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Field evaluation of certain oils, plant extracts, pesticides and bio-insecticides and their mixtures on some sucking pests infesting watermelon and pepper plantations

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ABSTRACT

The toxic effect of certain compounds including two pesticides [fenitrothion (Sumithion) and etoxazole (Baroque)], mineral oil (K.z-oil), plant oils extracted from citrus such as baladi mandarin, sour orange, acidless orange and blue gum, microbial pesticides (Biofly and Agerin) and mixtures of Kz-oil with plant oils and microbial pesticides, against *Thrips tabaci, Aphis gossypii, Empoasca* sp., *Bemisia tabac* and *Tetranychus urticae* on watermelon (*Citrullus lanatus var.cococynthoides* L.) and pepper (*Capsicum annum* L.) plantations have been done under field conditions.The results achieved in this study can be summarized in the following: Fenitrothion was the most toxic compound followed by Kz-oil on *T. tabaci*. Plant oil extracts were of a moderate toxic effect, while etoxazole was the least toxic compound on *T. tabaci*. Fenitrothion was the most toxic compound followed by baladi mandarin oil extract and Kz-oil on *A. gosspyi*. Etoxazole was of a moderate toxic effect, but blue gum, sour orange oil and acidless orange oil extracts were the least toxic treatments on *A. gosspyi*. Fenitrothion was the highest effective compound in reducing the population density of *Empoasca* sp. after the first spray followed by Kz-oil + baladi mandarin oil, Kz-oil + sour orange oil and etoxazole. The other tested compounds were moderately effective except sour orange oil, acidless orange oil, blue gum oil, Biofly and Agerin which were the least effective compounds on *Empoasca* sp. No significant differences were found among compounds after the second spray. Fenitrothion was the most effective compound in reducing the population density after the first spray followed by baladi mandarin oil, Kz-oil, Kz-oil + baladi mandarin oil and Kz-oil + blue gum oil on *B. tabaci*. The other tested compounds were moderately effective except sour orange oil, Biofly and Agerin which were the least effective compounds. All the tested compounds gave satisfactory result in reducing whitefly population ranged between 64.27 and 91.62% after the second spray with significant differences. Kz-oil was the most toxic

compound followed by fenitrothion and baladi mandarin oil extract on *T. urticae*. Sour orange oil, blue gum and acidless orange oil extracts have a moderate toxicity, while etoxazole was the least toxic compound on *T. urticae*. The results showed that Biofly and Agerin were highly toxic to *T. tabaci* and *A. gossypii* while they were of a moderate toxic to *T. urticae*. The results showed that all mixtures had potentiation effect against *T tabaci, A. gossypii* and *T. urticae*. Generally it can be concluded that, all tested compounds reduced the mean numbers of sucking pests on watermelon and pepper plantations., The tested compounds could be arranged descendingly according to their toxicity to the sucking pests as follows: Pesticides > mixtures > plant oil extracts > mineral oil > microbial pesticides.

INTRODUCTION

Vegetable crops are liable to a variety of pest infestations. Sucking pests are the most serious and destructive pests to invade watermelon and pepper plantations in Egypt.

The intensive use of chemical compounds for controlling pests resulted many problems such as population outbreaks of the pests and their resistance development against all known pesticide groups which leads to pest control failures, high costs, crop loss and economic disaster, in addition to its effect on the environment which constitute toxic hazards to human health, domestic animals, predators and wildlife. Generally it is important to do our job carefully by both controlling pest populations meanwhile protecting the environment from the potential adverse effect of pesticide uses.

The possibility of controlling sucking pests by a combination of biological and chemical methods had proved to be less costly, safe on the environmental constituents, minimizing chemical residues in the end product and also, more permanent method of control than had pesticides alone (Rizk *et al.*, 1999 and Omar and El-Kholy 2001).

The present study aimed to investigate the effect of the following tested compounds, and their toxic potentiality of fenitrothion and etoxazole, mineral oil (Kz-oil), plant oil extract from citrus fruit peels such as baladi mandarin, sour orange and acid less orange and blue gum, microbial pesticides such as Biofly and Agerin and mixtures of Kz-oil with plant oils and microbial pesticides against *Thrips tabaci, Aphis gossypii, Empoasca*

sp., *Bemisia tabac* and *Tetranychus urticae* on watermelon and pepper plantations.

MATERIALS AND METHODS

Tested compounds: Nine compounds were tested in the formulated form. The dosages were calculated on the basis of active ingredient as ppm except for the microbial pesticide; Biofly (*Beauveria bassiana*) which calculated on the basis of number of conidia/ml. The tested compounds were as follows:

Pesticides: Fenitrothion (50% E.C.) *O,O*-dimethyl *O*-4-nitro-*m*-tolyl phosphorothioate. Etoxazole (10% S.C.) (RS) –S- tert-butyl–2-[2-(2, 6-difluorophenyl) –4,5- dihydro- 1.3 oxazol-4-y1] phenetole.

Mineral oil: K.Z. oil (95% E.C.) formulated mineral oil supplied by Kafer El-Zayat Pesticides and Chemicals Company.

