 72.61, 73.18 and 72.52 %, respectively in the 2018/2019 season opposed to 76.09, 74.61, 72.97 and 71.38 %, respectively in the 2019/2020 season. The enzymes activity were not affected by the K. Z. oil, and Neem extract AgNPs applied on tomato plants. Mineral oil and plant extracts could form the basis for a successful formulation of bio-pesticides.

Keywords: Pesticides, Enzymes ,Tomato, Cotton aphid, Soil fertility

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.), one of the great important vegetables in Upper Egypt, has the highest cultivated total area among vegetables at the global level. Egypt is one of the highest tomatoes grown acreage by producers and exporters. the total production weight of tomatoes was approximately 6.6 million tons (Anonymous, 2019). Tomato is considered a major element of the Mediterranean and Asian diet it is used daily all over the world as raw, processed as a canned product, juice, or paste (Engindeniz, 2006). Aphids are major agricultural pests infesting tomato plants. The cotton aphid, *Aphis gossypii* Glover (Hemiptera: Aphididae) couse direct damage to crops by the feeding through phloem tissue. Moreover, they can also contribute to severe indirect damage by acting as primary vectors of many plant viruses. Aphids have a high proliferation rate and have been shown to adapt quickly to host-plant phenology and ecology, plant physiology and biochemistry (Pettersson *et al*., 2007). Severe infestation by aphids can lead to reduced photosynthetic activity, vigor and growth. Leading to decreasing the production (Jazzar and Hammad, 2003).

Growers on traditional farms employ a number of chemical insecticides to control aphids. However, as organic farming becomes more popular in the country, there is a need to utilise environmentally friendly biopesticides and other bio-based techniques to combat the aphid problem. Biopesticides attack in general only the target pests and closely related organisms in contrast to the chemical insecticides that affect a wide range of organisms thus causing harmful influence on the environment and soil fertility. In addition to decomposing quickly, thereby resulting in lower exposures and largely avoid pollution problems (Biswas *et al*., 2014). A survey of literature indicted that very little attention has been paid to this important area of research. The increasing concern of consumers and government to achieve food safety has led growers to explore new environmentally friendly methods instead of, or supplement, the current traditional practices. Pesticides affect negatively the soil micro-organisms that may cause a ripple effect that can last for years. Micro-organisms are essential for soil fertility.

The efficacy of some insecticides in controlling *Aphis gossypii* on tomato plants and their effect on soil fertility were poorly studied in tomato fields in Upper Egypt. Therefore, the present investigation may contribute positively to add some information about this regard, which may help in achieving a successful control program for reducing the expected damage of this pest in tomato fields and to find out the side effects of insecticidal applications.

MATERIALS AND METHODS

The current investigation was carried out to evaluate the toxicity of Malathion 57% EC, Potegon 20% SP, K. Z. oil, and Neem (*Azadirachta indica*) extract AgNPs at recommended concentrations (Table 1) against *Aphis gossypii* in tomato fields during the summer cultivations of 2018/2019 and 2019/2020 seasons at the Experimental Farm, Faculty of Agriculture, South Valley University, Qena, Egypt.

Table 1. List of tested compounds against cotton aphid

Trade name	Common name	Rate/Fed.
Malathion 57% EC	Malathion	1 L/200 L.w
Potegon 20% SP	Acetamiprid	25gm/100 L.w
K. Z. oil	Mineral oil	1 L/200 L.w
Neem extract AgNPs	Azadirachtin, nano particles	1 L/200 L.w

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Each of the tested compounds was sprayed using a 20 L knapsack sprayer with one nozzle, as foliar treatment, after being diluted with water at the rate of 200-liter spray liquid per feddan two sprays were applied (2018/2019 and 2019/2020 seasons). The control plots were sprayed only with water. Also, care was taken to avoid any drift among the treated plots. The experiment has been designed with a randomized complete block design (RCBD) using three replicated/treatment occupied an area of 1/100 feddan (7m. long by 6m. wide.). The tested cultivar was (Super Jakal) which have been cultivated in the last week of October. The control treatment was applied with deionized water as untreated. The outer plants were never sampled to avoid border effects. Samples were randomly collected at cross directions per plot. Counting of *A. gossypii* indivaduls was always performed only in the morning.

