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Effect of magnetized water on the bio-efficacy of alpha cypermethrin against *Thrips tabaci* (Thysanoptera: Thripidae) infesting green onion plants

Mohamed, H. Soliman; Hosnea, A. Afifi; Ola, M. Roshdy and Ahmed, I. Amer
Plant Protection Research Institute, Agricultural Research Center, Dokki, Giza, Egypt.

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Abstract

Onion, *Allium cepa* L. belongs to the family Alliaceae and is an herbaceous winter vegetable. Onion is used approximately every day in a large variety of dishes as a fresh salad or added in cooking dishes. *Thrips tabaci* Lindeman (Thysanoptera: Thripidae) causes damage to onions by their rasping and sucking mouth parts affecting both the yield and viability of the seed yield. The water which is used in the spray solution causes degradation to insecticide as a result of heavy metals mixing with water. The specific objectives of the present study were to find out the effectiveness of the water magnetization on bio-efficacy to alpha cypermethrin against thrips infesting green onion compared with normal water. The present investigation was carried out at the Plant Protection Research Station, at Qaha station, Qalyubia governorate, Egypt during the winter 2021–2022. The results of statistical analysis reported that there were significant differences between each treatment in case of initial effect, after 3, 5, 7 and 14 days from spray. Whereas insignificant deference in case of residual effect after two applications. Concerning the first spray, magnetic water with alpha cypermethrin treatment was the most superior recording 85.44 % at initial effect, followed by alpha cypermethrin with un-magnetization water at 49.24 % and magnetic water recording 21.45 % reduction. The highest reduction of residual effect was 71.58 % for magnetic water with alpha cypermethrin followed by alpha cypermethrin with un-magnetization water 62.01 %, and magnetic water caused 49.48 % reduction to *T. tabaci* individuals. In the case of second application, concerning immediate annihilation (Initial effect) magnetic water with alpha cypermethrin comes in first order followed by alpha cypermethrin with un-magnetic water and magnetic water, respectively. The paper recommended that from necessary water magnetization before adding alpha cypermethrin.

Introduction

The onion crop *Allium cepa* L. belongs to the family Alliaceae and is considered one of the important export crops, which is distinguished from other crops in that it grows in most climatic regions of the

world and Egypt. It is considered one of the countries distinguished in the production of onions. Onions are compatible with the environmental and climatic conditions in Egypt with the needs of this crop. It has many advantages that make it occupy a distinguished position among the producing and exporting countries in the global markets (Astley *et al.,* 1982). The total cultivated area of onion is 4057 feddans with an annual production of 57744 tons of bulb with an average of 14.233 ton/feddan (Ministry of Agriculture and Land Reclamation Statistic, 2019).

Onions are infested with many pests including insects (Arkhipove, 1984). The onion thrips, *Thrips tabaci* Lindeman Thysanoptera, Thripidae) principally a pest of onion crops. Both nymphs and adults greatly harm the crop, resulting in yield losses of 10–20 % per year and leaf damage of up to 40–60 % (Waiganjo *et al.,* 2008). Onion thrips when fed on leaves cause death in young plants, reduced onion yield, seeds and bulb size. If onion thrips are not controlled, onion yield reduction can reach levels from 34 % to nearly 50 % (Fournier *et al.*,1995).

Also, the trips cause environmental problems and remain persistent and active. It is difficult to control this pest by causes its small size and hidden inter and between bulbs leaves habits (Lewis, 1997). Methods of various control using different materials were used to reduce the population of onion thrips below economic injury level (EIL) and to get high production of onions. Groundwater used for irrigation and dilution can contain salts and heavy metals, reducing insecticide efficiency and sedimentation. Magnetically Treated Water (MTW) has many benefits, but it needs to be investigated to clarify its role and biological effects on humans, animals, and plants (Pang and Deng, 2008). Hasaani *et al.* (2015) studied the interaction of magnetic fields with flowing water and found that physical properties such as pH, TDS, EC, viscosity, surface tension, and thermal conductivity decreased. Water molecules have a small dipole and can be affected by exogenous electric and magnetic fields, leading to changes in conductivity, TDS and pH. (Baker and Judd, 1996). Kotab (2013) found that the magnetic water conditioner increased pH by 15.65 % for 820 minutes of non-stop circulation, while TDS and Hardness were not affected. Biological benefits claimed include increased commercial earliness of crops; increased yield; increased vitamin C, sugar and total acid content and increased flowering and fruit set (Pavlov *et al.,* 1983). Under Egyptian conditions, the application of magnetic technology is a new concept. Guo *et al.,* (1994) reported that magnetizing seeds is very efficient to increase the number of germinating seeds and to hasten the germination process.

