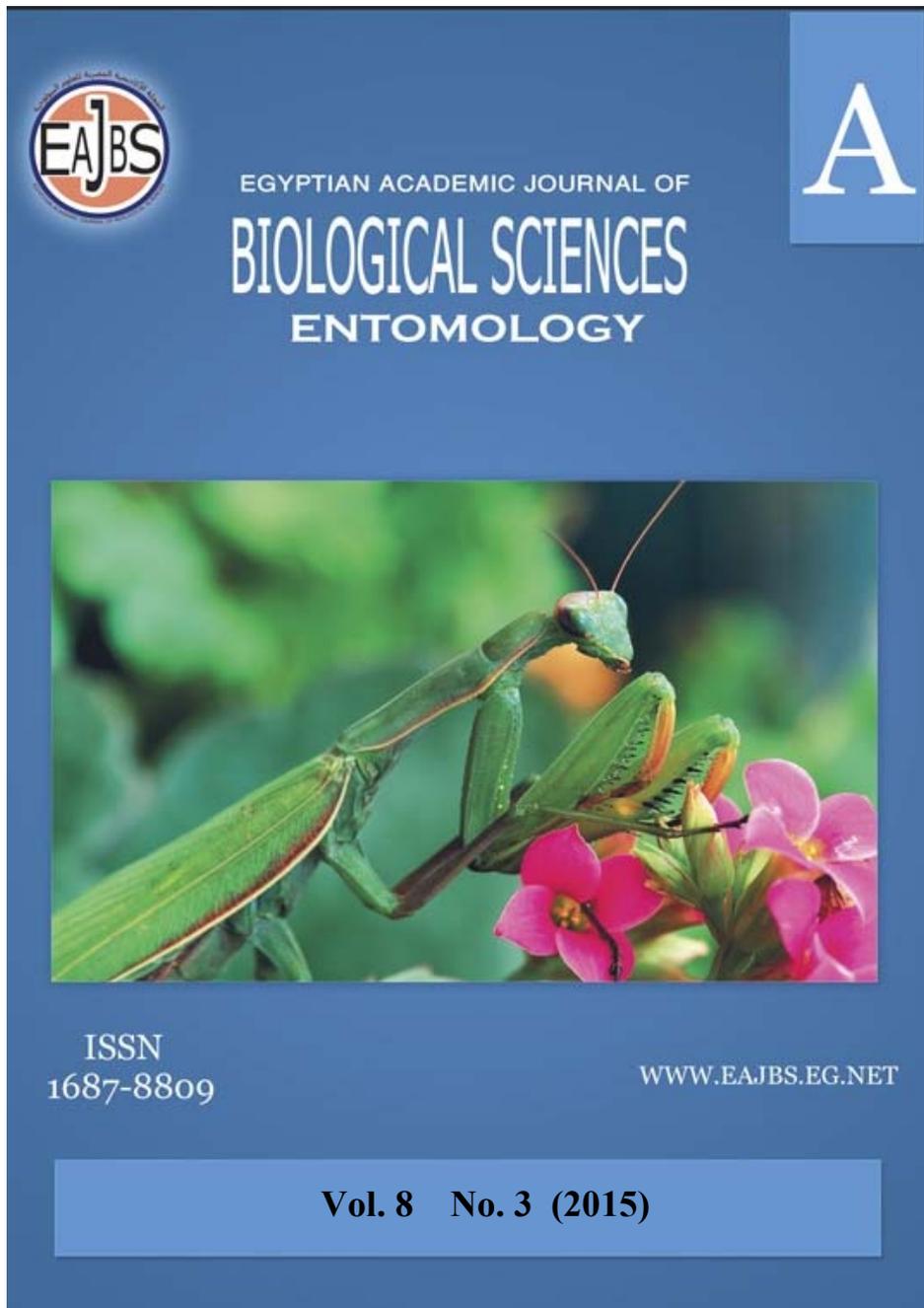


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www.eajbs.eg.net

Citation: *Egypt. Acad. J. Biolog. Sci. (A. Entomology) Vol.8 (3)pp.49-57 (2015)*



The Effect of Some Fertilizer Treatments, Chemical and Biological Control on The Population Density of Certain Squash Pests and On The Yield Crops

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ARTICLE INFO

Article History

Received: 10/10/2015

Accepted: 25/11/2015

Keywords:

Acaricides
Aphid
Biological control
Jassid, mealy bug
Piercing sucking insect
Thrips
Spider mites
Squash
Whitefly
Yield.