To assess the effect of pesticides on *A. gossypii*, ten leaves were taken at random from each replication. The leaves from the chosen shoots' upper, middle, and lower leaves were arranged in paper bags. All samples were taken to the lab and examined under a binocular microscope. The infestation was examined soon before spraying, as well as 1, 4, 7, 10, 13, and 15 days after treatment.

Reduction persentage in infestation was calculated using Henderson and Tilton equation (1955).

Reduction Percentage =100 {1- (Cb/Ca x Ta/Tb)}

Where:

T a = Mean % of infestations in treated plots after spray.
C b = Mean % of infestations in check plots before spray.
T b = Mean % of infestations in treated plots before spray.
C a = Mean % of infestations in check plots after spray.

Effect of tested compounds on soil enzymes

Surface loamy soil (0 - 20 cm) was collected and transferred to the laboratory in a soil bag. The soil was air-dried, ground, and passed through a 1 mm sieve to remove stones, plastics, and roots. The soil was of light texture with low contents of organic matter. The physical characteristics viz. nature of soil, organic matter, pH, and electrical conductivity were ascertained before sarting the experiment. The physicochemical properties of soil used in these studies are given in Table (2).

Table 2. Physico-chemical properties of soil

Sand	Silt	Clay	Texture	pH (1:2.5)	EC (dS m^{-1})	Calcium Carbonate (%)	Organic Matter (%)	Total N (%)	Available P(mg/ kg)	Available K(mg /kg)
70	25	5	Sandy loam	8.21	1.14	7.56	0.94	0.016	21.41	253

The procedure followed for the dehydrogenase activity study was fallowed according to Casida *et al.* (1964). It is based on the principle that 2,3,5-triphenyl tetrazolium chloride (TTC) used as an electron acceptor in place of oxygen (O_2), is reduced to triphenyl formazan (TPF), the quantity of which is directly proportional to dehydrogenase activity. The activity is expressed as µg of TPF formed g^{-1} soil h^{-1} at 37 °C. While the procedure followed for the determination of phosphatase activity was as that of Tabatabai and Bremner (1969). P-nitrophenol phosphate (P-NP) which is used as a substrate is hydrolyzed to P-nitrophenol (P-P). P-nitrophenol is extracted and quantified to assess phosphatase activity. The activity is expressed as µg of P-nitrophenol phosphate hydrolyzed g^{-1} soil h^{-1}. On the other hand, the procedure followed for determination of urease activity was as that of Watts and Chrisp (1954). The unhydrolyzed urea is complexed with a coloring agent. The intensity of the color developed is directly proportional to the quantity of urea present. The quantity of urea hydrolyzed is computed and expressed as µg g^{-1} soil h^{-1} at 37 °C.

Characterization of nano-scale silver nanoparticles:

UV–visible spectra analysis

The optical density (OD) of silver nanoparticles (AgNPs) of azadirachtin was measured using a "Shimadzu UV-2401 PC, Japan" scanning spectrophotometer for UV–visible spectrum analysis. Measurements were made with a resolution of 1 nm and a scanning speed of 300 nm/min between 200 and 800 nm. The UV–vis spectra of 1 ml aliquots of the sample and 2 ml deionized as water in quartz cell was used to monitor the reduction of Ag+ ions (Wiley *et al*., 2006). To adjust the baseline as a blank, a volume of 2mM silver nitrate was employed.

Transmission electron microscopy (TEM):

The precipitate that collected at the bottom of the conical flasks and the suspension above were sampled after the reaction for transmission electron microscopy (TEM) analysis. Using a "LEOL-2010, Japan" transmission electron microscope (TEM) equipped® with a digital "Kodak Megaplus 1.6i camera" and image analysis and processing software, the size and form of extract nanoparticles were studied at 70 kV. (AMT, USA). As previously stated by Sathishkumar *et al*., (2009) the sample was pared by depositing a drop of each solution on a carbon-coated copper grid and drying at room temperature. TEM micrographs were used to estimate the size distribution of the resultant nanoparticles.

