Plant Archives Vol. 20, Supplement 1, 2020 pp. 1450-1459 **e-ISSN:2581-6063 (online), ISSN:0972-5210**

BIOEFFICACY OF PLANT EXTRACTS AND ENTOMOPATHOGENIC FUNGI (*TRICHODERMA ALBUM*) IN CONTROLING *MYZUS PERSICAE* AND *BEMISIA TABACI*

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Abstract

The present study was conducted to evaluate the efficiency of plant extracts, volatile oils of *Ocimum basilicum* and *Rosmarinus officialis*, fixed oils of *Ricinus communis* and *Nigella sativa* and entomopathogenic fungus *Trichoderma album* as alternative to chemical insecticides on pests of economic crop, potato *Solanum taberosum* L. in Egypt, the green peach aphid *Myzus persicae* and the sweet potato whitefly *Bemisia tabaci*. All LC_{50} treatments showed highly toxic and repellency effect against the adult of green peach aphid and the nymphs of sweet potato whitefly. Result also indicated that *M. persicae*was susceptible to *R. communis* and *N. sativa* at LC_{50s} were determined by 3960.70 and 11128.17 ppm., respectively, while with *B. tabaci* are 2268.6 and 3682.02 ppm., respectively. *M. persicae* and *B. tabaci* were susceptible to Biozed (biocide) at their LC_{50s} which are 24.73 and 27.75 ppm., respectively. The treatments affect some biological aspects and decrease the duration of a petrous *M. persicae* than control and resulted in a decrease of aphid's injury caused to potato crop. The longevity of adult aphid was highly significance decreased by all treatment compared with the control (10.96) days. The parturition period at which adult become mature and able to produce progenies decreased clearly from the control (9.33) days in all treatments. All treatments caused a clear decrease in the number of offspring ranged between (1.706) and (5.416) offspring for *O. basilicum* and biozed respectively, compared by the control which recorded (18.5) offspring.

Keywords **:** Entomopathogenic fungi, *Trichoderma album , Myzuspersicae , Bemisiatabaci*

Introduction

The potato *Solanum taberosum* L. is an important Solanaceous crop in many parts of the world and Egypt. In the field, potato plants are attacked by several insect pests, such as aphids, white flies and tuber moth (Abd El-Fattah *et al*., 2000). *Myzus persicae*, green peach aphid is a highly polyphagous species capable of infecting plants in more than 40 different plant families (El-Malak *et al*., 2000).Damage caused by aphids occurs directly due to feeding on plant-sap, or indirectly by transmitting many virus diseases to the host plants. (Ali 2008 and Murati*etal*, 2013). Whitefly, *Bemisiatabaci* had a composite range of around 300 plants species within 63 families (Mound and Halsery, 1978), it is a vector of 111 plant viruses (Jones, 2003).The use of insecticides in controlling aphids and white fly leads to several problems, not only increasing resistant strains of aphids and white fly to those chemicals but also in induction of environment pollution and disturbance of natural balance (El-Maghraby 1993 and Ali-Catzim *et al*., 2015). Natural plants products and its derivatives are considered alternative agents to the currently chemicals used for insect control as it's constitute rich sources of bio-active chemicals (Prowse *et al*., 2006 and Maurya *et al.,* 2009). Plant extracts are effective, safe, cheap and easy to process and apply for farmers in developing countries (Belmain *et al*., 2001; Isman 2006 and Regnault-Roger *et al.,* 2012).

Essential oil can be inhaled, ingested or skin absorbed by insects *Ocimum basilicum* have toxic effect against aphids (Russo *et al.,*2001 and Singh *et al*., 2012). *Rosmarinus officialis*is strong antifeedant against *Myzuspersicae* (Santana *et al*., 2014). *Ricinus communis* have high efficient in the control of nymphs of *Bemisiatabaci* (Lima *et al*., 2011 and Lima *et al*., 2013). Furthermore, entomopathogenic fungi also conserve as alternative to broad spectrum chemical pesticides, which showing a great potential for controlling aphids (Pedrini *et al*., 2007). In addition it can also produce some effective antimicrobial agents for controlling plant diseases as *Trichoderma* ssp., *Metarhiziumanisopliae*, *Beauveriabassiana*, *Paecilomyces* spp. and *Verticillium* spp. (Butt *et al*., 2001). *Trichoderma* spp. Has been widely used as antagonistic fungulagenst against several pests as well as plant growth enhances (Verma *et al.,* 2007). *Trichoderma album* (biozed) cause high toxicity against adult of cabbage aphid (El-Gendy, 2015).Therefore, the current work was undertaken to study the effects of some plant extracts and one entomopathogenic fungus (*Trichoderma album*) on *M. persicae* and *B. tabaci*.