Volatile oil extractions from citrus peels: Volatile oil extracted from citrus fruit peels of [(*Citrus deliciosa* Blanc, baladi mandarin), (*Citrus aurantium* L., sour orange) and (*Citrus sinensis* Osbek, acidless orange)] (Family. *Rutaceae*) in Pesticide Department at Kafr El- Sheikh University, by steam distillation using the method of A.O.A.C. (1990) with Clavenger traps apparatus (oils lighter than water type). Citrus fruits were purified thoroughly washed in detergent solution to remove any surface of pesticide residues and rinsed with tap water. Then fruits were washed in methanol 30%, rinsed with tap water again and finally rinsed with distilled water. The peels should be free from white spongy, the peels were cut into small pieces.

Batches of 50 g small pieces were mixed with distilled water at ratio of 1:4, then blended and the mixture was placed in the distillation flask. Distillation was carried out for 1 hour until no further oil incensement was observed. The oils were separated from the water condensated and dried through anhydrous sodium sulphate and kept in dark containers in the refrigerator in addition to blue gum oil (*Eucalyptus globulus* L.) which was obtained from the market.

Microbial insecticides: Biofly (*Beauvaria bassiana*) as a liquid microbial pesticide containing 3 X 10^7 conidia/ml. It was supplied by El-Nasser Company for Fertilizers and Pesticides. Egypt. Agerin (*Bacillus thuringiiensis* kurstaki), 32000 International Units per milligram (6.4% a.i.)

was supplied by Abbott Laboratories Chemical and Agricultural Products Division. North Chicago. 11, USA.

Field assessments: Toxicological studies were carried out at the experimental farm of Faculty of Agric., Kafr El-Sheikh, Tanta Univ. The tested compounds were applied at the recommended doses using a knapsack sprayer with one nozzle. The experimental cultivated area of watermelon and pepper was divided into plots of $40m^2$. Each treatment was distributed in a completely randomized design with four replicates. The tested compounds used and their application rates are shown in Table (1).

Table (1): Tested compounds in the field applications; formulation and application rates (El-Fakharany, 2005)

Tested compounds	Rate of application/liter water		
	Thrips	Aphid, Whitefly, Leafhopper	Mite
Pesticides			
Fenitrothion (50% E.C.)•	3.75 cc	3.75 cc	3.75 cc
Etoxazole (10% S.C.)•	0.25 cc	0.25 cc	0.25 cc
Mineral oil			
K.Z. oil (95% E.C.)•	17.5 cc	10 cc	10 cc
Plant oil extracts			
Baladi mandarin**	30.1 cc	0.49 cc	15.4 cc
Sour orange**	35.6 cc	5.7 cc	25.6 cc
Acidless orange**	36.4 cc	5.8 cc	40.1cc
Blue gum**	31.8 cc	4.7 cc	28.3 cc
Microbial pesticides			
Biofly (3 X 10^7 conidia/ml.)•	1.5 cc	1.5 cc	1.5 cc
Agerin (6.4% W.P)•	1 g	1 g	1 g
Mixtures			
K.Z. oil* + Baladi mandarin**	8.75 + 30.1cc	5cc + 0.49 cc	5cc + 15.4 cc
K.Z. oil* + Sour orange**	8.75 + 35.6 cc	5cc + 5.7 cc	5cc + 25.6 cc
K.Z. oil* + Acidless orange**	8.75 + 36.4 cc	5cc + 5.8 cc	5cc + 40.1 cc
K.Z. oil* + Blue gum**	8.75 + 31.8 cc	5cc + 4.7cc	5cc + 28.3cc
K.Z. oil* + Biofly*	8.75 + 0.75 cc	5cc + 0.75cc	5cc + 0.75 cc
K.Z. oil* + Agerin*	8.75 + 0.5 g	5cc + 0.5 g	5cc + 0.5 g

• = Recommended dose, * = Half of the Recommended dose, ** = LC_{50}

The infestation was determined by counting all available stages appeared on 15 leaves which were taken from each replicate, (5 from lower, 5 from the middle and 5 from the top) for pepper plants, while it was from the first, middle and the end of watermelon plants respectively at random. The counts of thrips (nymphs and adults) aphid (nymphs and adults), whitefly (larvae),

leafhoppers (nymphs and adults) and mites (mobile stages) were done just before spraying, and then after 1,3,5,7 and 14 days of applications.

On watermelon plantations: for thrips, first spary was done on May 24 and the second spary on June 14, 2003 and for aphids and spider mites, sprayed occurred on June 28 and the second spary on July 19, 2003.While for whitefly, sprayed occurred on June 14, the second and third applications were carried out on June 28 and July 19, 2003, respectively. For leafhopper, sprayed occurred on May 24, the second and the third application were done on June 28 and July 19, 2003, respectively.

On pepper plantations for thrips, sprayed occurred on May 24 and the second application on June 7, 2003. For aphids, whitefly and leafhopper, sprayed occurred on August 17 and the second application on September 3, 2003, and for spider mites sprayed occurred on June 7 and the second application on August 17, 2003.

Percentages of reduction for the infestation of the target pests were estimated according to Henderson and Telton (1955) equation as follows:

$$\% \text{ of reduction} = 100\ [1 - (B \times A^{*}) / (A \times B^{*})]$$

Where:

A = No. of individuals before spraying.
B = No. of individuals after spraying.
A^{*} = No. of individuals in check before spraying
B^{*} = No. of individuals in check after spraying

Statistical analysis: All data were subjected to one-way analysis of variance (ANOVA) followed by Duncan multiple range test (Cohort software Inc., 1985) to determine the significant differences among means values at the probability level of 0.05.