Fourier Transform Infra-Red Spectroscopy (FTIR) spectra:

At room temperature, the FTIR spectra of AgNPs were recorded on a Perkin–Elmer spectrophotometer in the range 4000–400 cm^{-1}. The UV140404B spectrophotometer was used to record diffuse reflectance spectra in the wavelength range of 200–800 nm. The 'Origin 7' software was used to plot numerical data (Slman, *et al*., 2018).

X-Ray Diffraction (XRD) analysis:

The resultant solution of the produced nanoparticles of silver was spun for 30 minutes at 10,000 rpm using XRD analysis. To prepare powder AgNPs for X-ray powder diffraction studies, the solid residues of AgNPs were washed twice with double distilled water and then dried at 80 °C. The patterns of powder X-ray diffraction (XRD) were recorded on a (Shimadzu XRD-6000) using copper radiation (Cu Ka, 1.5406) at 40 kV and 30 mA. (Slman *et al*., 2018).

RESULTS AND DISCUSSION

Tests proving the formation of AgNPs for fresh Neem leaves (*Azadirachta indica*):

This research used and presented a complete study on the production of silver nanoparticles by fresh Neem leaves (*Azadirachta indica*). When aqueous silver ions were introduced to plant extracts, they were converted to silver nanoparticles. 24 hours prior to the reaction, the colour of the solution changed from yellow to dark brown, indicating the creation of silver nanoparticles. UV–vis spectrophotometer analysis was used to track the generation and stability of reduced silver nanoparticles in colloidal solution. The UV–vis spectra showed maximum absorbance at 420 nm, which increased with time of incubation of silver nitrate with the plant's extract. The dual role of the plant extract as a reducing and capping agent and the presence of some functional groups was confirmed by FTIR analysis of silver nanoparticles. The size, shape, and morphology of nanoparticles have been determined using transmission electron microscopy (TEM). It demonstrates that the silver nanoparticles are well disseminated and primarily spherical, with some NPs having irregularly shaped structures, as shown in Fig (1)

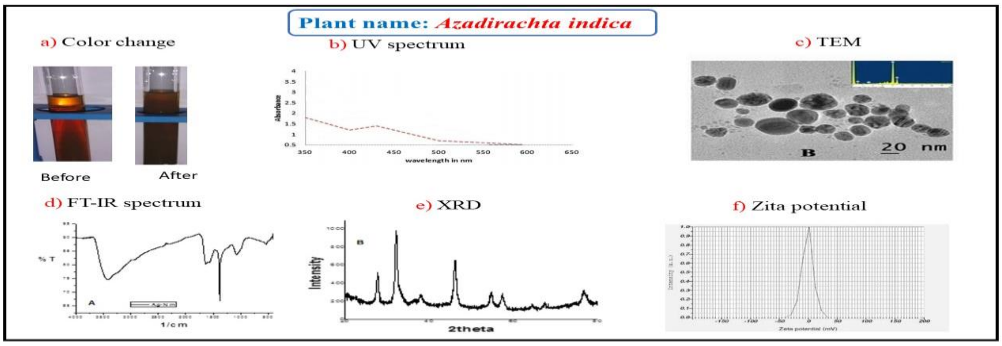

Fig. 1. Tests of silver nanoparticles formation by aqueous extract of Neem (*Azadirachta indica*) extract.

The impact of the toxicity of Malathion 57% EC, Potegon 20% SP, K. Z oil, and Neem extract AgNPs at recommended concentrations against *A. gossypii* and their side effect on enzymes as indicators on fertility of soil cultivated with tomato during the summer seasons of 2018/2019 and 2019/2020 were evaluated.