Material and Methods

The present study was carried out in the laboratory of Plant Protection Research Institute, Sharquia Branch, Zagazig.

Rearing technique of potato aphid, *Myzuspersicae* (Sulzer)

The aphid, *M. persicae* used in these experiments were collected from *Solanum tuberosum* (potato) fields from Sharquia Governerate and transferred to the laboratory. The aphid colonies were kept on each rearing plants for several generations. Every week (5-7 days) plants were replaced with new ones in order to keep colonies alive. Aphid colonies were prevented from external contamination by placing infested plants in cages covered with a muslincloth. Aphids were collected after 10 days by brushing them carefully from the leaves, were used in this study (Billal NIA *et al*., 2015).

1. Plant materials.

The plants under study were *Rosmarinus officinalis* was obtained from Menia Elkameh Sharquia Governerate, *Ocimum basilicum* was obtained from Kafer Saqur Sharquia Governerate, *Ricinus communis* was obtained from El Katara village Sharquia Governerate and *Nigella sativa* was obtained from local markets. They were identified in the Herbarium (caim)–flora phyto – Taxonomy Researches. Hortecultural Research institute. Agriculture Research Center. Ministry of Agriculture. Dokki. Cairo (Egypt).

These plants divided into two groups A&B according to their tested constituents (volatile oils and fixed oils). These plants listed in table (1) .These plants have many benefit for humans.

Table 1: The plants used for screening of their insecticidal activities against *Myzuspersicae* and *Bemisiatabaci*.

Used parts	Family name	Common name	Scientific name	Tested plant groups
Leaves	Lamiacoca	Basil	*Ocimumbasilicum*	Group(A) volatile oils
Aerial parts	Labiatae	Rosemary	*Rosmarinusofficinalis*	
Seeds	Euphorbioceae	Castor beans	*Ricinuscommunis*	Group(B) fixed oils
Seeds	Ranunculacea	Black seed	*Nigella sativa*	

2. Extraction technique of volatile oils (group A).

The volatile oils were extracted from different air dried parts of the two tested plants which represented in table (1) group (A) by steam distillation for 3h using a Clevenger type apparatus. The oils were dried over anhydrous sodium sulphate. The isolated oils have apale yellow color. Oils were distinguished with their characteristic strong odour. The oils were kept in a sealed vial at 4 °C until further analysis (Hossaina *et al*., 2008).

2.1 Identification of volatile oil constituents

For identification of constituents of the selected volatile further anlaysis using GC/MS (70 ev. Energy) in National Research Center, Cairo, Egypt according to the method of Likenes and Nickerson (1966) and Bernhard *et al*. (1983). GC/MS analysis technique was performed on a series 115890. They HulettPakard gas chromatogram which have the following specifications: A colum HP-I (cross-linked methyl silicon), (12mx. 0.2 mmx. 0.33) high speed capillary column programmed. Temperatures ranging from 30 ºC to 180 ºC at 50 c/min and flour rate 1 ml/min.

2. 2. Extraction technique of fixed oils (group B)

Extraction of the two plants fixed oil was performed at room temperature using crushed seeds. Where, the dry powder seeds were steeped in petroleum ether (60/80). The petroleum- ether extracts were filtered over anhydrous sodiumsulphate. A rotary evaporator apparatus was used to remove the solvent; oils were stored in dark brown bottles at $4C^{o}$until use.

2.3. Determation of fatty acids.

Free fatty acids were separated from crude oils as its methylated form in Food Technology Research Institute according to method by A.O.A.C. (1995) and determined by using liquid chromatography analysis (Macherey-Nagel, Düren, Germany) according to procedure reported by Arens *et al*. (1994).

2.4. Isolation of unsaponifiable fractions.

About 6 gm of crude oil refluxed with 100 ml of 10% alcoholic potassium hydroxide for 6hr. and most of the alcohol was distilled off. The obtained residue was diluted with 50 ml distilled water and extracted with ether (5×300 ml).The combined ethereal extract was washed several times with distilled water to remove any alkalinity, dried over anhydrous sodium sulphate and evaporated to give 2 gm of the unsaponifiable matter. Unsaponifiable compounds analysis carried out in gas-liquid chromatography GLC in National Research Center, Cairo, Egypt according to Ramadan and Mörsel (2003).

2.5. Tested Biocide.

- **Trade name:** Biozed 2.5%.
- **Scientific name:** *Trichoderma album*.

Biozed, acomercial product of *Trichoderma album* 2.5×10^{4} spores/ml. (250 gm/100 L. water) as recommended concentration. This fungus was obtained as wet table pale yellow powder from the Plant Disease Research Institute, Ministry of Agriculture.

Uses: It can produce some effective antimicrobial agent for controlling plant diseases (Butt *et al*., 2001).