RESULTS AND DISCUSSION

The effectiveness of the tested compounds on sucking pests inhabited watermelon plantations:

T. tabaci

Fenitrothion was the most effective compound in reducing *T. tabaci* population density (the same result was obtained by Nasseh and Link (1990)

after the first and second sprays (81.44 and 93.24) followed by kz-oil + baladi mandarin oil (78.70 and 86.59 %) , kz-oil + blue gum (75.15and 86.59%), Kz-oil + acidless orange oil (71.21and 86.09%), kz-oil + sour orange oil (74.96 and 82.62 %), etoxazole (71.08 and 82.62%), kz-oil + Biofly (70.25 and 76.84%) and Kz-oil + Agerin (68.89 and 86.59 %) respectively. The other tested compounds were moderately effective except Biofly and Agerin which were the least effective compounds. Generally, no significant differences were found among compounds except fenitrothion, Biofly and Agerin (Table 2). Similar results were also obtained by Abdel-Wahab *et al.*, (2001) and Al-Fawaeer and Abu-Abeid (2002).

Table (2): Reduction percentages of the tested compounds on *T. tabaci* (nymphs and adults) populations on watermelon plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	97.95^{a}	77.31	81.44^{a}	99.88^{a}	91.58	93.24^{a}
Etoxazole	80.40^{c}	68.76	71.08^{ab}	83.33^{c}	82.44	82.62^{ab}
Mineral oil						
K.Z. oil	64.99^{g}	58.28	59.62^{ab}	66.67^{e}	64.97	65.31^{ab}
Plant oil extracts						
Baladi mandarin	79.80^{cd}	62.45	65.92^{ab}	76.67^{d}	64.97	67.31^{ab}
sour orange	72.43^{e}	57.61	60.57^{ab}	73.33^{e}	64.97	66.64^{ab}
Acidless orange	77.63^{d}	58.23	62.11^{ab}	73.33^{e}	64.97	66.64^{ab}
Blue gum	69.96^{f}	65.18	66.14^{ab}	76.67^{d}	94.97	67.31^{ab}
Microbial pesticides						
Biofly	7.94^{j}	67.76	55.79^{ab}	33.33^{f}	64.97	58.64^{b}
Agerin	21.41^{i}	60.48	52.67^{b}	33.33^{f}	94.97	58.64^{b}
Mixtures						
K.Z. oil+B.M.	82.22^{c}	77.82	78.70^{ab}	83.33^{c}	87.41	86.59^{ab}
K.Z. oil+S.O.	80.94^{c}	73.36	74.96^{ab}	83.33^{c}	77.47	82.62^{ab}
K.Z. oil+A.O.	73.14^{e}	70.73	71.21^{ab}	86.67^{b}	81.97	86.09^{ab}
K.Z. oil+B.G.	58.08^{b}	72.54	75.15^{ab}	83.33^{c}	87.41	86.59^{ab}
K.Z. oil+Biofly	66.22^{g}	71.26	70.25^{ab}	77.78^{d}	76.61	76.84^{ab}
K.Z. oil+Agerin	59.77^{h}	71.18	68.89^{ab}	83.33^{c}	87.41	86.59^{ab}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

A. gossypii

Data in (Table 3) showed that fenitrothion was the most effective compound in reducing *A. gossypii* population density after the first and second sprays, followed by Agerin, etoxazole, Kz-oil + Biofly, acidless

orange oil, Kz-oil + Agerin, Kz-oil + baladi mandarin oil, Biofly, Kz-oil + blue gum oil, baladi mandarin oil and blue gum oil. Kz-oil + acidless orange oil and Kz-oil were moderately effective, whereas sour orange oil was the least effective compound. Generally, all treatments gave satisfactory results in reducing *A. gossypii*. The reduction percentages (general average) ranged between 70.10 and 98.92 in the first spray as well as 70.05 and 99.29 in the second spray. These results agreed with the findings of El-Hariry *et al.*, (1998) Abdel -Aziz et al.(2002), Rizk et al(1999) and Sharaf and El-Basyouni (2002).

Table (3): Reduction percentages of the tested compounds on *A. gossypii* (nymphs and adults) populations on watermelon plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	96.80^{b}	99.44	98.92^{a}	98.00^{b}	99.29	99.04^{a}
Etoxazole	90.41^{c}	96.05	94.94^{ab}	92.00^{d}	95.73	94.98^{ab}
Mineral oil						
K.Z. oil	85.41^{g}	83.61	83.97^{c}	86.00^{f}	84.23	84.58^{b}
Plant oil extracts						
Baladi mandarin	87.89^{f}	91.49	90.77^{abc}	88.00^{e}	92.00	91.20^{ab}
sour orange	72.39^{k}	69.53	70.10^{d}	73.00^{j}	70.05	70.64^{c}
Acidless orange	80.22^{i}	97.50	94.05^{abc}	81.00^{h}	97.55	94.24^{ab}
Blue gum	99.88^{a}	87.17	89.91^{abc}	99.90^{a}	88.1	90.46^{ab}
Microbial pesticides						
Biofly	87.59^{g}	94.46	93.09^{abc}	88.00^{e}	94.73	93.38^{ab}
Agerin	95.74^{bc}	96.53	97.00^{d}	97.00^{bc}	97.23	97.18^{a}
Mixtures						
K.Z. oil+B.M.	94.39^{c}	92.98	93.26^{abc}	95.50^{c}	93.75	94.10^{ab}
K.Z. oil+S.O.	85.29^{g}	95.87	93.75^{abc}	86.00^{f}	96.30	94.24^{ab}
K.Z. oil+A.O.	82.74^{h}	85.25	84.75^{bc}	84.00^{g}	85.88	85.50^{b}
K.Z. oil+B.G.	99.88^{a}	91.27	92.99^{abc}	99.90^{a}	91.43	93.10^{ab}
K.Z. oil+Biofly	92.33^{d}	94.50	94.07^{abc}	93.00^{d}	95.07	94.66^{ab}
K.Z. oil+Agerin	76.03^{j}	98.61	94.09^{abc}	77.00^{i}	98.42	94.14^{ab}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

