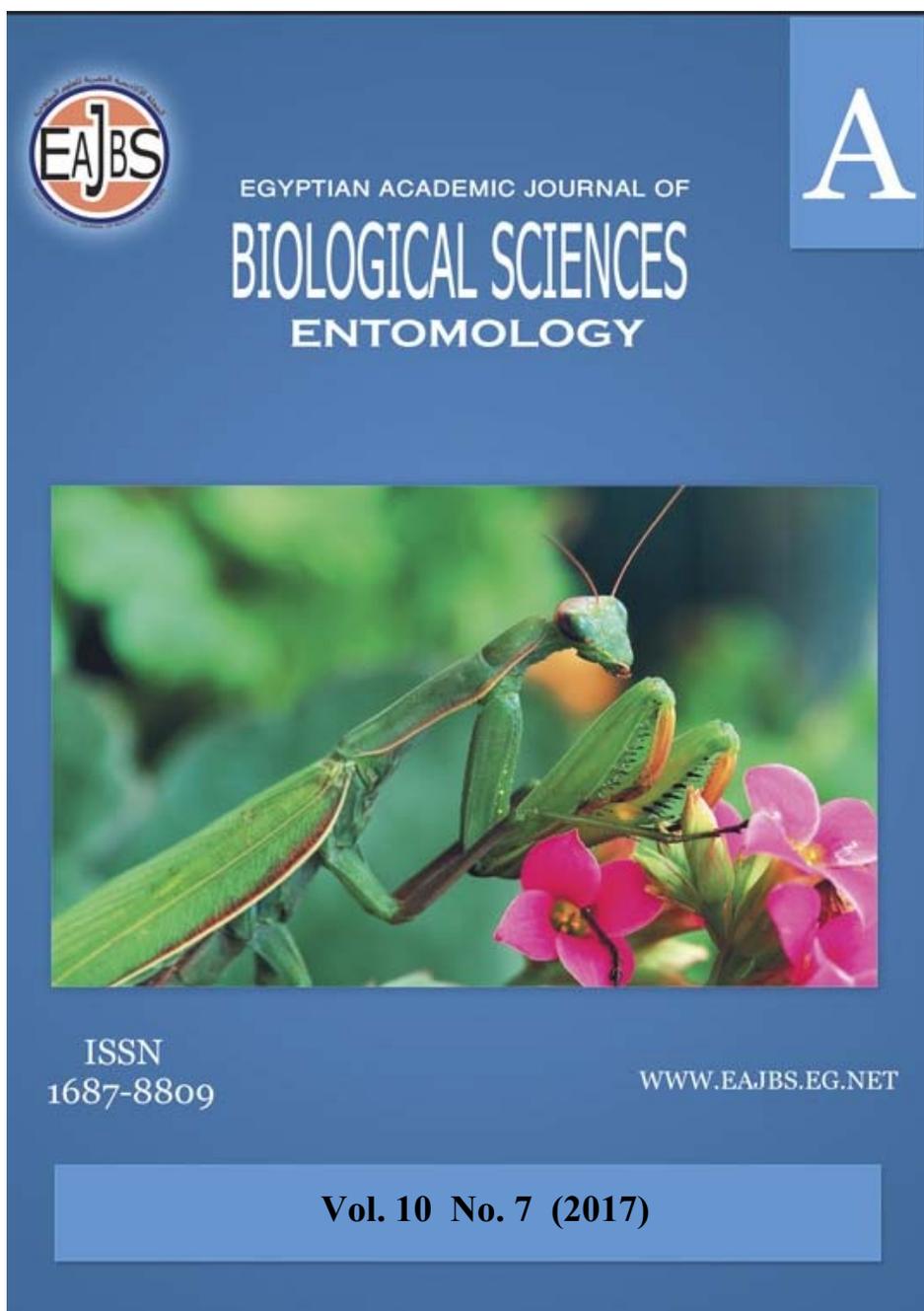


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The Effect of Magnetic Force and Magnetic Water on Behavior and Population of *Tetranychus urticae* and *Esuseis scutalis* on Soybean in the Laboratory and Field.