3. Bioassay tests.

The serial concentrations of aqueous solutions for each of the tested compounds were prepared. Discs of potato leaves were dipped in the above solutions for 10 seconds then left to dry at room temperature, treated discs were put separately in Petri dishes each one consider as one replicate every 20 individuals of aphids were transferred to one treated leaf disc. Aphids treated with different compounds were counted after 72 hr. Mortality data were corrected according to Abbott's formula (1925). LC-P lines were established and LC_{50} values were determined.

Abbott's formula: $$\%R = \frac{\text{Control - Treatment}}{\text{Control}} \times 100$$

The toxicity lines were statistically analyzed according to the method described by (Finney, 1952). The relative efficiency of the tested pesticide was determined according to (Sun, 1950) as follow:

$$\text{Toxicity index} = \frac{LC_{50} \text{ or } LC_{90} \text{ of the compound (A)}}{LC_{50} \text{ or } LC_{90} \text{ of the compound (B)}} \times 100$$

A = is the most effective compound.

B =is the other effective compound.

Relative potency values were measured according to the method describe by Zidan and Abdel- Maged(1988).

$$\text{Relative potency} = \frac{LC_{50} \text{ or } LC_{90} \text{ of the compound (A)}}{LC_{50} \text{ or } LC_{90} \text{ of the compound (B)}}$$

The mean of Accumulative mortality% were determined after 6 days. The latent effected of tested compound at (LC_{50}) on the biological aspects of adult stage of *M. persicae* (longevity of adult, Pre parturition, parturition, Post parturition Periods and number of offspring per adult) were also determined. All data obtained were subjected to statistical analysis using the analysis of variance with CoStat statistics software (2005). Mean of the treatments were separated using least significant differences (LSD) test at ($P\leq0.05$) level of significance.

Results and Discussion

1. Identification of free fatty Acids.

The analytical data obtained from GLC spectrum of methelated fatty acids fraction was shown in the Table (1) these data illustrated that, these are twelve fatty acids of heptadecenoic and *N. sativa* seed's oil. Four saturated fatty

acid were detected in *R. communis* namely palmitic margaric, stearic and aracidic acid, stearic acid (2.51%) is the major saturated acid while margric acid (0.06%) is the minor one. Five saturated fatty acid were detected, namely palmitic, margaric, stearic, aracidic and behenic acid in *N. sativa* seed. Palmitic acid is the major saturated acid (11.71%) while margaric acid (0.10%) is the minior one. On the other hand, there are eight unsaturated fatty acids, palmitoleic, heptadecenoic, oleic, linoleic, linolenic, Gadoleic, Docosatetradecanoic and Ricinoleic acid, the major is Ricinoleic acid (73.18%) while heptadecenoic acid (0.01%) is the minor one in *R. communis.* Seven unsaturated fatty acids, palmitoleic, heptadecenoic, oleic, linoleic, linolenic, Gadoleic, and Ecosadienoic acid, linolenicacidis the major (55.19%) while heptadecenoic acid (0.05%) is the minor one *N. sativa*. Total saturated fatty acid were represented by (5.02%-17.13%), while unsaturated fatty acids were (94.98%-82.87%) in *R. communis* and *N. sativa,* respectively.

The GLC analysis of unsaponifiable matter of *R. communis* and *N. sativa* showed in table (2), demonstrated that *R. communis* and *N. sativa*unsaponifiable matters percentage is 0.70% and 1.14%, respectively.

Table 1: Free fatty acids and their relative percentage in *R. communis* and *N. Sativa* oil analysis by gas- liquid chromatography (GLC).

Fatty acid		*R. communis*	*N. Sativa*
Name	**Carbon**	**Relative**	**Relative**
Palmatic acid	C16 (0)	2.30	11.71
Palmitoleic acid	C16 (1)	0.02	0.20
Margaric acid	C17(0)	0.06	0.10
Heptadecenoic acid	C17(1)	0.01	0.05
Stearic acid	C18(0)	2.51	3.14
Oleic acid	C18(1)	8.89	24.15
Linolenic acid	C18(2)	10.13	55.19
Linoleic acid	C18(3)	0.76	0.27
Arachidic acid	C20(0)	0.15	1.87
Gadoleic acid	C20(1)	1.23	0.32
Ecosedienoic acid	C20(2)	-	2.69
Behenic acid	C22(0)	-	0.11
Docsatetradecanoic acid	C22(4)	0.76	-
Ricinoleic acid	C18(OH)	73.18	-
Total saturated fatty		5.02	17.13
Total un saturated fatty		94.98	82.87

Table 2 : The unsaponifiable matters of *R. communis and N. sativa* oil analyzed by gas – liquid chromatography (GLC).