Empoasca sp.

Fenitrothion also was the most potent compound in reducing the population density of *Empoasca* sp. after the first treatment followed by Kz-oil + baladi mandarin oil and etoxazole. The reduction percentages of the other compounds were less than 70%.In case of the tested bio-insecticides

(Biofly and Agerin) were the least effective compounds. After the second spray, it was observed that the population density of *Empoasca* sp. decreased in all treatments except Biofly and Agerin (Table 4).

B. tabaci

The data in Tables (5) showed that,Kz-oil + baladi mandarin oil was the most effective compound in reducing the population density of *B. tabaci* after the first spray, followed by Kz-oil + blue gum oil, etoxazole, Kz-oil + Agerin, Kz-oil + acidless orange oil and sour orange oil. The other tested compounds were of a moderate effect except Kz-oil, Biofly and Agerin which were the least effective compounds. No significant differences were found among treatments on the second spray.

Table (4): Reduction percentages of the tested compounds on *Empoasca* sp. populations on watermelon plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	87.00^{a}	84.26	84.81^{a}	86.67^{a}	82.51	83.34^{a}
Etoxazole	74.00^{b}	79.39	78.31^{ab}	64.44^{f}	80.53	77.31^{a}
Mineral oil						
K.Z. oil	44.29^{g}	58.99	56.05^{bc}	46.67^{i}	69.96	65.30^{ab}
Plant oil extracts						
Baladi mandarin	51.25^{e}	65.76	62.86^{abc}	73.33^{e}	70.87	71.43^{ab}
sour orange	56.67^{d}	64.73	63.12^{abc}	75.38^{d}	66.59	68.35^{ab}
Acidless orange	48.00^{f}	64.72	61.42^{abc}	73.33^{e}	60.81	63.32^{ab}
Blue gum	67.50^{c}	60.01	61.15^{abc}	73.33^{e}	57.54	60.69^{ab}
Microbial pesticides						
Biofly	35.00^{h}	53.44	49.75^{c}	20.00^{k}	57.94	50.36^{b}
Agerin	56.67^{d}	38.18	41.88^{c}	33.33^{j}	54.56	50.31^{b}
Mixtures						
K.Z. oil+B.M.	67.50^{c}	84.66	81.23^{ab}	86.67^{a}	80.46	81.70^{a}
K.Z. oil+S.O.	48.00^{f}	61.93	59.15^{abc}	84.76^{b}	76.19	77.90^{a}
K.Z. oil+A.O.	44.29^{g}	60.87	57.55^{abc}	82.22^{c}	73.95	75.60^{b}
K.Z. oil+B.G.	56.67^{d}	64.15	62.65^{abc}	86.67^{a}	77.02	78.95^{a}
K.Z. oil+Biofly	48.00^{f}	66.81	63.05^{abc}	50.00^{h}	70.77	66.62^{ab}
K.Z. oil+Agerin	35.00^{h}	64.41	58.52^{abc}	62.67^{h}	62.55	62.57^{ab}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

Table (5): Reduction percentages of the tested compounds on *B. tabaci* (larvae) populations on watermelon plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	83.33^{c}	70.80	73.31^{ab}	50.00^{d}	72.32	67.86^{a}
Etoxazole	99.88^{a}	72.14	77.69^{a}	99.88^{a}	64.85	71.85^{a}
Mineral oil						
K.Z. oil	66.67^{c}	51.49	54.53^{ab}	53.57^{c}	62.16	60.44^{a}
Plant oil extract						
Baladi mandarin	66.67^{c}	60.36	61.62^{ab}	99.88^{a}	70.76	76.58^{a}
sour orange	77.78^{d}	61.71	64.92^{abs}	53.57^{c}	74.48	70.29^{a}
Acidless orange	66.67^{c}	63.07	63.79^{ab}	45.83^{e}	80.38	73.07^{a}
Blue gum	77.78^{d}	67.04	69.18^{ab}	99.88^{a}	68.76	74.98^{a}
Microbial pesticides						
Biofly	33.33^{f}	60.42	55.00^{ab}	40.91^{f}	74.42	67.72^{a}
Agerin	16.67^{g}	47.03	40.95^{b}	56.67^{b}	75.81	71.98^{a}
Mixtures						
K.Z. oil+B.M.	88.89^{b}	78.15	80.29^{a}	99.88^{a}	74.09	79.25^{a}
K.Z. oil+S.O.	83.33^{c}	72.59	74.74^{a}	99.88^{a}	71.74	69.51^{a}
K.Z. oil+A.O.	83.33^{c}	72.59	74.74^{a}	99.88^{a}	64.86	71.86^{a}
K.Z. oil+B.G.	88.89^{b}	76.68	79.02^{a}	99.88^{a}	64.86	71.86^{a}
K.Z. oil+Biofly	66.67^{c}	68.17	67.87^{ab}	45.83^{e}	76.55	70.44^{a}
K.Z. oil+Agerin	76.78^{d}	75.94	76.11^{a}	50.00^{d}	67.55	64.04^{a}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