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ABSTRACT

Two experiments were carried out to study the effects of magnetic force and magnetic water on two spotted spider mites *Tetranychus urticae* (Koch) (Acari: Tetranychidae) and *Esuseis scutalis* (El-Badry) (Acari: Phytoseiidae). In the first experiment leaflets of infested soybean with *T. urticae* and *E. scutalis* were passed through different concentrations of magnetic force and magnetic water at different time intervals the concentrations of magnetic force and magnetic water in the laboratory were 100, 200, 300, 400 and 500 Gausses, respectively, while Magnetic force and magnetic water in the field were 1000, 2000, 3000, 4000 and 5000 Gausses, respectively. The second experiment was conducted by sprayed the infested leaflets to *T. urticae* and *E. scutalis* at three time intervals. The results in both experiments revealed that the numbers of two tested mites were reduced after treated with magnetic force or magnetic water. Also, the data indicated that magnetic force was the most effect on adults and the eggs stage of *T. urticae*, but was the least effective on *E. scutalis*, while magnetic water was moderate effect on eggs and adults of two tested mites. Under the field condition the magnetic force was the most effect on behavior and population of *T. urticae* and *E. scutalis*, while magnetic water was moderate effect on the population and behavior of eggs and motile stages to *T. urticae* and adults of *E. scutalis*

INTRODUCTION

The wide use of the chemical compounds resulted many problems such as population out breaks and chemical resistance. The continues use the compounds to control for pests has caused environmental pollution. Therefore it has become necessary to search on safe compounds against pests. The magnate is been measured by Gauss and every 10000 G equal to tesla. The magnetic field to the earth is about 0.5 gauss (Marshall and Skitek 1987).

Tetranychus urticae (Koch) is one of the most phytophagous spider mite species and it's a major pest in many cropping system world-wide (Nauwen *et al.* 2001), attacking different agricultural crops such as field crops, vegetables, fruits and ornamental plants (Dermauw *et al.* 2012). Tetranychid mites have been reported as pests of more than 300 plant species (Jeppson *et al.* 1975), ranging from green house crops to small fruit and trees. The two-spotted spider mite, *T. urticae*, considered one of the main economic pests of soybean, which cause a great damage and sever losses (El-Sanady *et al.* 2008).

The use of predators had proved to be one of the most effective control method

for tetranychid mites and the most effective predators have been found in the family, Phytoseiidae on various crops (McMurtary and Croft 1997).

Esuseis scutalis (El Badry 1967) is an importance phytoseiids mite on various crops (Croft and Mc Grotary 1977) and it is a key predator for managing spider mites (Specht, 1968). This predator is a specialized predator of the two spotted spider mites; reproduce mor quickly than the two spotted spider mites. Fed on all stages of the two spotted spider mite.

Also, *Phytoseiulus persimilis* (Athias-Henriot) is an important phytoseiidae mites on various crops (Croft and McGrotary 1977). And it is a key predator for managing spider mites (Specht, 1968). The possibility of controlling phytophagous mites by a combination of biological and chemical methods had proved aless costly and more permanent method of control than had pesticides alone (Hosny *et al.* 2003) and (Magouz and Saadoon 2005).

Soybean, *Glycine max* (L.) Merr., considered one of the relatively newcrop into the Egyptian a agricultural , which combines in one crop both the dominant supply of edible vegetable oil and dominant supply of high-protein feed supplements for livestock. Other fractions and derivatives of the seed have substantial economic importance in a wide range of industrial, food, pharmaceutical, and agricultural products (Smith and Huyser 1987). Yield and productivity of soybean can be significantly affected by some biotic factors such as insect and mite pests so, two experiments were carried out to study the effects of magnetic force and magnetic water on two spotted spider mites *Tetranychus urticae* (Koch) (Acari: Tetranychidae) and *Esuseis scutalis* on soybean.

MATERIALS AND METHODS

Culture techniques:

Culture techniques of *Tetranychus urticae*:

The two-spotted spider mite, *Tetranychus urticae* was reared according to Dittrich (1962).

Culture technique of predatory mite *Esuseis scutalis*:

The 1st predator used in this study was *Esuseis scutalis* (El-Badry) (Acari; Phytoseiidae) which was collected and described by El-Badry (1967) and Overmeer *et al.* (1982).