ABSTRACT

Field experiments were carried out at the Agricultural Research station, Qualiobeya Governorate during two successive seasons (Summer and Nile Plantation) to investigate the effect of different fertilizers on the squash infestation by different piercing sucking pests and on the resultant yield. Moreover the efficacy of four chemical acaricides (Ortus super, Arrow, Killmite and Vertimec) and two predaceous mites {*Phytoseiulus persimilis* (Athias–Henriot) and *Amblyseius gossypii* (El-Badry) against phytophagous mites, *Tetranych usurticae* Koch, and *T. cucurbitacearum* (Sayed) at Qualiobeya Governorate. Results showed that squash yielded by the Mixture treatment (NPK) fertilizer was higher than other fertilizers in the two seasons and the reduction percentage recorded by using Ortus super and killmite approaches that of *P. persimilis*.

INTRODUCTION

Vegetables are very important commodity, most vegetables have a high economical value, and as a source of nutritive food especially vitamins and minerals. The impressive health benefits of squash* are derived from the organic compounds, nutrients, vitamins, and minerals that they contain. Squash is an important source of many nutrients, including vitamin C, potassium, manganese, copper, phosphorous, calcium, iron and other antioxidant compounds. These vitamins and minerals are important antioxidant components in the body, which help to neutralize free radicals throughout the body. Furthermore, squash contains very high levels of vitamin A, including carotenoid phytonutrients and other important anti-inflammatory and antioxidant compounds. All of this together helps the body to boost its immune response and defend against the foreign substances,

Fertilizers are sources of mineral elements which plants required for growth and development. The Macro-nutrients are the main nutrients plants needed and are usually included in all fertilizers. These nutrients, which include nitrogen, phosphorus, potassium, calcium, magnesium and sulfur, are necessary to help plants develop new growth as well as fortifying the structure and defences of the existing plant cells, their deficiencies or excesses result in marked effects on growth and yield crops.

Piercing sucking pests (spider mite, whitefly, aphids, leafhoppers, mealy bug and thrips) are widely spread attacking a wide variety of agricultural crops and causing considerable damage, either directly by sucking plant juice or indirectly as vector transmitting plant diseases. (Carter, 1990). The two spotted spider mite is considered one of the important pests during summer plantation causing various degrees of damage and yield losses (Faris *et al.*, 2004). Also, it considers a main pest of Cucurbitaceae which include Squash plant. Recommendation of certain acaricides are still the only method for controlling this pest. Nevertheless, different predatory mite species were released by several authors, Heikaland Fawzy (2002), Heikaland Fawzy (2004), Fawzy *et al.* (2006)

The objective of this work is to survey mite and insect pests associated with squash crop and to investigate the influence of different fertilizer treatments on the rate of pests' infestation to squash plants and their effects on the resultant yield. Moreover, to evaluate the role of the predaceous mites in reducing the population density of different pests comparing to some chemical acaricides.

MATERIAL AND METHODS

A randomized complete block design was used to perform this experiment for studying the effect of different types of fertilizers on the rate of infestation with different piercing sucking pests (spider mites, whiteflies, thrips, aphid, mealy bug and jassid) of squash plants (*Cucurbitapepo* L.) and on the yield. The experimental area was about (125.28 m²) divided into 21 equal plots of 3.6 m² each for the six different fertilizers and the control of 3 replicates for each treatment. Each plot consists of 2 ridges of 3 meters long and 60 cm apart. The seed were sowed on March, 15th in the first season and on August, 3rd in the second season, 25 cm spacing between hills.