T. uriticae

Etoxazole was the most effective compound in reducing *T. uriticae*. population among the tested compounds after first spray, followed by kz-oil + baladi mandarin oil while Kz-oil + Agerin, Kz-oil + sour orange oil, acidless orange oil, Kz-oil + acidless orange oil and Kz-oil have a moderate effect, whereas Kz-oil + blue gum oil, baladi mandarin oil, blue gum oil, sour orange oil, Kz-oil + Biofly, Biofly and Agerin were the least effective compounds. After the second spray,Kz-oil + Biofly,Kz-oil + blue gum oil and Kz-oil + acidless orange oil were the most effective compounds in reducing *T. uriticae*. Populations, followed by acidless orange oil, Kz-oil + sour orange oil, Kz-oil + Agerin, Kz-oil + baladi mandarin oil, sour orange oil, etoxazole, baladi mandarin oil and blue gum oil while Agerin, Kz-oil and Biofly were of moderate effect. Fenitrothion was the least effective

compounds (Table 6). , the same result was obtained by Gamieh et al (2000).

Zein *et al.*, (2002) reported that, potentiation effect of KZ-oil + black pepper extract against *T. uriticae* adults. Moreover, the joint action of mixtures of plant oils on mineral oils with pesticides was found to be effective against *T. tabaci, A. gossypii* and *T. urticae* as showed by many investigators (Barakat *et al.*, 1985; Haydar *et al.*, 1996 and Helmy *et al.*, 2002). El-Khodary *et al.*, (2007) revealed that, fenitrothion gave high toxic effect against *T. tabaci. A. gossypii* and *T. urticae* but etoxazole was the least toxic compound against *T. tabaci* while high toxic for *T. urticae.*

Table (6): Reduction percentages of the tested compounds on *T. uriticae* (mobile stages) populations on watermelon plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	57.85^{i}	52.49	60.29^{ab}	84.73^{d}	56.54	62.14^{d}
Etoxazole	96.50^{a}	79.64	83.04^{a}	99.88^{a}	78.72	82.95^{abc}
Mineral oil						
K.Z. oil	77.30^{cd}	58.24	61.89^{ab}	77.22^{fg}	73.53	74.26^{bcd}
Plant oil extracts						
Baladi mandarin	72.75^{ef}	52.22	56.33^{ab}	78.63^{f}	83.22	82.50^{abc}
sour orange	73.12^{e}	51.09	55.49^{ab}	77.68^{fg}	86.79	84.97^{abc}
Acidless orange	67.25^{h}	61.85	62.90^{ab}	90.99^{b}	88.53	89.02^{ab}
Blue gum	70.83^{fg}	53.33	56.84^{ab}	75.98^{gh}	81.28	80.22^{abc}
Microbial pesticides						
Biofly	14.71^{k}	51.51	44.15^{b}	42.27^{j}	80.86	73.03^{cd}
Agerin	10.63^{l}	51.14	43.04^{b}	69.07^{i}	80.42	78.15^{abc}
Mixtures						
K.Z. oil+B.M.	78.07^{bcd}	74.87	75.51^{ab}	81.60^{e}	87.63	86.39^{ab}
K.Z. oil+S.O.	79.82^{b}	63.03	66.39^{ab}	86.81^{c}	89.04	88.59^{ab}
K.Z. oil+A.O.	78.89^{bc}	58.98	62.86^{ab}	91.89^{b}	89.67	90.11^{a}
K.Z. oil+B.G.	76.01^{d}	52.93	57.55^{ab}	84.57^{d}	92.02	90.53^{a}
K.Z. oil+Biofly	44.33^{j}	54.72	52.61^{ab}	86.59^{cd}	91.87	90.81^{a}
K.Z. oil+Agerin	70.30^{g}	68.43	68.80^{ab}	74.39^{h}	91.58	88.14^{abc}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

The effectiveness of the tested compounds on sucking pests inhabited pepper plantations:

T. tabaci

Fenitrothion was the most effective compound in reducing the population density of *T. tabaci* after the first and second sprays followed by etoxazole and Kz-oil + baladi mandarin oil. The other tested compounds have moderate effects except Kz-oil, sour orange oil, Biofly and Agerin were the least effective compounds. Generally, significant differences were found among the tested compounds (Table 7), as reported by Abdel-Aziz et al (2002) and Iskander and EI-Sisi (2001).