Reductions in percentages of infestation by *A. gossypii* after application of tested insecticides and their alternatives are shown in Tables 3 and 4. The obtained results indicated that Malathion was the highest efficacy in reducing infestation, exhibiting 86.86, 96.05, 73.59, 77.50, 77.48, and 68.02 % reductions during the 2018/2019 season. While it exhibited 88.78, 91.55, 67.00, 73.45, 72.78, and 62.94 % reduction during 2019/2020 season when application took place at the recommended rate on tomato plants on 1, 4, 7, 10, 13 and 15 days after treatment, respectively.

Table 3. The reduction percentage of *A. gossypii* infestation after 1st spray by different treatment during 2018/2019 season.

Compounds	Rate / fed.	Pre-spray count	% Reduction post-treatment (day)						Mean
			1	4	7	10	13	15	
Malathion 57% EC	1L/200 L.w	81.67	86.86	96.05	73.59	77.50	77.48	68.02	79.92
Potegon 20% SP	25gm/100 L.w	58.67	83.56	83.88	66.61	61.92	66.40	73.28	72.61
K. Z oil	1L/200 L.w	61.67	76.52	75.11	64.53	80.04	73.85	69.05	73.18
Neem AgNPs	1L/200 L.w	69.33	71.52	74.49	72.90	70.90	73.42	71.87	72.52

The tested compounds could be arranged in descending order according to their efficacy as: Malathion 57% EC > Potegon 20% SP > K. Z oil > Neem extract AgNPs.

The result in Tables (3 & 4) indicated that Potegon 20% SP succeeded in controlling *A. gossypii*, since it reduced infestation by 83.56, 83.88, 66.61, 61.92, 66.40, and 73.28 % after 1, 4, 7, 10, 13 and 15 days of application for tomato plants during 2018/2019 season, opposed to 86.00, 84.30, 67.61, 58.86, 76.87, and 74.04 % on 2019/2020 season. Neem extract AgNPs resulted the lowest reduction percenages by 71.52, 74.49, 72.90, 70.90, 73.42, and 71.87 %, respectively in 2018/2019 and 71.60, 73.76, 72.03, 68.47, 71.03, and 71.36%, respectively in 2019/2020 season.

Table 4. The reduction percentage of *A. gossypii* infestation after 2nd spray by different treatment during 2019/2020 season.

Compounds	Rate/ fed.	Pre-spray count	% Reduction post-treatment (day)						Mean
			1	4	7	10	13	15	
Malathion 57% EC	1L/200 L.w	73.33	88.78	91.55	67.00	73.45	72.78	62.94	76.09
Potegon20% SP	25gm/100 L.w	65.00	86.00	84.30	67.61	58.86	76.87	74.04	74.61
K. Z oil	1L/200 L.w	63.33	74.70	84.90	60.04	76.06	72.47	69.69	72.97
Neem extract AgNPs	1L/200 L.w	70.00	71.60	73.76	72.03	68.47	71.03	71.36	71.38

Data in Tables (3 and 4) revealed that Malathion 57% EC, Potegon 20% SP, K. Z oil, and Neem extract AgNPs succeeded in controlling *A. gossypii*, where the means of reduction percentages of infestation were 79.92, 72.61, 73.18, and 72.52 % in 2018/2019 season, respectively. While, those were 76.09, 74.61, 72.97, and 71.38%, respectively in the 2019/2020 season. In similar investigation, Salem *et al*. (1986) tested malathion 57% E.C. at a rate of 1.5 liters / feddan aginst *R. maidis*. They indicated that 4-5 malathion applications minimize aphid damage. Omar *et al.* (2003) found that results of the laboratory tests showed that Silwet L-77 was the most toxic compound recording 0.81 and 12 ppm as LC_{50} and LC_{90}, respectively, followed by Malathion 62 and 220 ppm for LC_{50} and LC_{90}, respectively. Although, Sallam (2002) found that the descending order of efficiency of the tested compounds against aphid population was pirimicarb, pirimiphos-methyl, Malathion, Bio-Dux, and K.Z. oil. Also, Sunil (2020) reported that maximum reduction of aphid (88.89%) was recorded from Imidacloprid 17.8% SL at 50 g a.i./ha opposed to (85.34%) at 37.5 g a.i./ha at 3 days after spray. In other inveastgation, Sharma and Kumar (2020) indicated that thiamethoxam 25 WG 0.008 percent remained the most effective treatment against aphids, followed by dimethoate 30 EC 0.03 percent. Spiromesifen 22.9 SC 0.028 percent and indoxacarb 14.5 SC 0.005 percent, While Lambda-cyhalothrin 5% EC at 0.003 percent remained the least effective treatment.