Hillal and Hillal (2000) reported that full wheat germination of 100 % was obtained after 6 days for magnetic treatment compared to a rate of 83 % after 9 days for normal practice. They also observed that the germination of pepper seeds was higher with magnetically treated seeds compared to seeds with magnetically treated irrigation water. Cucumber seeds had the highest germination percentage when both irrigation water and seeds were magnetically treated. They also reported that tomato seeds responded more favorably to magnetically treated irrigation water than the magnetically treated seeds. Due to the high price of the water magnetizer, we thought of using a round magnetic pole was low cost. The specific objectives of the present study were to find out the effectiveness of the water magnetization on bio-efficacy to alpha cypermethrin against thrips infesting green onion compared with normal water.

Materials and methods

1. Insecticides: alpha cypermethrin 10 % EC at a rate of 100cm / 100 L of water.

Magnetized water:

Magnetized water was obtained by passing irrigation water on the magnetized water apparatus (2 inch/ 2000 salinity, inner diameter 3 cm - device length 60 cm – strong 5000 Gauss - flow rate 2 m^2/hour. In this study, using groundwater from the water well at a depth of 80 meters, the water was collected after a period of half hour from startup, whereon divided the water into two kinds, the first type of groundwater was using magnetized water after 15 minutes from passes during magnetic pole, thenceforth adding of insecticide to magnetized water, the two types from groundwater were normal water without using a magnetic pole.

Onion plants were examined weekly till the appearance of *T. tabaci* above the critical economic threshold limit. A Knapsack sprayer (Dorsal sprayer) was used to spray each treatment alone. The experimental sprayed twice between it was 14 days. Plant samples were taken from each plot, 10 plants were taken and put in paper bags, after that transferred to the laboratory at the station of Plant Protection Research, Qaha, Qalyubia governorate, Egypt to examination. *T. tabaci* adult and nymph were counted and recorded after 1st, 3rd, 5th, 7th and 14th day from application, mean and reduction percentages were recorded and statistical analysis was carried out according to Henderson and Tilton (1955) equation. % reduction percentage = 100 * (1 - (Ta * Cb)/ (Tb * Ca), where:

Ta= number of thrips after spray; Tb= number of thrips before spray.

Ca =number of thrips in the control after spray; Cb = number of thrips in the control before spray.

2. Experimental design:

The present investigation was carried out at plant protection research station, at Qaha, Qalyubia governorate, Egypt, during winter 2021/ 2022 to study and evaluate effect of magnetized water on bio- efficacy to alpha cypermethrin insecticide against *T. tabaci*, infesting green onion plants at field. The onion field divided into 4 treatments, each treatment was distributed on 12 plots, plot area 1/100 from faddan (42 m^2). The treatments distributed on area randomized complete block design. Onion plants (Var. red), date of planting was the last week of December 2021.

3. Statistical analysis:

The reduction percentage of thrips was analyzed by one-way ANOVA and means were compared by using student's least significant difference. Significance level was $P< 0.05$. Analysis was conducted using SAS statistical software (SAS Institute, 2003).

Results and discussion

1. Impact of water magnetization on bio-efficacy of alpha – cypermethrin against *Thrips tabaci*:

The current study was conducted to know the effectiveness magnetized water on efficiency of alpha cypermethrin 10 % EC against the population of *T. tabaci*. The data regarding the mean number of *T. tabaci* before and after application. The data from (Table 1 and Figure 1) show pre-treatment beginning 156, 216, 239 and 274 individuals of *T. tabaci* at treatments as follows: Magnetized water with alpha cypermethrin treatment, normal water with alpha cypermethrin, control (Normal water) and magnetized water. In the same table, initial effect after 1st day from the application, the results indicated that the population decreased compared with before treatment whereby noticed that less population record 22 individuals when sprayed using magnetized water with alpha cypermethrin, but other treatments were as follows: normal water with alpha cypermethrin record 107, magnetized water record 217 and control (Normal water) record 241 individuals. The same trend occurs at the 3rd and 14th day from spray where adding insecticide to magnetized water come to the first order record of 10 and