Table (7): Reduction percentages of the tested compounds on *T. tabaci* (nymphs and adults) populations on pepper plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	96.00^{a}	80.10	84.28^{a}	97.00^{a}	84.34	86.87^{a}
Etoxazole	81.00^{cde}	82.66	82.33^{ab}	82.00^{cd}	83.13	82.90^{ab}
Mineral oil						
K.Z. oil	65.00^{i}	59.71	60.77^{bcd}	66.50^{h}	60.88	62.00^{bc}
Plant oil extracts						
Baladi mandarin	80.00^{de}	65.59	68.47^{cd}	82.00^{cd}	68.25	71.00^{abc}
sour orange	71.00^{h}	60.62	62.69^{cd}	72.00^{g}	60.75	63.00^{bc}
Acidless orange	75.00^{g}	61.31	64.05^{cd}	76.00^{f}	62.50	65.20^{abc}
Blue gum	70.00^{h}	68.53	68.82^{cd}	71.00^{g}	69.13	69.50^{abc}
Microbial pesticides						
Biofly	15.00^{k}	67.42	56.93^{cd}	17.00^{j}	71.75	60.80^{bc}
Agerin	22.00^{j}	58.67	51.33^{d}	24.00^{i}	65.13	56.90^{c}
Mixtures						
K.Z. oil+B.M.	85.00^{b}	80.81	81.65^{ab}	87.00^{b}	81.75	82.80^{ab}
K.Z. oil+S.O.	82.00^{cd}	76.65	77.72^{abc}	83.00^{c}	77.75	78.80^{abc}
K.Z. oil+A.O.	79.14^{ef}	76.67	77.16^{abc}	80.00^{de}	77.75	78.20^{abc}
K.Z. oil+B.G.	83.50^{bc}	76.05	77.54^{abc}	84.00^{c}	77.11	78.49^{abc}
K.Z. oil+Biofly	77.22^{fg}	74.01	74.65^{abc}	78.00^{ef}	77.25	77.40^{abc}
K.Z. oil+Agerin	70.50^{h}	78.89	77.12^{abc}	71.00^{g}	81.25	79.20^{abc}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

A. gossypii

The data presented in Table (8) concerning *A. gossypii* show that fenitrothion was the most effective compound in reducing its population density after the first and second sprays followed by etoxazole, Kz-oil +

Agerin, baladi mandarin oil, kz-oil + sour orange oil, kz-oil + baladi mandarin and Kz-oil + acidless orange oil. The other tested compounds were moderately effective except Biofly which was the least effective one. Statistically, significant differences were found among the tested compounds, as reported by Shaheen et al (1992) and Magouz (2003).

Table (8): Reduction percentages of the tested compounds on *A. gossypii* (nymphs and adults) populations on pepper plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	99.88^{a}	99.58	99.84^{a}	99.88^{a}	99.88	99.90^{a}
Etoxazole	99.88^{a}	96.89	97.59^{ab}	76.19^{c}	99.88	95.13^{ab}
Mineral oil						
K.Z. oil	96.42^{b}	81.53	84.51^{abc}	76.19^{c}	83.05	81.68^{ab}
Plant oil extracts						
Baladi mandarin	82.79^{d}	95.80	93.19^{abc}	95.24^{b}	96.66	96.38^{ab}
sour orange	81.37^{de}	70.69	72.82^{cd}	96.19^{b}	83.29	85.88^{ab}
Acidless orange	91.26^{c}	81.45	83.41^{cd}	71.43^{f}	70.40	70.61^{b}
Blue gum	62.18^{f}	81.78	77.86^{cd}	88.09^{d}	65.33	69.88^{b}
Microbial pesticides						
Biofly	28.71^{g}	69.73	96.53^{d}	6.67^{i}	92.03	74.96^{ab}
Agerin	26.25^{g}	93.35	79.93^{cd}	26.98^{h}	91.63	78.69^{ab}
Mixtures						
K.Z. oil+B.M.	92.44^{c}	89.01	89.69^{abc}	90.48^{c}	96.83	95.56^{ab}
K.Z. oil+S.O.	91.49^{c}	96.33	95.34^{abc}	95.24^{b}	97.41	96.98^{ab}
K.Z. oil+A.O.	89.51^{c}	92.19	91.65^{abc}	96.19^{b}	88.19	89.79^{ab}
K.Z. oil+B.G.	79.02^{e}	74.89	75.72^{bcd}	90.84^{c}	73.83	77.16^{ab}
K.Z. oil+Biofly	84.27^{d}	81.32	81.91^{cd}	62.90^{g}	99.88	92.48^{ab}
K.Z. oil+Agerin	96.07^{b}	96.22	96.19^{ab}	99.88^{a}	99.88	99.88^{a}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

Empoasca sp.

The data presented in Table (9) show that, fenitrothion was the most effdctive compound in reducing the population density of *Empoasca* sp. after the first spray followed by Kz-oil + baladi mandarin oil, Kz-oil + sour orange oil and etoxazole. The other tested compounds were moderately effective except sour orange oil, acidless orange oil, blue gum oil, biofly and agerin which were the least effective compounds. No significant differences were found among compounds after the second spray.