Name of oil	Unsaponifiable matter%
Ricinuscommunis	0.70
Nigella sativa	1.14

2. Toxicological studies

2.1. Toxicological effects against adult of *M. persicae* and nymphs of *B.tabaci* under laboratory conditions

The toxicity of two volatile oils, two fixed oils and one biocide were evaluated against adult of *M. persicae* and nymphs of *B. tabaci* to determine the concentration which kill fifty percent of the pest (LC_{50}) under laboratory condition, the toxicity index when compared with the most effective treatment and recorded the relative potency by comparing the lowest one.

2.2. Susceptibility of *Myzuspersicae* adult to the two volatile oils

Regarding data in Table (3) and Fig. (1) indicated that, *M. persicae* was susceptile to basil (*O. basilicum*) oil and rosemary (*R. officinalis*) oil at LC_{50} value. Their LC_{50s}value were 2120.58 ppm and 5248.14 ppm, respectively. The toxicity index of *R. officinalis* 40.40% when compared with the most effective one, which had 100% toxicity index. The relative potency of basil oil was calculated 2.47 times more toxic than rosemary oil. So, the toxicity of basil was higher than rosemary oil when the toxicityindex and the relative potency measured based on the other oil tested against *M. persicae.* And also, data in Table (4) and Fig. (2) indicated that, nymphs of *B. tabaci* were susceptile to basil (*O. basilicum*) oil and rosemary (*R. officinalis*) oil at LC_{50} value. Their LC_{50s} value were 501.80 and 2020.46 ppm, respectively. The toxicity index of *R. officinalis* 24.83% when compared with the most effective one, which had 100% toxicity index. The relative potentyof basil oil was calculated 4 times more toxic than rosemary oil. So, the toxicity of basil was higher than rosemary oil when the toxicity index and the relative potency measured based on the other oil tested against

Table 3 : Toxicity of *Ocimum basilicum and Rosmarinus officinali s* volatile oils against adult of *Myzus persicae.*

Slope	Relative potency	Toxicity index %	Confidence limits of LC_{50}		LC_{50} ppm	Mortality%	Con (ppm)	Tested plants
			upper	lower				
1.409	2.475	100.00	3406.11	1062.53	2120.58	93.33%	10000	*Ocimumbasilicum*
						76.66%	7500	
						60.60%	5000	
						46.60 %	2500	
						40.00%	1250	
						26.66%	626	
0.970	1.00	40.406	7893.04	3919.14	5248.14	60.00%	10000	*Rosmarinusoffi cinalis*
						53.33%	5000	
						33.33%	2500	
						26.66%	1250	
						20.00%	626	

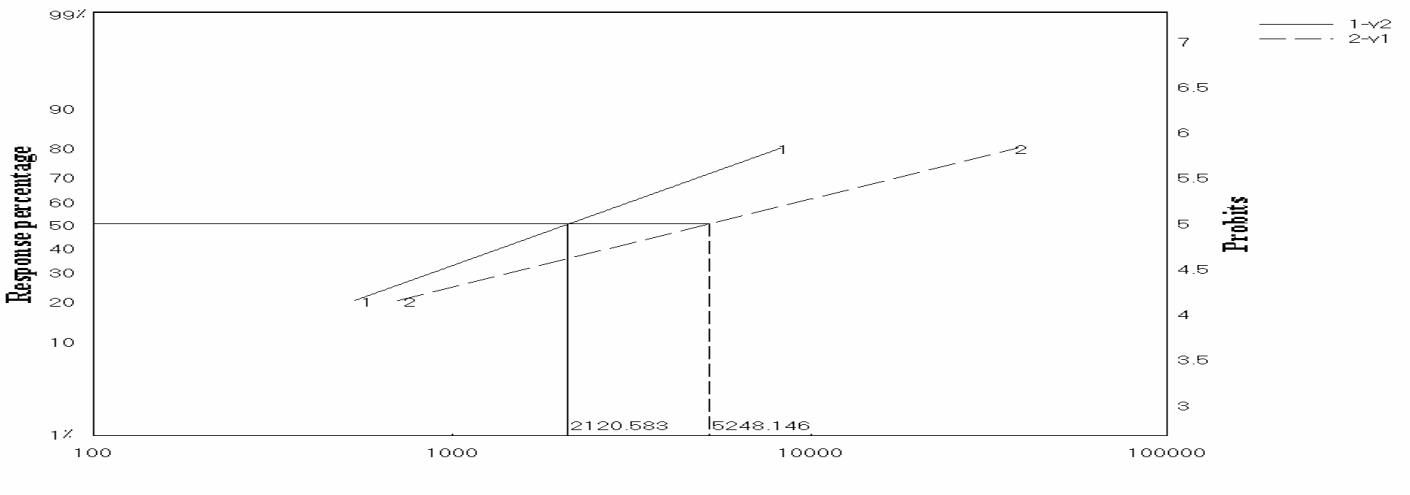

Fig. 1 : Log. Conc. Mortality regression lines of the plant volatile oils against adult of *Myzuspersicae.*