Experimental techniques:

Effect of tested compounds to adult females of *T. urticae*:

To evaluate the toxic effect of tested chemicals to the two-spotted spider mite *T. urticae*, all compounds were evaluated by the leaf disc dip technique according to Siegler (1947) .Mortality counts were made 24 hours after treatment. Correction for the control mortality was made using Abbott's formula (1925). Data were plotted on log dosage probit papers and statistically analyzed according to Litchfield and Wilcoxon (1949). Each treatment was replicated four times. In the lab after placing the disk in the plant is placed magnetic strength in the middle of these disks and then placed four pieces of metal on the edges of the dish to activate the magnetic forces and become in the image of moving magnetic field as these forces move from north to south and the area of the dish homogeneous magnetic effect. The magnetic field is placed in the middle of this piece and then four metal pieces are placed on the edges of the area to activate the magnetic forces and become in the moving image of the magnetic field as these forces move from north to south and the area of the dish is homogeneous magnetic effect.

Effect of tested compounds to eggs of two-spotted spider mite *T. urticae*:

Red spider mite eggs as prey were obtained by placing approximately 10 adult females of *T. urticae* on a clean castor bean leaf disc placed upper side upon a water soaked cotton wool pad in petri dish. Sufficient discs were set up to provide enough eggs for the following day's experiments. The adult mites were allowed to oviposit overnight and then were removed. Prey eggs were never longer than 24 hours old at the start of an experiment. The number of eggs on each disc was counted. The discs attached with eggs were immersed in each chemical dilution on the test liquid for seconds with gentle agitation. Untreated discs were immersed in distilled water. The tested eggs were kept together with untreated controls, in a holiday chamber of about 25 ± 2 °C and $70 \pm 5\%$ R.H. Assessment of the results was made when the emergent eggs in the control have reached the protonymphal stage. A count was then made of by this formula:

$$\text{Egg mortality} = (a/b) \times 100.$$

(a) untreated eggs, (b) number of total eggs which counted before treatment with toxicant. Correction for control mortality was made using Abbot's formula (1925).

Effect of tested compounds to adult females of predatory mite; *E. scutalis*.

The predator was reared by the same technique as described by Overmeer *et al.* (1982). The culture was kept under the same conditions of temperature and humidity.

Effect of compounds residues on *T. urticae* egg deposition and egg-hatching:

To assay the residual effect of each tested chemical at LC₂₅ level on adult prey mites, the technique advised by Keratum and Hosny (1994).

Effect of compounds residues on egg consumption, egg laying and egg hatchability of predatory mite:

The method which was adopted by Keratum and Hosny (1994).

RESULTS AND DISCUSSION

Laboratory studies.**Effect of magnetic water and magnetic force against adult and eggs of two-spotted spider mite *T. urticae*:**

The data represented in Table (1) indicated that concentrations (500 G) was caused the highest effects in egg deposition comparable to the control treatment through the magnetic force with (5.25 % reduction) followed concentrations (400 G) by (7.25 % reduction), while concentrations (300 and 200 G) caused a moderate reduction in egg deposition by (11.50 and 14.50% reduction). The least effects in egg deposition was to concentrations (100 G) by (19.00% reduction).

The magnetic water concentration (500 G) was caused the highest effective in egg deposition comparable to the control treatment through the magnetic force with (11.45 % reduction) followed concentration (400 G) by (12.21 % reduction) while concentration (300 and 200 G) caused a moderate reduction in egg deposition by (15.20 and 15.39 % reduction). The least effective in egg deposition was to concentration (100 G) by (20.33% reduction). Nabeel (2010) studied the effect of magnetic field on the number of eggs *T. urticae*. The number of eggs was highly affected by the time of exposure.

Also, the data in Table (1) indicated that all concentrations caused decrease in egg hatchability comparable to the control treatment in the magnetic force and the magnetic water. But in the concentrations of magnetic forces were caused the highest effective in egg hatchability followed by the concentrations of magnetic

water, the results suggested that concentration (500 G) was the most effective compound on egg hatchability (15.47 %) followed by concentration (400 G) by (18.83%). While concentrations (300) had a moderate effect on that character (29.64%). The concentration (100 G) was the least effective one (52.36 %) on this biological character to magnetic force. But the concentrations of magnetic water, results suggested that concentration (500 G) was the most effective compound on egg hatchability (21.47%) followed by concentration (400 G) by (24.13%). While concentration (300 G) had a moderate effect on that character (32.11%). The concentration (100 G) was the least effective one (55.29 %).