Fertilizer treatments: The tested fertilizers used were:

- 1- Urea, 46 % N₂ is applied at rate 300 kg. /feddan.
- 2- Calcium super phosphate, 15.5% P₂O₃ (150 kg/feddan).
- 3- Potassium sulfate, 47% K₂O (100 kg/feddan).
- 4- A mixture of the 3 previous fertilizers N, P & K at the rate of 300, 150 and 100 kg/feddan, respectively.
- 5- Micro-elements solved in water as Folifert [Zn 7.06 %; Mn 4.20 %; Fe 2.80 %; Cu 2.0 %; Bo 0.60 % & Mo (Molibidium) 0.05 %].
- 6- Mycorrhizal fungi are applied by their mixture with pieces of moisten soil and put on each hill in weight 50.75 gm in the planting date.
- 7- The Check plots (plots applied with water only).

Two sprays were applied using plastic atomizer, the first after complete germination and the second spray was on leaves at the time of flowering. The control plots were treated with water in the same days of spraying foliage fertilizers while the remaining fertilizers were added to soil around the plants in the time of spraying foliage fertilizers. All plots received the normally recommended agricultural practices and kept free from any insecticidal treatment. Fruits were picked up and weighted at the time of harvest ten times during the season. Ten leaves were randomly collected weekly from each replicate, making a sum of 30 leaves for each treatment. Collected samples were transferred for examination in the laboratory and counts were made.

Another experiment was conducted to evaluate the effect of biological and chemical control methods on the spider mites infesting the squash plants. The experimental area was about 125.28 m² divided into 21 equal plots of about 3.6m² each and having six different treatments and control. Each plot with two ridges of 3

meters long and 60 cm. apart.

The Biological Control agent: included releasing the predatory mite, *Phytoseiulus persimilis* (Athias–Henriot) and *Amblyseius gossypii* (El-Badry) . The predators were obtained from their mass rearing on spider mites *T. urticae* Koch on bean plant *Phaseolus vulgaris* (L.) in the laboratory.

Releasing of the predatory mite was initiated when the population density of mites on squash sample averaged 3 – 5 individuals / leaf. Individuals of the two predators were released on May 6th, the predator released was carried out with bean leaflet harboring 10 – 12 individuals per leaflet. Randomized samples of 10 leaves (2 inches²) per replicate were investigated just before the predator release to record the number of eggs and movable stages of *T. urticae*, and *T. cucurbitacearum* as precount, while post counts were undertaken weekly until the harvest

The Chemical Control Treatment: by spraying the four following acaricides:

- 1) Ortus super (fenpyroximate) applied at rate 50 cm³ / 100L. water
- 2) Arrow (abamectin) applied at rate 40 cm³ / 100L. water
- 3) Killmite (abamectin) applied at rate 40 cm³ / 100L. water
- 4) Vertimec (abamectin) applied at rate 40 cm³ / 100L. water.

These compounds were applied only once on May 6th. Samples for examination of the spider mite's eggs, and adults were taken just before acaricide application and after one, three, five, seven, ten and fourteen days from application. Precautions had been done to prevent contamination among fertilizer treatments.

Data analysis:

Analysis of variance was conducted to determine the significance between means by using SAS 9.3.1 portable. Whereas the means were compared through LSD tests, least significant differences at p: 0.05 level. Furthermore, Percentage of reduction in mite populations for each predator and each acaricide were calculated according to Henderson and Tilton equation (1955).

RESULT

Population abundance of piercing sucking pests in different treatments:

Data in Tables (1 & 2) show mean numbers of different piercing sucking pests, the motile stages of spider mites, adult and nymphs of aphid and thrips, nymphs of whitefly, jassid and mealy bug over 2 inches² of each thirty squash leaves in each treatment in summer and Nile plantation

Spider mite, *Tetranychus spp.*

Among the different treatments in the two seasons, the N₂ treatments recorded low effect on spider mite in the two seasons of mean 8.00 and 0.93 motiles which were lower than those of the control 13.25 & 2.56 motiles, respectively, without significant difference between them. Plots treated with Mycorrhiza and Micro-elements recorded a high infestation rate by the spider mites 19.45 & 15.83 and 2.18 & 4.44 motiles in the two seasons, respectively, without significant differences. Our results are in agreement with Ghallab *et al.* (2014), they concluded that these fertilizers provided a less nutrient diet for mites.