Plant materials and their extracts have been used for decades, and the majority of African agronomists have been conveniently using various plant materials for insect pests management (El-Wakeil, 2013). These plant materials contain different chemical substances or compounds and modes of action that have different properties such as repellentcy insecticidal, antifeedants, growth inhibitors, oviposition inhibitors, ovicides, and growth-reducing effects on a variety of insect pests Beltagy and Omar(2016), and Mohan and Gujar(2002). Conversely, the regular application of synthetic insecticides by growers has led to countless problems like environmental pollution, pest resistance development, and human health issues (Nyirenda *et al.*, 2011).

The findings in this investigation indicated that neem extract and K Z oil contribute to protection against aphids. But the acquired results proved that their effect was less than those occurred by synthetic pesticides. There is a need to use other pest management methods such as plant materials (biopesticides) and their extracts, cultural methods, and biological control to reduce the level of resistance, pesticide residues on crops, and flourishing agricultural yields.

Effect of tested compounds on soil enzymes

1- Dehydrogenase activity

The activity of dehydrogenase in soil under tomato plants sprayed with K. Z. oil and Neem extract AgNPs remained unchanged but in the case of Malathion 57% EC, dehydrogenase activity was reduced compared with control, the highest reduction was observed after pesticidal application three days (0.10 μg TPF g^{-1} soil h^{-1}) in comparison to the soil sample which was analyzed after one day of pesticide application (0.16 μg TPF g^{-1} soil h^{-1}). In case of Potegon 20% SP, dehydrogenase activity was reduced (0.10 μg TPF g^{-1} soil h^{-1}) compared with control, and the activity of the dehydrogenase enzyme was restored after 15 days of pesticide treatment Table (5).

Table 5. Effect of tested compounds on soil dehydrogenase activity (μg of TPF g^{-1} soil h^{-1})

Compounds	Dehydrogenase activity (μg of TPF g^{-1} soil h^{-1})/ Days Post-treatment					
	1	3	5	7	10	15
Malathion 57% EC	0.16 ±0.01	0.10 ±0.01	0.11 ±0.00	0.11 ±0.01	0.12 ±0.01	0.13 ±0.01
Potegon 20% SP	0.15 ±0.01	0.14 ±0.01	0.10 ±0.00	0.13 ±0.00	0.14 ±0.01	0.15 ±0.01
K. Z. oil	0.14 ±0.01	0.14 ±0.01	0.14 ±0.02	0.15 ±0.01	0.14 ±0.00	0.14 ±0.01
Neem extract AgNPs	0.11 ±0.01	0.11 ±0.00	0.11 ±0.01	0.12 ±0.01	0.11 ±0.01	0.12 ±0.00
Control	0.16 ±0.01	0.16 ±0.01	0.16 ±0.00	0.15 ±0.00	0.16 ±0.02	0.16 ±0.01

The insecticidal treatment reduced the dehydrogenase activity compared to control. A slight effect has been noticed in case of K. Z. oil, and Neem extracts AgNPs (Table 5).

2- Phosphatase activity

The greatest reduction of phosphatase activity was observed in soil after 3 days of Malathion 57% EC, and Potegon 20% SP applications (1.97 and 2.11 μg p-NP g^{-1} soil h^{-1}, respectively), compared to the control sample analyzed at the same time (2.82 μg p-NP g^{-1}soil h^{-1}). The activity of phosphatase was restored after 15 days of application in case of Potegon 20% SP Table (6).