181 adults, but these results differed at the 5th and 7th days from spray recorded 28 and 105 individuals as a second order after normal water with alpha cypermethrin which records 8 and 100 individuals while other treatments come after that. In case of, residual effect adding alpha cypermethrin to magnetized water record less population 81 individuals compared with other treatments normal water +Alpha cypermethrin record 137 individuals, magnetized water record 172.5 individuals and control record 339 individuals, respectively.

Table (1): Mean number of *Thrips tabaci* before and after first spray.

Treatments	Mean number of *Thrips tabaci* before and post-treatment						Residual effect
	Pre Treatment	Initial effect	3 Days	5 Days	7 Days	14 Days	
Magnetized water	274	217	157	163	170	200	172.5
Magnetized water + Alpha cypermethrin	156	22	10	28	105	181	81.0
Normal water +Alpha cypermethrin	216	107	50	8	100	390	137
Control (Normal water)	239	241	305	315	346	390	339

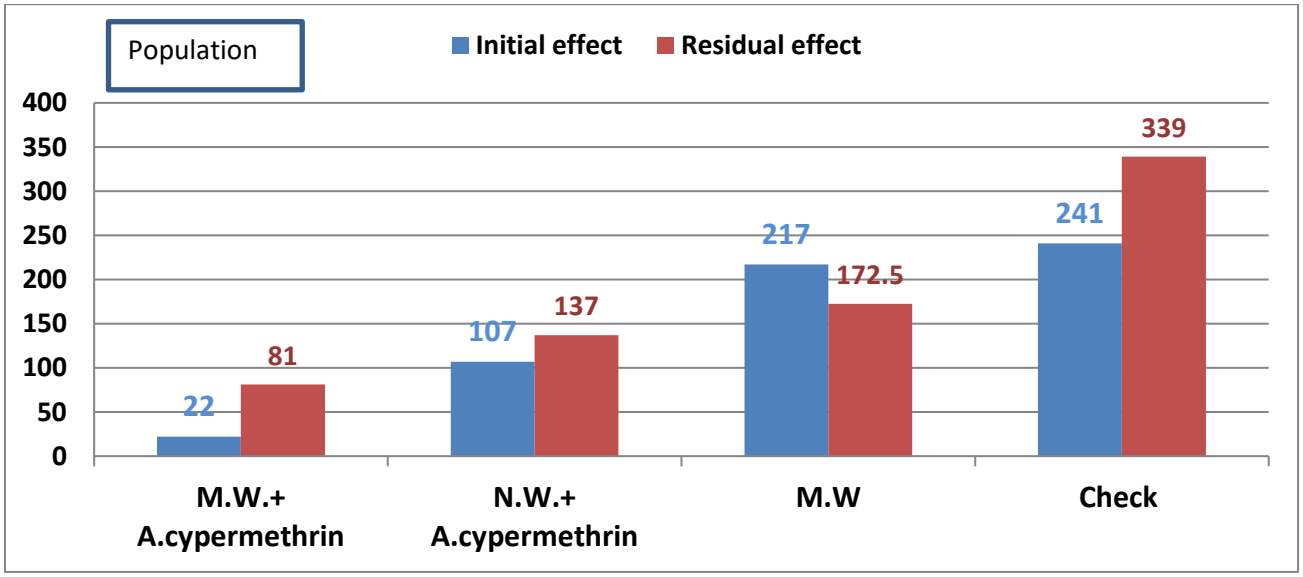


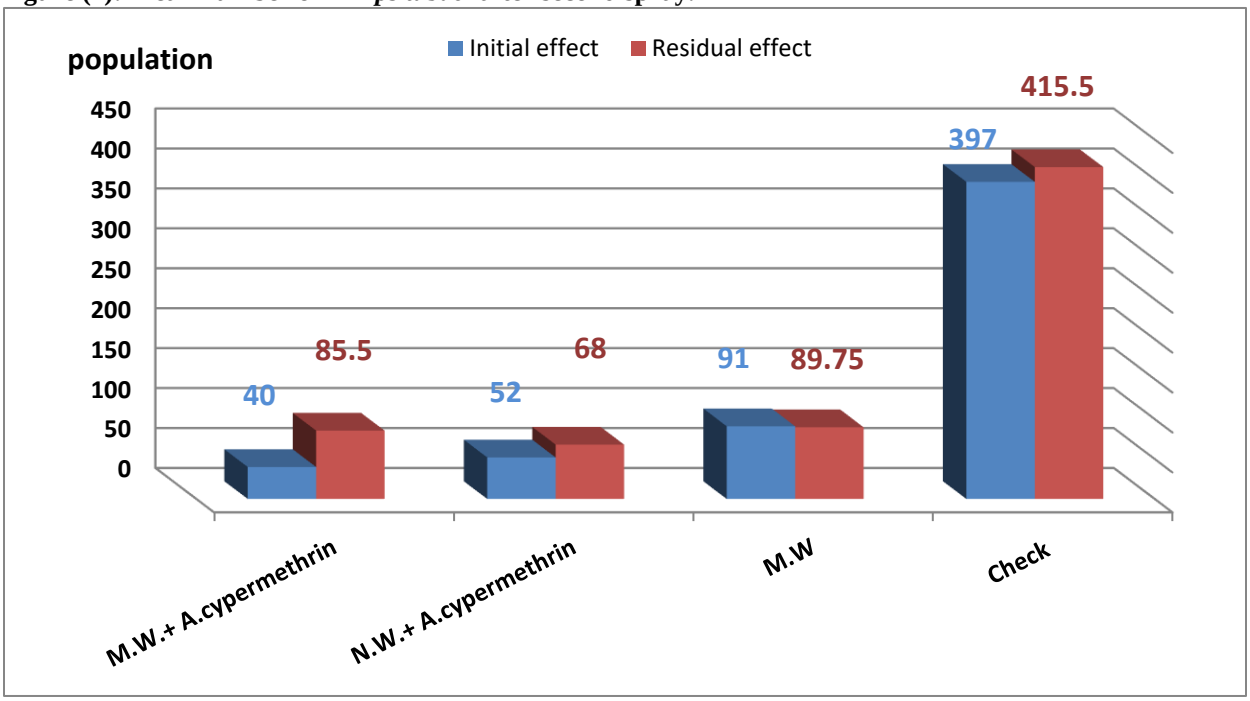
Figure (1): Mean number of *Thrips tabaci* after first spray.

The results tabulated in (Table 2 and Figure 2) show that each treatment reduces the population of *T. tabaci* after the first spray (Initial effect) contrast with the population before the spray without control treatments. In the case of the initial effect (After the first day from spray) the data illustrate that mixing alpha cypermethrin with magnetic water recorded less population of 40 individuals followed by alpha cypermethrin with un-magnetization 52 individuals, magnetic water 91 individuals and control 397 individuals. On the other hand, the column includes residual effect in the same table and the same Figure (2) the results obvious that treatment of alpha cypermethrin with un-magnetization water recorded 68 individuals, magnetic water with alpha cypermethrin 85.5 individuals thenceforth magnetic water recorded 89.75 and control (Check) which record 415.5 individuals.