Whitefly, *Bemisia tabaci* (Gennadius)

In both summer and Nile plantation, the N₂ treatments showed the greatest effect on white fly population with mean average of (58.83 & 24.26 nymphs, respectively). On the other hand, plots treated with Mixture and Micro-elements revealed a minimize infestation by whitefly nymphs (48.42 & 46.71 nymphs) and (15.89 &

17.07nymphs) in the two seasons, respectively, without significant differences between treatments.

The present results go in line with the finding of Omar *et al.* (1993), El-Khayat *et al.* (2014) and Ghallab *et al.* (2014), they indicated that the application of Micro-elements considerably reduced the mean population of whitefly nymphs and the fertilizers, N₂ and P₂O₅ with lowest level of K₂O provide good nutrition for plant growth and as a result whitefly counts were generally elevated.

Thrips, *Thripstabaci* Lindquist

The lowest infestation level by *T. tabacion* squash leaves was observed on plants received Mixture fertilizer(NPK) followed by Micro-elements recorded 17.62 & 3.89 and 18.75& 4.37 individuals in the two seasons respectively, without significant difference compared to untreated plants 18.42 &4.51 individuals /2 inches².

Ebaid and Mansour (2006) recorded the same results, they mentioned that Microelements (Zn, Mn, Fe and Cu) had significant differences in the reduction of thrips population on cotton plants.

Jassid, *Empoascadeciapiens* Paoli

The population density of jassid exhibited the lowest initial effects noticed in N₂combined with P₂O₃ and Micro-elements treatments with mean seasonal numbers of 0.00 and 1.22 nymphs without significant difference between treatments, while the highest infestation rate was recorded in plots treated with N₂ fertilizer with mean numbers 0.75 & 1.89 nymphs, in the two seasons, respectively.

Table 1: Effect of fertilizers on the infestation of squash plants by some piercing sucking pests and on the resultant yield in Summer plantation

Treatments	Mean number of piercing sucking pests / 2 inches ²					Yield
	<i>Tetranychus spp.</i>	<i>Bemisiatabaci</i>	<i>Thripstabaci</i>	Jassid	<i>Myzuspersicae</i>	
Control	13.25	49.54	18.42	0.67	3.87	1.8
Mycorrhiza	19.45	55.54	17.25	0.33	3.62	2.8
Micro-elements	15.83	46.71	18.75	0.5	3.12	4.11
NPK	10.42	48.42	17.62	0.42	2.79	4.21
N ₂	800	58.83	20.42	0.75	5.67	2.72
N ₂ + P ₂ O ₃	16.04	55.25	27.46	0	6.58	4.03
N ₂ + K ₂ O	14.96	50.63	28.87	0.42	4.25	3.74
LSD	10.34	32.5	14.6	0.49	5.94	2.1

Table 2 - Effect of fertilizers on the infestation of squash plants by some piercing sucking pests and on the resultant yield in Nile plantation

Treatments	Mean number of piercing sucking pests / 2 inches ²						Yield
	<i>Tetranychus spp.</i>	<i>Bemisiatabaci</i>	<i>Thripstabaci</i>	Jassid	<i>Myzuspersicae</i>	<i>Pseudococcu ssp.</i>	
Control	2.56	18.78	4.51	1.48	17.96	9.81	1.72
Mycorrhiza	2.18	19.52	5.70	1.59	7.11	13.67	2.33
Micro-elements	4.44	17.07	4.37	1.22	11.67	3.48	3.11
NPK	1.78	15.89	3.89	1.70	9.37	9.29	3.22
N ₂	0.93	24.26	5.29	1.89	17.67	11.48	2.51
N ₂ + P ₂ O ₃	0.7	20.44	5.18	1.48	11.44	13.44	3.02
N ₂ + K ₂ O	0.93	12.74	5.07	1.44	14.11	13.44	3.06
LSD	4.44	15.32	3.32	1.1	13.89	10.12	2.04

These findings agree with Habibullah *et al.* (2007) who indicated that an excessive dose of N₂ fertilizer produced lush green plants which attract the sucking pests.