Ali *et al.*, (2014) and Hussein. (2014) found a linear negative relationship between the force of magnetic field and the percentages of the different pests eggs hatchability.

Table 1: Effect of magnetic water and magnetic force against adult and eggs of two-spotted spider mite *T.urticae*:

Concentrations (G)	Magnetic force(MF)			Magnetic water(MW)		
	No. of adults	Reduction of egg deposited/5 adults	Hatchability %	No. of adults	Reduction of egg deposited/5 adults	Hatchability %
Force 100	25.50±1.29b	19.00±1.51b	52.36	26.50±1.29b	20.33±0.88b	55.29
Force 200	19.25±0.50bc	14.50±1.91c	33.57	21.25±0.95bc	15.39±0.94c	36.86
Force 300	16.25±2.21c	11.50±1.91d	29.64	18.75±0.95c	15.2±1.15cd	32.11
Force 400	12.75±2.87d	7.25±0.95de	18.83	14.25±1.25e	12.21±1.00d	24.13
Force 500	11.50±1.29e	5.25±1.50e	15.47	12.50 ±0.57f	11.45±0.56e	21.47
Control	30.85±0.070a	27.25±0.75a	65.73	32.75±1.375a	29.4±1.01a	67.64

Effect of magnetic water and magnetic force against *Esuseis scutalis*.

The data in Table (2) indicated that all concentrations caused a decrease in prey egg consumption through the magnetic force and magnetic water, the concentration (500 G) was the highest decrease effect in prey egg consumption comparable to the control treatment, followed by concentrations (400 and 300 G) while concentrations (200 and 100 G) were the least effect in prey egg consumption but not similar to control treatment.

Table 2: Effect of different compounds residues on feeding capacity of predatory mite *E. scutalis* on soybean leaf discs:

Concentrations (G)	Magnetic force(MF)			Magnetic water(MW)		
	No. of consumed gg/adult/day		Average	No. of consumed egg/adult/day		Average
	1 st day	2 nd day		1 st day	2 nd day	
Control	17.25±0.50a	16.50±1.00a	16.87±0.75a	17.25±0.95a	18.00±0.81a	17.62±0.88a
Force 100	9.50±0.57b	9.50±0.57b	9.50±0.57b	8.50±0.57b	9.50±0.57b	9.00±0.57b
Force 200	9.25±0.50bc	9.00±0.81bc	9.12±0.655bc	8.00±0.81bc	8.25±0.50c	8.12±0.655bc
Force 300	8.50±0.57c	7.75±0.50c	8.12±0.535c	7.00±0.81c	7.00±0.81cd	7.00±0.81c
Force 400	6.25±1.25d	7.25±0.50cd	6.75±0.87d	6.50±1.00cd	6.75±0.95d	6.62±0.975d
Force 500	5.00±0.00e	4.75±0.50d	4.87±0.25e	4.50±0.57d	4.50±0.57e	4.50±0.57ef

The effects of different concentrations on *T. urticae* eggs were clearly observed in Figs. (1-5).