2.2.1. Susceptibility of adults of *Myzuspersicae* and nymphs of *B. tabaci* to the two fixed oils.

The results presented in Table (4) and Fig. (3) showed that *M. persicae*were susceptible to *R. communis* and *N.sativa* at LC_{50} values. Their LC_{50s} values were determined by 3960.70 and 11128.17 ppm, respectively. The toxicity index for each tested oils are 100 and 35.59% for *R. communis* and *N. sativa* respectively. The relative potency of *R. communis* oil was calculated as 2.810 times more toxic than *N. sativa.* Thus *R. communis* oil is the most poten oil and the highest insecticidal activity than *N. sativa* against *M. persicae,* also the results presented in table (5) and Fig. (4) showed that nymphs of *B. tabaci* were susceptible to *R. communis* and *N.sativa* at LC_{50} values. Their LC_{50s} values were determined by 2268.6 and 3682.02 ppm, respectively. The toxicity index for each tested oils are 100 and 61.61% for *R. communis* and *N. sativa* respectively. The relative potency of *R. communis* oil was calculated as 1.62 times more toxic than *N. sativa.* Thus *R. communis* oil is the most poten oil and the highest insecticidal activity than *N. sativa* against nymphs of *B. tabaci.*

Table 4 : Toxicity of *Ocimumbasilicum and Rosmarinusofficinalis* volatile oils against nymphs of *B. tabaci.*

Tested Plants	Con (ppm)	Mortality%	LC_{50} ppm	Confidence limits of LC_{50}		Toxicity index %	Relative potency	Slope
				Lower	Upper			
Ocimum basilicum	10000	82.90	501.80	185.94	849.82	100.00	1.99	0.725
	5000	78.82						
	2500	70.39						
	1250	64.11						
	625	50.26						
Rosmarinus officinalis	10000	67.66	2020.46	1089.27	3251.389	24.83	4.02	0.548
	5000	61.33						
	2500	48.51						
	1250	44.25						
	625	41.73						

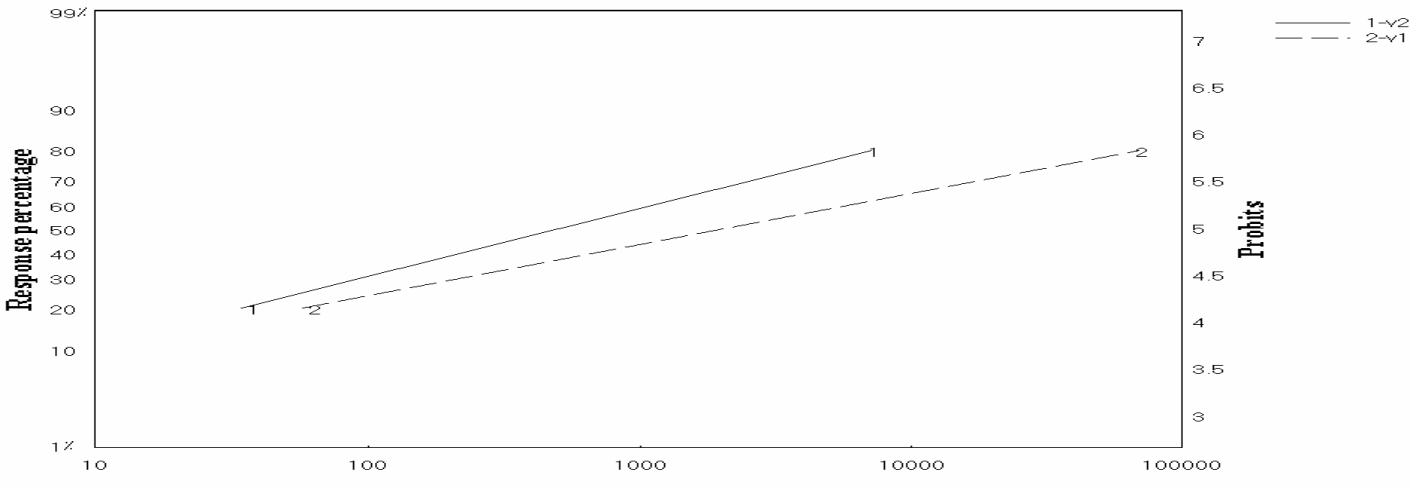

Fig. 2 : Log. Conc. Mortality regression lines of the plant volatile oils against nymphs of *B. tabaci.*

Table 4 : Toxicity of *Ricinus communis and Nigella sativa* fixed oils against adult of *Myzus persicae.*