The largest reduction of phosphatase activity in soil accarred after 3rd day of Malation (1.97 μg P-NP g^{-1} soil h^{-1}).

Table 6. Effect of tested compounds on soil phosphatase activity (μg of P-NP hydrolyzed g^{-1} soil h^{-1})

Compounds	Phosphatase activity (μg of P-NP hydrolyzed g^{-1} soil h^{-1})/ Days Post-treatment					
	1	3	5	7	10	15
Malathion 57% EC	2.82 ±0.01	1.97 ±0.03	2.11 ±0.02	2.46 ±0.00	2.48 ±0.01	2.73 ±0.04
Potegon 20% SP	2.76 ±0.01	2.11 ±0.03	2.52 ±0.01	2.66 ±0.00	2.74 ±0.02	2.77 ±0.01
K. Z. oil	2.83 ±0.02	2.83 ±0.00	2.82 ±0.01	2.82 ±0.03	2.83 ±0.02	2.82 ±0.01
Neem extract AgNPs	2.82 ±0.01	2.85 ±0.03	2.87 ±0.01	2.85 ±0.00	2.86 ±0.01	2.85 ±0.02
Control	2.82 ±0.01	2.82 ±0.01	2.82 ±0.01	2.82 ±0.01	2.82 ±0.01	2.82±0.01

No phosphatase activity reduction was observed in the soil after K. Z. oil, and Neem extracts AgNPs applications than control (Table, 6).

3- Urease activity

The findings obtained in this study proved that Malathion 57% EC, and Potegon 20% SP inhibited urease activities. While K. Z. oil and Neem extract AgNPs had undetectable effect on overall urease activity as compared to the control. Inhibitory action of Malathion 57% EC and Potegon 20% SP on urease activity was observed throughout the sampling period as compared to control when applied (1.10 and 1.12 μg urea hydrolyzed g^{-1} soil h^{-1}).

The maximum reduction of urease activity (1.10 μg of urea hydrolyzed g^{-1} soil h^{-1}) was observed in the soil after three days of Malation application compared to 1.17 μg of urea hydrolyzed g^{-1} soil h^{-1} for the control treatment (Table, 7).

Table 7. Effect of tested compounds on soil urease activity (μg of urea hydrolyzed g^{-1} soil h^{-1})

Compounds	Urease activity (μg of urea hydrolyzed g^{-1} soil h^{-1})					
	1	3	5	7	10	15
Malathion 57% EC	1.17 ±0.02	1.10 ±0.04	1.11 ±0.01	1.13 ±0.02	1.14 ±0.01	1.14 ±0.00
Potegon 20% SP	1.16 ±0.01	1.12 ±0.02	1.13 ±0.02	1.13 ±0.01	1.14 ±0.04	1.15 ±0.01
K. Z. oil	1.15 ±0.02	1.16 ±0.02	1.15 ±0.03	1.15 ±0.01	1.16 ±0.00	1.15 ±0.01
Neem extract AgNPs	1.16 ±0.01	1.16 ±0.04	1.15 ±0.00	1.16 ±0.01	1.15 ±0.03	1.15 ±0.01
Control	1.17 ±0.05	1.17 ±0.01	1.16 ±0.03	1.17 ±0.00	1.16 ±0.02	1.17 ±0.01

Based on the information presented above, it could be concluded that the microbial activities (i.e., enzyme activities) in soil were not affected by the K. Z. oil, and Neem extract AgNPs applied on tomato plants, while the chemical insecticidal application caused reduction in these activites (Table 5, 6 and 7).