Table (9): Reduction percentages of the tested compounds on *Empoasca* sp. populations on pepper plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	99.88[a]	93.07	94.42[a]	99.88[a]	96.61	97.27[a]
Etoxazole	62.50[c]	91.19	85.45[abc]	87.33[c]	86.62	86.76[a]
Mineral oil						
K.Z. oil	62.50[c]	73.36	71.19[abc]	99.88[a]	80.44	84.33[d]
Plant oil extracts						
Baladi mandarin	75.00[b]	81.98	80.59[abc]	87.33[c]	82.48	83.45[a]
sour orange	62.50[c]	92.98	62.88[bc]	76.25[d]	80.41	79.58[a]
Acidless orange	75.00[b]	58.65	61.92[bc]	96.00[b]	83.11	85.69[a]
Blue gum	62.50[c]	67.11	66.19[abc]	99.88[a]	73.26	78.58[a]
Microbial pesticides						
Biofly	25.00[d]	67.54	59.03[c]	33.50[e]	84.66	74.42[a]
Agerin	25.00[d]	67.35	58.88[c]	24.00[f]	90.72	77.38[a]
Mixtures						
K.Z. oil+B.M.	99.88[a]	86.83	89.44[ab]	99.88[a]	92.79	94.20[a]
K.Z. oil+S.O.	99.88[a]	83.54	86.81[abc]	99.88[a]	87.64	90.09[a]
K.Z. oil+A.O.	99.88[a]	77.11	81.66[abc]	99.88[a]	88.67	90.91[a]
K.Z. oil+B.G.	99.88[a]	79.73	83.76[abc]	99.88[a]	83.65	86.89[a]
K.Z. oil+Biofly	75.00[b]	82.23	80.78[abc]	95.53[b]	89.11	90.39[a]
K.Z. oil+Agerin	75.00[b]	84.73	82.78[abc]	96.38[b]	87.48	89.26[a]

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

B. tabaci

While for *B. tabaci*, fenitrothion was the most effective compound in reducing the population density after the first spray followed by baladi mandarin oil, Kz-oil, Kz-oil + baladi mandarin oil and Kz-oil + blue gum oil. Negm (2001) found that KZ - oil was the high effective against *B. tabaci*. The other tested compounds in the present study were moderately effective except sour orange oil, Biofly and Agerin which were the least effective compounds. All the tested compounds gave satisfactory result in reducing whitefly population ranged between 64.27 and 91.99% after the second spray with significant differences (Table 10).

Table (10): Reduction percentages of the tested compounds on *B. tabaci* (nymphs and adults) populations on pepper plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	86.89^{a}	67.52	71.39^{a}	95.40^{cd}	77.18	80.83^{abc}
Etoxazole	85.71^{a}	61.96	66.71^{a}	91.19^{f}	91.73	91.62^{a}
Mineral oil						
K.Z. oil	79.99^{b}	66.91	69.52^{a}	75.69^{h}	75.91	75.87^{abc}
Plant oil extracts						
Baladi mandarin	79.29^{b}	67.79	70.09^{a}	87.14^{g}	83.10	83.91^{abc}
sour orange	32.05^{h}	49.78	46.23^{a}	75.45^{h}	81.22	80.07^{abc}
Acidless orange	47.71^{g}	65.76	62.15^{a}	92.50^{ef}	82.33	84.36^{abc}
Blue gum	58.72^{f}	58.08	58.21^{a}	99.88^{a}	90.03	91.99^{a}
Microbial pesticides						
Biofly	13.74^{i}	56.61	48.04^{a}	25.00^{i}	79.02	68.21^{bc}
Agerin	14.94^{i}	58.53	49.81^{a}	10.00^{j}	77.84	64.27^{c}
Mixtures						
K.Z. oil+B.M.	71.72^{c}	68.77	69.36^{a}	96.06^{bcd}	90.46	91.58^{a}
K.Z. oil+S.O.	68.61^{d}	65.39	66.04^{a}	97.92^{abc}	87.51	89.59^{a}
K.Z. oil+A.O.	67.36^{d}	69.26	68.88^{a}	98.50^{ab}	83.80	86.74^{ab}
K.Z. oil+B.G.	73.02^{c}	66.81	68.05^{a}	99.88^{a}	91.11	92.87^{a}
K.Z. oil+Biofly	64.58^{e}	55.58	57.38^{a}	94.63^{de}	85.19	87.08^{ab}
K.Z. oil+Agerin	71.94^{c}	61.64	63.69^{a}	98.60^{ab}	82.89	86.03^{ab}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

T. urticae

Kz-oil + Agerin was the most effective compound in reducing the population density of *Tetranychus* sp. After the first and second sprays followed by Kz-oil + Biofly, Kz-oil + baladi mandarin oil, Kz-oil + acidless orange, Kz-oil + blue gum oil, Kz-oil + sour orange oil and etoxazole. Kz-oil, blue gum oil and fenitrothion were of moderately effective while the other compounds were the least effective and no significant differences were found among them (Table 11). Plant oils were found effective against *T. urticae* by many investigators under field conditions (Castiglioni *et al.*, 2002 and Farrag and Zakzouk, 2002).

The results achieved in this study can be summarized in the following findings:

- All tested compounds reduced the mean numbers of sucking pests on watermelon and pepper plants.
- The tested compounds could be arranged descendingly according to their toxicity as follows: Pesticides > mixtures > plant oil extracts > mineral oil > microbial pesticides.

Table (11): Reduction percentages of the tested compounds on *T. urticae* (mobile stages) populations on pepper plantations.