Aphid, *Myzus persica* (Sulzer)

The infestation by aphid was not consistently high during the summer season but it was high in the Nile season. The highest average number of aphid was in plots received different rate of nitrogen fertilizers, N₂, Nitrogen combined with Phosphate and Nitrogen combined with Potassium.

The N₂ treatments showed the high infestation by aphids with mean average of 5.67 & 17.67 individuals in Summer and Nile plantation respectively, while the lowest infestation level on squash leaves was observed on plants received Mixture fertilizer (NPK) of 2.79 & 9.37 individuals, in the two seasons, respectively without significant differences between them.

The obtained results agree with the findings of Ebaid and Mansour (2006) they indicated that Mixture (NPK) fertilizer and Micro elements showed significant decrease in population density of aphids than control. Also, other investigators recorded the effect of N₂ fertilization on the aphid infestation in many field crops; by increasing the N₂ fertilizers an increase of aphid infestation is expected (Abdel-Fattah 1975).

Mealy bug, *Pseudococcus sp.*

The mealy bugs, *Pseudococcus sp.* registered in the second season only. The Micro-elements fertilizer revealed the lowest infestation by mealy bugs followed by mixture (NPK) treatment (3.48 & 9.29 nymphs) with significant differences compared to control and other treatments followed by NPK (9.29 nymphs, respectively). On the other hand, the ammonium compounds suffered the highest infestation rate by mealy bug.

Relationship between fertilizer treatments and resultant yield

Data in Tables (1&2) showed that the highest total squash fruit yields was obtained by applying the mix of NPK treatment recorded (4.21 & 3.22 Kg / 10 plants) in the two seasons, respectively, followed by Micro-elements (4.11 & 3.11 Kg / 10 plants). Statistical analysis demonstrated that means of squash fruit yielded by NPK fertilizer was significantly higher than other fertilizers. This finding agree with Habashi *et al.* (2007), they indicated that means of cucumber yielded by NPK fertilizer was significantly higher than other fertilizers. While the Mycorrhiza, N₂ and the untreated plants gave the lowest total squash fruit yields (2.8, 2.72 & 1.8 Kg / 10 plants) and (2.33, 2.51 & 1.72 Kg / 10 plants), in the two seasons, respectively. El-Sappagh (1998) found that addition of different nitrogenous fertilizers caused increased in infestation rate by aphid, jassid, whitefly and also reduction of squash yield.

The effect of tested acaricides on *Tetranychus spp.* Population**The efficiency against *T. urticae***

Data in Tables (3) showed the effect of different acaricides on the two spotted spider mite populations, *Tetranychus spp.* All the tested compounds reduced spider mite population on squash plants compared with the check. Regarding the initial effect (one day after spraying), all the tested compounds significantly reduced the spider mite recorded 100% except of the acaricide, Vertimec was less effective (43.34 %) in controlling the spider mite mobile stages compared to the other compounds. After 3, 5, 7, 10 and 14 days of spray, the efficacy of the compounds decreased to 91.37, 58.11, 75.76 and 49.97% for Ortus super, Arrows, Killmite and Vertimec, respectively, which indicate that these compounds caused spider mite populations rebounds; this may be due to some abiotic factors. The acaricide, Ortus super was more effective in controlling the spider mite mobile stages than other compounds resulting in 91.37 followed by Killmite of 75.76 %.

Table 3: Effect of chemical compounds against spider mite *Tetranychusurticae* and *T. cucurbitacearum* and their eggs in squash crops

Acaricides	Mean No of mite before treat.	Initial effect after one day	Reduct. R%	Residual effect (No of mites / leaf after treatment)					Resi. effect aver.	R%	Yield / Kg
				3d.	5 d.	7 d.	10d	14 d			
Ortus super	8.7	0	100	0	0.33	0	0.33	0.33	0.19	91.37	4.66
Arrows	5.00	0	100	1.0	0.66	0	1.00	1.00	0.53	58.11	4.18
Killmite	16.3	0	100	0	3.00	0	1.00	1.00	1.00	75.76	4.52
Vertimec	4.66	0.66	43.34	0.33	0.66	0.1	0.40	1.50	0.59	49.97	4.04
Control	23	17	--	5.3	4.7	5.7	6.7	6.7	5.82	--	1.8