Fig (1) Concentrations 100 (Gausses) on eggs



Fig (2) Concentrations 500 (Gausses) on eggs

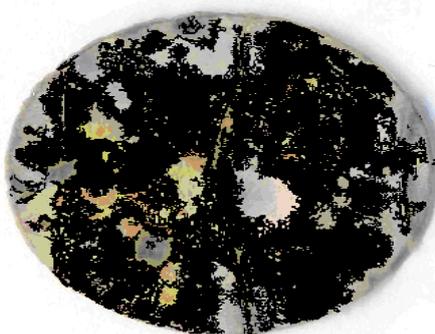


Fig (3) Concentrations 200 (Gausses) on eggs

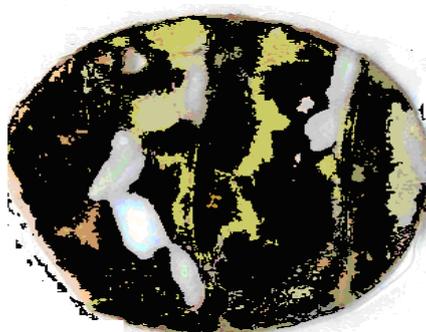


Fig.(4) Concentrations 300 (Gausses) on eggs

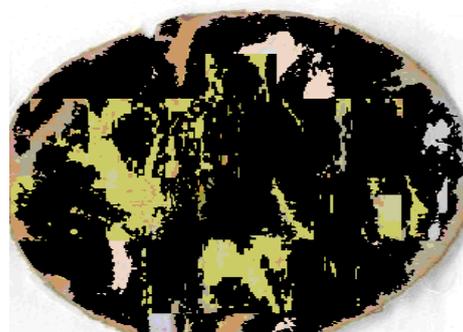


Fig.(5) Concentrations 400 (Gausses) on eggs

The data in Figure (2) showed that concentration (500 G) was the most effective concentrations on eggs of adult females of *T. urticae*. While concentration (100 G) was the least one and this due to the number of eggs increased this to magnetic force the same effect found in spray with magnetic water. The data due to direct effect of magnetic field on increasing some enzymes inside the eggs which make them mature in short times as compared by the control, Nabeel (2010).

Field studies:

Field experiments on soybean plants were carried out in the farm of Agricultural Research Station, Sakha, Kafr El-Sheikh, Egypt in order to study the effects of magnetic force and magnetic water on *T. urticae* and *E. scutalis* with different tested concentrations. Samples of 10 soybean leaves were randomly collected from each plot before and after treatment at intervals of two weeks. The percentage reduction of infestation was calculated for each treatment according to Handerson and Tilton equation (1955). All data recorded were analyzed according to the method of Duncan's multiple range tests.

Number of motile stages of mite *T.urticae* treated with different Concentrations on soybean plants in the field:

The data presented in Table (3) show that concentrations (500 G) was the most effective in reducing the population density of motile stages of *T. urticae* two weeks after treatment, followed by concentrations (400 G) while the concentrations (300 G) and (200 G) were of moderate effect, whereas concentrations (100 G) was the least effective concentrations in reducing the population density of motile stages of *T. urticae*. One week after application it was observed that the population density of motile stages of *T. urticae* decreased, in general. On all treatments were effective in reducing the population density.

Table 3: Number of motile stages of mite *T. urticae* treated with different Concentrations on soybean plants in the field

Concentrations (G)	Reduction %					
	Magnetic force(MF)					
	1 week	3 weeks	5 weeks	7 weeks	9 weeks	12 weeks
1000	18.64	23.74	26.63	29.56	32.59	30.75
2000	22.85	26.34	34.55	47.23	40.33	38.64
3000	36.71	38.22	44.59	47.71	55.35	53.44
4000	48.36	53.65	56.73	58.56	63.47	60.72
5000	61.55	63.75	66.43	70.21	77.82	73.64
Concentrations (G)	Reduction %					
	Magnetic water(MW)					
	1week	3 weeks	5 weeks	7 weeks	9 weeks	12 weeks
1000	15.69	18.43	18.58	21.45	28.62	26.99
2000	16.78	21.75	27.55	31.23	30.69	28.66
3000	31.58	33.84	38.77	42.59	46.73	46.88
4000	41.12	44.91	47.73	49.85	47.43	45.65
5000	54.45	58.55	60.01	62.27	64.33	62.46

Population of adult mites *T.urticae* on soybean plants:

Data presented in Table (4) showed that the mean number of individuals of two Spotted spider mites *T. urticae* (Koch) (Acari: Tetranychidae) and *E. scutalis* were reduced by magnetic force and magnetic water concentrations with different degrees of effectiveness between them. The correlation coefficient values of the concentrations to magnetic force and magnetic water were insignificant positive values of *T. urticae* were (0.618 and 0.545 respectively). But the correlation coefficient values to *E. scutalis* were (0.205 and 0.221 respectively).