Compounds	The first spray			The second spray		
	Initial effect %	Residual effect (average)	General average	Initial effect %	Residual effect (average)	General average
Pesticides						
Fenitrothion	63.64^{fg}	57.90	59.05^{a}	64.00^{fg}	59.00	60.00^{a}
Etoxazole	99.88^{a}	64.43	71.52^{a}	98.00^{a}	64.73	71.38^{a}
Mineral oil						
K.Z. oil	60.00^{g}	62.05	61.64^{a}	62.00^{g}	65.20	64.56^{a}
Plant oil extracts						
Baladi mandarin	73.33^{d}	54.32	58.12^{a}	74.00^{d}	61.50	64.00^{a}
sour orange	75.38^{d}	49.34	54.55^{a}	75.00^{d}	55.75	59.75^{a}
Acidless orange	73.33^{d}	52.68	56.81^{a}	73.00^{d}	56.00	59.40^{a}
Blue gum	73.33^{d}	57.66	60.79^{a}	72.90^{d}	61.50	63.78^{a}
Microbial pesticides						
Biofly	20.00^{h}	61.30	52.99^{a}	22.00^{h}	63.00	54.80^{a}
Agerin	20.00^{h}	67.50	58.00^{a}	21.00^{h}	71.13	60.35^{a}
Mixtures						
K.Z. oil+B.M.	84.00^{b}	78.66	79.73^{a}	85.00^{b}	79.85	80.88^{a}
K.Z. oil+S.O.	80.00^{c}	72.44	73.97^{a}	81.00^{c}	73.38	74.90^{a}
K.Z. oil+A.O.	84.00^{b}	76.52	78.97^{a}	83.00^{bc}	77.19	78.40^{a}
K.Z. oil+B.G.	80.00^{c}	74.94	75.95^{a}	81.00^{c}	76.00	77.00^{a}
K.Z. oil+Biofly	65.71^{ef}	84.50	80.39^{a}	65.75^{ef}	83.13	79.65^{a}
K.Z. oil+Agerin	68.00^{e}	83.87	82.68^{a}	67.50^{e}	82.87	79.69^{a}

B.M. = Baladi mandarin, S.O.= sour orange, A.O.= acidless orange and B.G.= Blue gum.
Mean followed by the same letter are not significantly different at the 5% level.

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التقييم الحقلي لبعض الزيوت (المعدنية والنباتية المستخلصة) والمبيدات الكيميائية والمبيدات الميكروبية ومخاليطها على بعض الافات الماصة التي تصيب نباتات بطيخ اللب والفلفل

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تم دراسة التاثير السام لبعض المركبات وهى اثنان من المبيدات الموصى بها (الفينتروثيون و الاتوكسازول) والزيت المعدني كزد والزيوت النباتية المستخلصة من قشور ثمار الموالح (يوسفى ، نارنج، برتقال سكرى، زيت الكافور) ومبيدان من المبيدات الحيوية (بيوفلاى والاجرين). بالاضافه الى مخاليط المركبات السابقه مع زيت كزد على التربس ومن البطيخ والذبابه البيضاء والجاسيد والعنكبوت الاحمر على نباتات بطيخ اللب والفلفل تحت الظروف الحقلية، ويمكن تلخيص النتائج المتحصل عليها فى النقاط التالية:

- مبيد الفنيتروثيون كان اكثر المركبات تاثيراً على التربس ويليه فى السمية زيت كزد وكانت الزيوت النباتية المستخلصة لها سمية متوسطة بينما مبيد الاتوكسازول كان اقل المركبات سمية.

- مبيد الفنيتروثيون كان اكثر المركبات سمية على من البطيخ ويليه زيت البرتقال السكرى ثم زيت كزد وكان مبيد الاتوكسازول له سمية متوسطة بينما الزيوت النباتية المستخلصة الاخرى كانت منخفضة السمية.

- مبيد الفنيتروثيون كان اكثر المركبات سمية فى خفض اعداد الجاسيد بعد الرشه الاولى ويليه مخلوط زيت كزد مع بعض المستخلصات النباتية ثم مبيد الاتوكسازول وكانت بقية المركبات لها سمية متوسطة فيما عدا بعض الزيوت النباتية المستخلصة والمبيدات الميكروبية كانت اقل سمية . وبعد الرشة الثانية لا توجد فروق معنوية بين المركبات المختلفة فى خفض تعداد الافة.

- مبيد الفنيتروثيون كان اكثر المركبات سمية فى خفض أعداد الذبابة البيضاء بعد الرشه الاولى ويليه الزيت المعدنى مع بعض المستخلصات النباتية الزيتية بينما باقى المركبات كانت لها سمية متوسطة ما عدا مستخلص النارنج والمبيدات الميكروبية كانت اقل سمية . بينما بعد الرشة الثانية كل المركبات اعطت نتيجة مرضية فى خفض تعداد الذبابة البيضاء بنسبة تتراوح من 64.27 الى 91.62%.

- زيت كزد كان اكثر المركبات سمية على الاكاروس الاحمر يليه الفنيتروثيون ومستخلص زيت البرتقال السكرى. وكانت باقى الزيوت النباتية المستخلصة الاخرى متوسطة السمية بينما الاتوكسازول كانت له سمية منخفضة.

- ويمكن القول بصفة عامة ان كل المركبات المختبرة ادت الى خفض تعداد الافات الماصة على نباتات البطيخ والفلفل مع اختلاف نسب الخفض فى الاصابه. ويكن ترتيب المركبات المختبرة على حسب التاثير على الافات الماصة كالتالى: المبيدات الكيميائية > المخاليط > الزيوت النباتية > الزيوت المعدنية > المبيدات الميكروبية.