Table (2): Mean number of *Thrips tabaci* before and after second spray.

Treatments	Mean number of *Thrips tabaci* before and post-treatment						Residual effect
	Pre-treatment	Initial effect	3 days	5 days	7 Days	14 days	
Magnetic water	225	91	51	70	110	128	89.75
Magnetic water with alpha cypermethrin	200	40	29	87	97	129	85.5
Alpha cypermethrin with un-magnetization water	187	52	34	60	65	113	68
Control (Un-magnetic water)	395	397	400	405	407	450	415.5

Figure (2): Mean number of *Thrips tabaci* after second spray.



2. Reduction percentage of *Thrips tabaci* infesting green onion after first spray by mixing water magnetization with alpha – cypermethrin:

Data in Table (3) show the impact of adding water magnetic to alpha cypermethrin on the reduction percent of *T. tabaci*, the results of statistical analysis reported that there were significantly different treatments in each treatment in the case of initial effect. Whereas, after 3, 5, 7 and 14 days from spray were insignificant differences between treatments and residual effects. The highest reduction percentage in initial effect was 85.44% for magnetic water with alpha cypermethrin, thenceforth alpha cypermethrin with un-magnetization water was 49.24 % and magnetic water recorded 21.45 % reduction. Whereas the residual effect of magnetic water with alpha cypermethrin come in first order with a reduction percent 71.58 % followed by alpha cypermethrin with un-magnetization water 62.01, and magnetic water caused 49.48 % reduction in *T. tabaci* individuals, with non-significant difference.