Table 4: Population of adult mites *T.urticae* on soybean plants.

Concentrations (Gausses)	Magnetic force(MF)		Magnetic water(MW)	
	<i>T.uretace</i> mean No.	<i>E. scutalis.</i> mean No.	<i>T. uretace</i> mean No	<i>E.scutalis.</i> mean No.
1000	166.76	4.22	175.33	4.37
2000	138.55	3.87	146.75	3.92
3000	106.62	3.55	115.47	3.67
4000	83.92	3.04	90.47	3.20
5000	57.85	2.89	63.37	2.96
Correlation	0.618	0.205	0.545	0.221

The effect of feeding and morphology of soybean plant after treatments:

The data in Figs. (6,7,8,9 and 10) showed that soybean leaves were effected with feeding of *T. urticae* and concentrations 500 G was the most effective with feeding on the leaves of soybean. While concentrations (100 G) had the least effective with feeding. On the other hand feeding and morphology of soybean plants which effected with *T. urticae* which treated by different concentrations to magnetic force and magnetic water were different effectiveness between all concentrations.



Fig.(6) Concentrations 100 (Gausses) on cotton



Fig.(7)Concentrations 200 (Gausses) on cotton



Fig.(8)Concentrations 300 (Gausses) on cotton



Fig.(9)Concentrations 400 (Gausses) on cotton



Fig.(10)Concentrations 500 (Gausses) on cotton

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ARABIC SUMMARY

تأثير تفاوت القوي المغناطيسي و الماء الممغنط على سلوك و تعداد الأكاروس النباتي (العنكبوت الأحمر ذو البقعتين) على فول الصويا في المعمل و الحقل. (*Euseius scutalis*) و أحد مفترساته

حمدي عبد الرحيم عبد الرحمن

معهد بحوث وقاية النباتات - مركز البحوث الزراعية - الدقي - الجيزة - مصر.

يعتبر الأكاروس النباتي أو العنكبوت الأحمر ذو البقعتين من الآفات الرئيسية التي تصيب نباتات فول الصويا و التي تسبب ضرر واضح في فقدان الإنتاجية للمحصول واستخدام المركبات الأكاروسية المستمر لمكافحة هذه الآفة أعطت مناعة لها تجاه هذه المركبات و أيضا تلوث ملحوظ للبيئة. لذا وجب البحث عن طرق للمكافحة في صورة أمنه علي البيئة و المحصول، حيث تم إجراء تجربتين لدراسة تأثير القوة المغناطيسية و الماء الممغنط علي العنكبوت الأحمر ذو البقعتين و المفترس الأكاروسي (*Euseius scutalis*) ، في التجربة الأولى تم تمرير وريقات فول الصويا بتركيزات مختلفة من الماء الممغنط و أيضا القوة المغناطيسية علي فترات زمنية مختلفة حيث كانت التركيزات في المعمل (100, 200, 300, 400, 500) جاوس بينما كانت التركيزات في الحقل (1000, 2000, 3000, 4000, 5000) جاوس. التجربة الثانية أجريت برش الماء الممغنط علي النباتات المصابة و تعريضها أيضا للقوة المغناطيسية لكل من الأكاروس النباتي و المفترس الأكاروسي علي فترات زمنية مختلفة حيث أظهرت النتائج في كلا الاختبارين أن عدد الأكاروسات النباتية و المفترس الأكاروسي قد انخفض بعد التعرض للقوة المغناطيسية حيث كانت الأكثر تأثير علي الطور المتحرك و طور البيض للأكاروس و كانت أقل تأثير علي المفترس الأكاروسي. في حين كان الماء الممغنط له تأثير متوسط علي البيض و الطور المتحرك للأكاروس النباتي. و أظهرت النتائج أن القوة المغناطيسية كانت أكثر تأثيراً علي سلوك الأكاروس النباتي في الحقل و المعمل و أيضا التعداد للأكاروس بالمقارنة بالماء الممغنط حيث كان تأثير الماء الممغنط متوسط علي تعداد الأكاروس سواء للبيض أو للأطوار المتحركة و سلوك الأكاروس النباتي و أيضا للطور المتحرك للمفترس الأكاروسي.