T. cucurbitacearum

				3d.	5 d	7 d	10d	14 d		R%	Yield / Kg
Ortus super	8.66	0.66	74.38	0.00	0.00	0.00	0.33	0.66	0.19	9.34	3.27
Arrows	8.66	1	61.18	0.00	1.00	0.00	1.33	4.00	1.27	55.9	1.97
Killmite	14.3	0.33	92.24	0.00	0.33	1.00	1.33	0.33	0.59	87.59	3.18
Vertimec	7.33	0.6	72.48	0.00	0.66	0.00	1.33	0.3	0.46	81.13	2.27
Control	42.7	12.7	--	11.0	13.3	11.7	20.0	15.0	14.2	--	1.8

Eggs of *Tetranychusspp*

				3d.	5 d	7 d	10d	14 d		R%
Ortus super	18.0	0.00	100	0.00	0.00	0.00	5.7	3	1.74	79.46
Arrows	28.3	0.00	100	0.3	2.3	0.00	10.6	13	5.24	60.65
Killmite	50.3	1.3	95	0.00	2.00	0.00	1.6	3.7	1.46	93.89
Vertimec	29.0	2.7	81.9	11.3	6.7	0.00	12	9.3	7.89	42.04
Control	36	18.6	--	10.3	14	12.7	19	28.7	16.94	--

The efficiency against *T. cucurbitacearum*:

The most effective compound after one day was Killmite 92.24% followed by Ortus super (74.38 %). After two weeks of spray, the maximum reduction population recorded Ortus super 93.4 followed by Killmite 87.59.

c-The efficiency against eggs of *Tetranychus spp.*

Data in Table (3) showed a completely reduction of mite eggs after one day of spraying the compounds, Ortus super and Arrows. Up to 14 days Killmite were the most potent compound reducing the population density of spider mite eggs.

Effectiveness of predaceous mites:

Regarding the mean reduction for the two predators released, it was observed that these two predators gave better results for bio controlling the *Tetranychus spp.* on squash. In Table (4) releasing of *Phytoseiulus persimilis* and *Amblyseius gossypii* revealed a reduction of 98.13 & 91.48 %, 100 & 80.72 % and 97.92 & 93.75 % of *T. urticae*, *T. cucurbitacearum* and their eggs, respectively, after one day; then percentage of reduction the population of *T. urticae* increased reaching 98.77 and 97.65 % after two weeks release. However, the mean reduction of eggs decreased after two weeks.

Results agreed with that of Heikal and Fawzy (2004) who indicated that population of *Tetranychus urticae* in festing cantaloupe field was significantly reduced after the release of the predaceous mite, *P. macropilis*. Also, Fawzy *et al.* (2006) recorded percent reduction of *Tetranychus* on peach reached 96.6 % while on almond reached 98.6 % after four month of releasing the predators.

Estimation the resultant yield by using some acaricides as chemical control:

Results concerning total squash fruit yield when using the four acaricides, in the two successive seasons are presented in (Table 3). The mean number of *T. urticae* before treatments showed the greatest numbers of spider mite (23 individuals /30

plants), while that of *T.cucurbitacearum* recorded (42.7 individuals /30 plants), the estimated total squash fruit yields obtained by applying the chemical compounds, Ortus super, Arrow, Killmite and Vertimec, against *T. urticae* were 4.66, 4.18, 4.52 and 4.04 kg / 10 plants, respectively. On the other hand, the estimated total squash fruit yields obtained by applying the previously mentioned acaricides against *T. cucurbitacearum* recorded 3.27, 1.97, 3.18 and 2.27 kg / 10 plants, respectively.