Table (3): Reduction percentage of *Thrips tabaci* infesting onion as a result after first application of water magnetization with alpha – cypermethrin.

Treatments	Reduction percentage after 1st application					
	Initial effect	3 Days	5 Days	7 Days	14 Days	Residual Effect
Magnetic water	21.45 c	55.26 c	54.66 c	57.33 ab	58.70 a	49.48 a
Magnetic water with alpha cypermethrin	85.44 a	95.24 a	86.12 b	49.21 b	41.89 a	71.58 a
Alpha cypermethrin with un-magnetization water	49.24 b	81.66 b	97.12 a	67.49 a	14.52 b	62.01 a
F. value	11.9	117.34	73.27	2.76	18.49	1.30
P value	0.0013	0.0001	0.880	0.123	0.001	0.325
LSD 05	18.06	6.12	8.39	17.98	16.91	31.74

3. Reduction percentage of *Thrips tabaci* infesting onion as a result after second application of water magnetization with alpha–cypermethrin:

From displayed the results in Table (4), the statistical analysis shows that there were significant differences between each treatment after application, where that F-value and LSD_{05} value at initial effect, 3rd day, 5th day, 7th day , 14th day and residual effect record following (33.73 and 6.01), (7.30 and 5.14), (1.88 and 14.41), (4.13 and 14.18) , (1.47 and 6.74) and (1.35 and 10.05) , respectively. Concerning immediate annihilation (Initial effect) magnetic water with alpha cypermethrin come in the first order recording 80.10 % reduction followed by alpha cypermethrin with un-magnetic water which record 72.33 % reduction and magnetic water with 59.75 % reduction, respectively. On the other side is the same (Table 4).

The results from residual effect recorded 65.99, 63.55 and 60.78 % reductions in *T. tabaci* individuals for alpha cypermethrin with un-magnetic water, magnetic water, and magnetic water with alpha cypermethrin, respectively. These results were in good agreement with that obtained by Shahin *et al.* (2016) demonstrated the beneficial effects of applying magnetic water treatment on soil and plants. The magnetic treatment of irrigation water plays an important role for the growth parameters of cucumber plants. Magnetic irrigation water and or magnetized seeds significantly increased the germination percentage of tomato, eggplant, squash and cucumber seeds. Morejon *et al.* (2007) observed an increase in germination of *Pinus tropicalis* seeds from 43% in the control to 81% with magnetically treated water. Sohail *et al.* (2018) found that Curacron at 4 ml/L H_2O is recommended against onion thrips and budworm in Swat Valley.

The onion should be regularly checked for the attack of this pest. If the population increases above Economic Injury Level (EIL) of 20 thrips per plant, then the crop should be sprayed with Curacron at recommended dose. Spraying can be repeated if the pest population exceeds this number. Magnetically treated seeds reduce *Tetranychus urticae* Koch (Acari: Tetranychidae) populations and *T. tabaci* with rising exposure time to the magnetic field (Alakhdar *et al.*, 2022).

Table (4): Reduction percentage of *Thrips tabaci* infesting onion as a result after second application of water magnetization with alpha – cypermethrin.

Treatments	Reduction percent after 2nd application					
	Initial effect	3 Days	5 Days	7 Days	14 Days	Residual Effect
Magnetic water	59.75 c	77.61 b	69.65 a	56.87 b	50.06 a	63.55 a
Magnetic water with alpha cypermethrin	80.10 a	85.68 a	57.57 a	52.92 ab	46.95 a	60.78 a
Alpha cypermethrin with un-magnetic water	72.33 b	82.35 a	68.7 a	66.26 a	46.95 a	65.99 a
F. value	33.73	7.30	1.88	4.13	1.47	1.35
P value	0.0001	0.015	0.214	0.058	0.285	0.313
LSD 05	6.01	5.14	14.41	14.18	6.74	10.05

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