Slope	Relative potency	Toxicity index %	Confidence limits of LC_{50}		LC_{50} ppm	Mortality%	Con (ppm)	Tested Plants
			Upper	Lower				
0.860	2.810	100.00	5594.96	2315.82	3960.70	86.66%	40000	*Ricinus communis*
						66.66%	20000	
						60.00%	10000	
						53.33%	5000	
						46.66%	2500	
1.199	1.000	35.59	14055.18	8900.17	11128.17	80.00%	40000	*Nigella sativa*
						53.33%	20000	
						46.66%	10000	
						40.00%	5000	
						20.00%	2500	

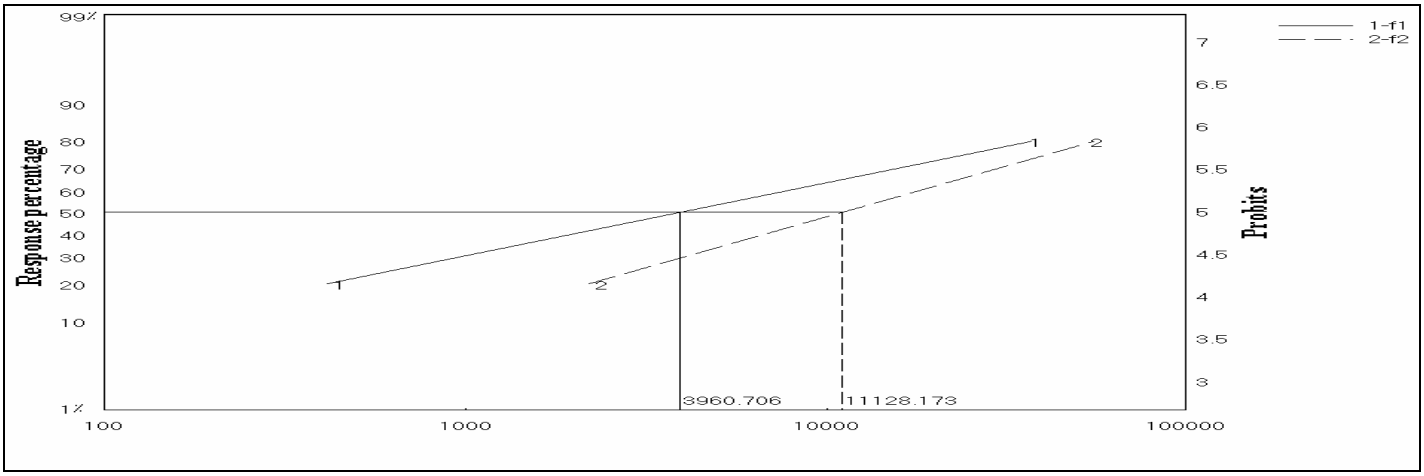

Fig. 3 : Log. Conc. Mortality regression lines of the plant fixed oils against adult of *Myzus persicae.*

Table 5 : Toxicity of *Ricinuscommunis and Nigella Sativa* fixed oils against nymphsof *B. tabaci.*

Slope	Relative potency	Toxicity index %	Confidence limits of LC_{50}		LC_{50} ppm	Mortality%	Con (ppm)	Tested Plants
			Upper	Lower				
1.11	1.62	100.00	3244.83	1288.31	2268.60	89.61	40000	*Ricinus communis*
						85.57	20000	
						76.55	10000	
						73.75	5000	
						45.00	2500	
1.27	1.00	61.61	4748.16	2598.06	3682.02	86.42	40000	*Nigella sativa*
						83.70	20000	
						80.34	10000	
						54.06	5000	
						38.88	2500	