Table 4: Biological control of *Tetranychus spp.* and their eggs on squash with the predaceous mites, *Phytoseiulus persimilis* and *Amblyseius gossypii* *T. urticae*

Predator	Mean No of mite before treatments	Initial effect after one day	Reduct. R%	Residual effect (No of mites / leaf after treatment)		Residual effect average	R%	Yield / Kg
				After 7 d.	After 14 d.			
<i>Phytoseiulus persimilis</i>	15	0.33	98.13	0.66	0.33	0.49	98.77	4.29
<i>Amblyseius gossypii</i>	13.3	1.33	91.48	0.33	1.33	0.83	97.65	4.12
Control	23	27	--	51	71	61	--	1.8

T. cucurbitacearum

				After 7 d.	After 14 d.		R%	Yield / Kg
<i>Phytoseiulus persimilis</i>	16	0.00	100	0.66	1	0.83	94.89	2.84
<i>Amblyseius gossypii</i>	13	2.7	80.72	0.33	2.33	1.33	89.92	2.07
Control	42.7	46	--	41.7	45	43.35	--	1.8

Eggs of *Tetranychus spp.*

				After 7 days	After 14 days		R%
<i>Phytoseiulus persimilis</i>	28	0.66	97.92	3.00	7.00	5	
<i>Amblyseius gossypii</i>	28.3	2	93.75	1.33	12.3	6.81	86.04
Control	36	40.7	--	38	86.1	0.00	--

The fore mentioned results obviously estimated that the highest total squash fruit yield was obtained by using the different acaricides compared to control 1.8 kg / 10 plants. The compound Ortus super recorded the best acaricides in reducing the spider mites and in turn give the highest squash fruit yield than other acaricides. An approximate estimation was the lowest fruit yield which affected by the pest *T. cucurbitacearum* and cause various degrees of damage and yield losses.

Estimation the resultant yield by using the predaceous mites as biological control

The estimated total squash fruit yields obtained by applying the predatory mite, *Phytoseiulus persimilis* (Athias-Henriot) and *Amblyseius gossypii* (El-Badry) against *T. urticae* were 4.29 and 4.12 kg / 10 plants, respectively, (Table 4). On the other hand, the estimated total squash fruit yields obtained by applying the previously mentioned predators against *T. cucurbitacearum* recorded 2.84 and 2.07 kg / 10 plants, respectively.

The highest total squash fruit yield was obtained by using the two previous predators against *T. urticae* compared to control 1.8 kg / 10 plants. An approximate estimation was the lowest fruit yield which affected by the pest *T. cucurbitacearum* and cause various degrees of damage and yield losses recorded the lowest total squash fruit yield (2.28 & 2.07 Kg. / 10 plants)

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ARABIC SUMMERY

تأثير بعض معاملات التسميد والمكافحة الكيماوية والبيولوجية على الكثافة العددية لبعض آفات نبات الكوسا وعلى المحصول الناتج

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أجريت التجربة بمحطة البحوث الزراعية بمحافظة القليوبية خلال عروتين متتاليتين (صيفي ونيلي) لعام 2014 لدراسة تأثير أنواع التسميد المختلفة على درجة الإصابة بالآفات الثاقبة الماصة وهي العنكبوت الأحمر بنوعيه الأحمر والأخضر والذبابة البيضاء، والتريس والبق الدقيقي والمن وذلك على نباتات الكوسا، وعلى المحصول الناتج . كما تم الإشارة إلى مكافحة هذه الآفات باستخدام بعض المفترسات الأكاروسية وبعض المبيدات الكيماوية وكانت النتائج المتحصل كالتالي:

- 1- سجلت معاملة اليوريا أقل معدل إصابة للعنكبوت ذو البقعتين للموسمين .
- 2- أعطى التسميد النيتروجيني N_2 أعلى معدل إصابة بالذبابة البيضاء،
- 3- سجل التسميد مايكوريزا أعلى معدل إصابة بالتريس والبق الدقيقي.
- 4- كانت معاملة الخليط NPK، والعناصر الصغرى أقل معدل إصابة بالآفات المختلفة وأعلى وزن من محصول الكوسا بينما أعطت النباتات التي حفظت بدون تسميد (كنترول) وكذلك التسميد النيتروجيني والتسميد مايكوريزا أعطوا أقل محصول من الكوسا.

وفي مجال المكافحة

أظهرت الدراسة أن معاملات المبيدات الأكاروسية كانت الافضل من التي حفظت بدون استخدام المبيد (الكنترول) في نقص أعداد الآفة وزيادة المحصول، وكذلك المكافحة الحيوية أعطت نتيجة متقاربة للمكافحة الكيماوية.