These results are in line with Lingxi *et al*. (2020) who assumed that the long-term co-existence of chlorothalonil, chlortetracycline, and ciprofloxacin altered the dissipation characteristics of chlorothalonil in soil and affected the soil enzyme activity levels, in addition to the possibility for contamination of soil surface and groundwater with the pesticide residues. In this respect Xiaoxia *et al*. (2020) reported over the course of 21 days, the effects of a commercial Cu $(OH)_2$ nano pesticides formulation (NPF) on enzyme activities and bacterial populations in loamy soil with a 3.61 percent organic matter content. Acid phosphatase activity remained unchanged regardless of exposure dose, however substantial (p 0.05) alterations in invertase, urease, and catalase activities occurred at doses of 5 mg kg^{-1} or above. As respected by Monkiedje *et al*., (2002), and Antonious (2003) mentioned that the pesticide use also lowers soil enzymatic activity, which is used as a biological indicator of soil fertility and biological processes in the soil environment. Also, the pace of enzymatic reactions in soil varies with the seasons and is primarily regulated by the concentration of enzymes and substrates involved in the processes, which is influenced by pH, granulometric composition, temperature, and the presence of activators and inhibitors, among other factors (Gianfreda and Rao, 2010; Jian *et al*., 2016).

Several studies have found that the activity of soil enzymes is either unaffected or decreases after pesticide treatments (Kalam, *et al*., 2004; Yan, *et al*., 2011). Scientists make greater reseach efforts to provoke local knowledge that smallholder growers possess about plant materials for pest management and their effect on soil fertility. The present study is one of the few studies conducted in Upper Egypt on the use of conventional pesticides, plant extracts, and a mineral oil to reduce the aphid population on tomato plants. The authers hypothesized that the plant material extracts will reduce the abundance and damage resulting from aphid infestations compared to the synthetic insecticide. The study was carred out to provide farmers with a cheaper and safer way of managing insect pests through using locally available plant material extracts in managing insect pests that would guarantee lower residue accumulation in their products, soil, and increase their production.

It could be concluded that there is a potential of using biopesticides, particularly the K.Z. oil, and neem-based formulations in control aphid on tomatoes, although not decresed effect than the synthetic insecticide, but can be included in modem pest management programs, where the use of synthetic pesticides is undesirable or restricted.

CONCLUSION

From the present two years results, it could be concluded that Malathion 57% EC can be considered the most effective treatment against aphid in tomato followed by Potegon 20% SP and K. Z oil. In contrast, Neem extract AgNPs was the least effective one although of this decreased direct effect on the target pest (aphids). K. Z oil and Neem extract AgNPs provide less effective soil enzyme, so those may be adviced to be sprayed on tomato plants for the cotton aphid control.

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فاعلية بعض المبيدات والبدائل ضد حشرة المن، *Aphis gossypii* Glover على محصول الطماطم وتأثيرها على خصوبة التربة

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تهدف الدراسة الحالية الى تقييم سمية الملاثيون 57٪ EC، بوتيجون 20% SP، زيت KZ، و مستخلص النيم AgNPs (*Azadirachta indica*) لمكافحة حشرة المن، *Aphis gossypii* ودراسة تأثير هذه المبيدات على انزيمات التربة متمثلة فى انزيم الديهايدروجينيز والفوسفاتيز واليوريز كمؤشرات على خصوبة التربة وعناصرها الكبرى وهى النيتروجين والفسفور والبوتاسيوم في محصول الطماطم. يمكن ترتيب المبيدات التي تم اختبارها بترتيب تنازلي حسب فعاليتها على النحو التالي: الملاثيون 57٪ EC > بوتيجون 20% SP > زيت KZ > مستخلص النيم . نجح الملاثيون 57٪ EC، بوتيجون 20% SP، زيت K.Z، ومستخلص النيم AgNPs في مكافحة آفة المن، حيث كانت متوسط نسب خفض الإصابة بالمن هي 79.92 و72.61 و73.18 و72.52٪ في موسم 2019/2018على التوالي. بينما كانت متوسطات نسبة الخفض في الإصابة بحشرة المن هي 76.09 و74.61 و72.97 و71.38٪ في موسم 2020/2019 على التوالي، ولم يتأثر نشاط انزيمات التربة بزيت K.Z ومستخلص النيم AgNPs المستخدم في الدراسة. أظهرت الدراسة أن الزيوت المعدنية والمستخلصات النباتية قد تلعب دور حيوي في برامج المكافحة المتكاملة لحشرة المن على محصول الطماطم.