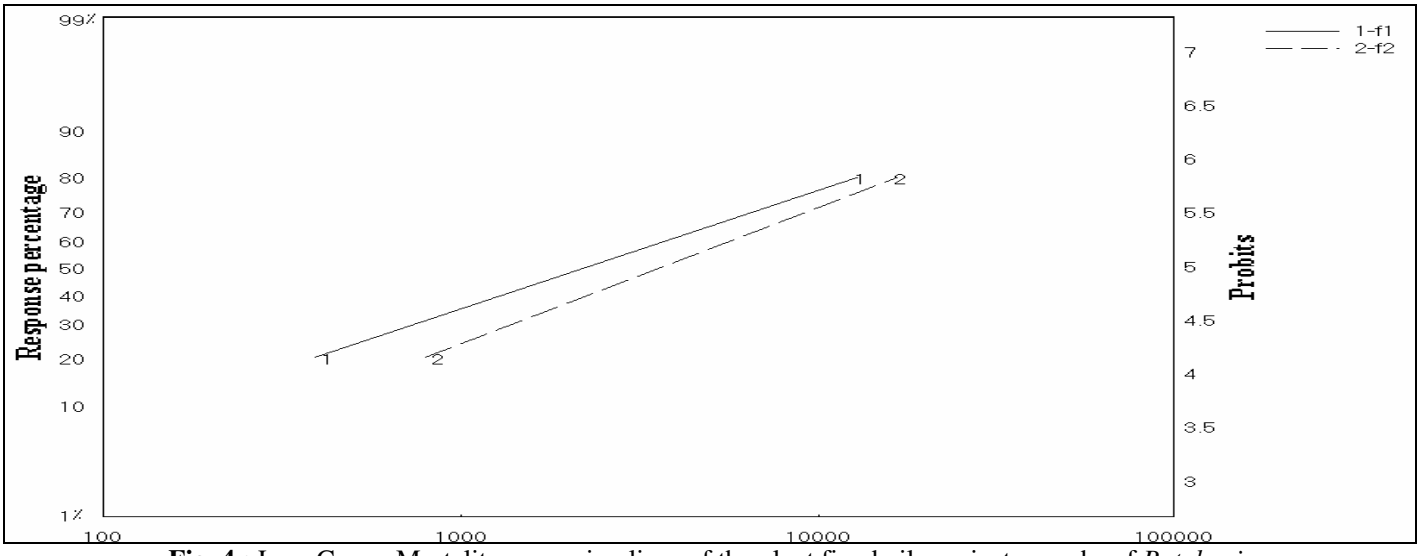

Fig. 4 : Log. Conc. Mortality regression lines of the plant fixed oils against nymphs of *B. tabaci.*

2.2.2. Susceptibility adultof*Myzuspersicae* and nymphsof *B. tabaci* to biozed.

Data in Table (6) and Fig. (5) indicatethat*M. persicae*were susceptible to Biozed (biocide) at its LC_{50}, which determined 24.73, results in table (7) and fig. (6) indicate that, nymphs of *B. tabaci* were susceptible to Biozed (biocide) at its LC_{50}, which determined 27.75.

Table 6 : Toxicity of biozed against adult *of Myzuspersicae*.

Con ppm	Mortality%	LC_{50} ppm	Confidence limits of LC_{50}		Toxicity index %	Relative potency	Slope
			Lower	upper			
62.5	66.66%	24.73	18.65	33.20	100.00	1.00	0.96
31.25	53.33%						
15.625	40.00%						
7.8125	33.33%						

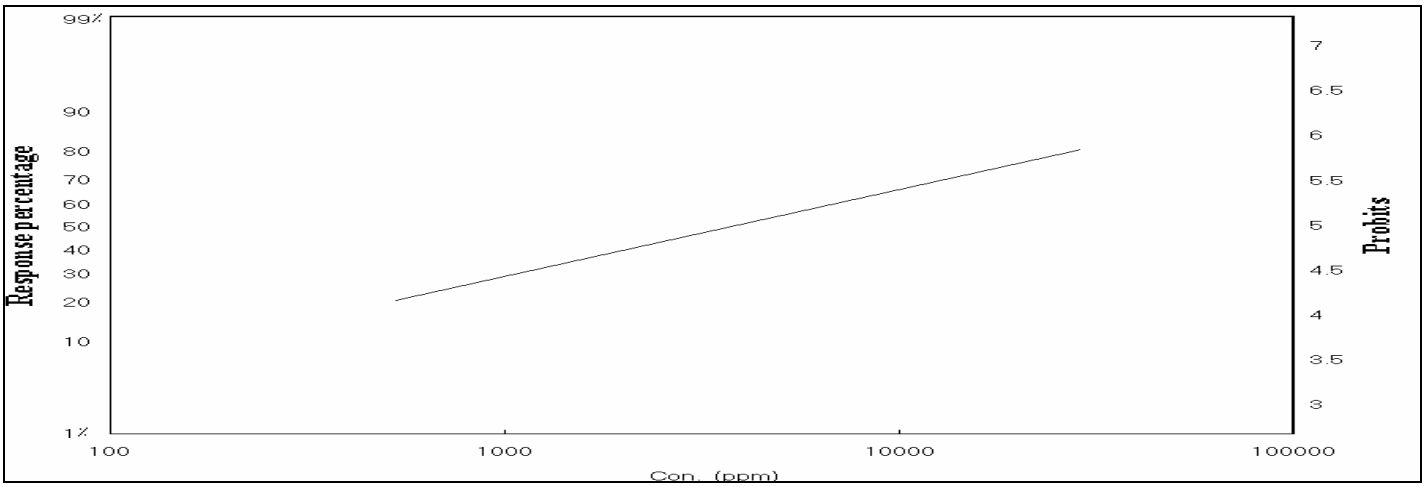

Fig. 5 : Log. Conc. Mortality regression lines of biozed against adult of *Myzuspersicae*.

Table 7 : Toxicity of biozed against nymphs of *B. tabaci.*

Con ppm	Mortality%	LC_{50} ppm	Confidence limits of LC_{50}		Toxicity index %	Relative potency	Slope
			Lower	upper			
62.5	68.66	27.75	20.64	35.20	100.00	0.912	0.98
31.25	55.33						
15.625	48.00						
7.8125	35.67						

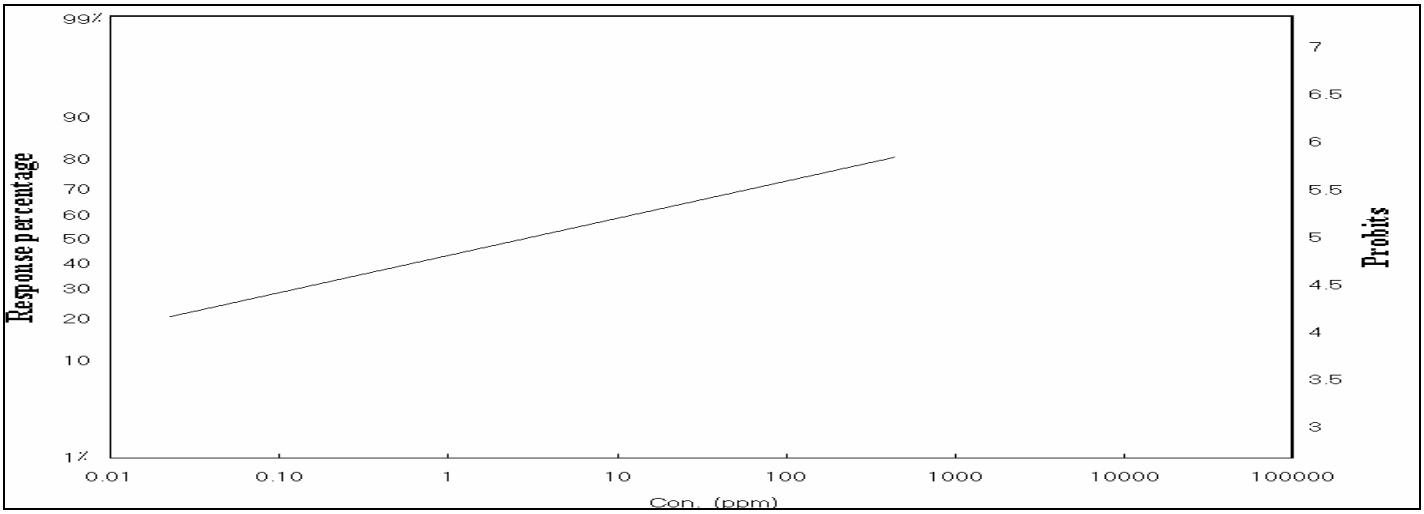

Fig. 6 : Log. Conc. Mortality regression lines of biozed against nymphs of *B. tabaci.*

2.3. Effect of tested treatments at their LC_{50} on adult of *M. persicae*.

Five treatments that classified into three groups: volatile oils, fixed oils and biocide were tested for their effect on adult of *M. persicae* and nymphs of *B. tabaci* at their LC_{50} under laboratory conditions. Table (8) and Fig. (7) showed that the mortality percentages of *M. persicae* increased by the time to reach its maximum after 6 days.

The mortality percentage after 3 days of treatment were 55.52, 50.2, 56.59, 51.36 and 45.66 for *O. basilicum, R. officinalis, R. communis,N. sativa* and biozed, respectively as compared to control. Tested materials gave mortality percentage after 6 days:80.08, 87.93,96.41, 90.17 and 98.65, respectively.

Table 8 : Effect of tested treatments on mortality of adults *M. persicae*.

Treatment	LC_{50}	Day	Two days	Three days	Four days	Five days	Six days
R. officialis	2120.58[d]	16.66[a]	46.33[a]	50.2[a]	60.34[a]	72.51[a]	80.08[ab]
O. basilicum	5248.14[b]	11.11[a]	38.06[a]	55.52[a]	81.46[a]	85.36[a]	87.93[b]
R. communis	3960.7[c]	13.01[a]	40.06[a]	56.59[a]	90.02[a]	92.87[a]	96.41[ab]
N. sativa	11128.17[a]	20.45[a]	42.06[a]	51.36[a]	80.08[a]	85.63[a]	90.17[ab]
T. album	24.73[e]	10.0[a]	36.66[a]	45.66[a]	85.98[a]	94.35[a]	98.65[ab]
F.	**	ns	ns	ns	ns	ns	ns
LSD	32.134	12.104	33.434	36.612	33.048	13.500	11.332

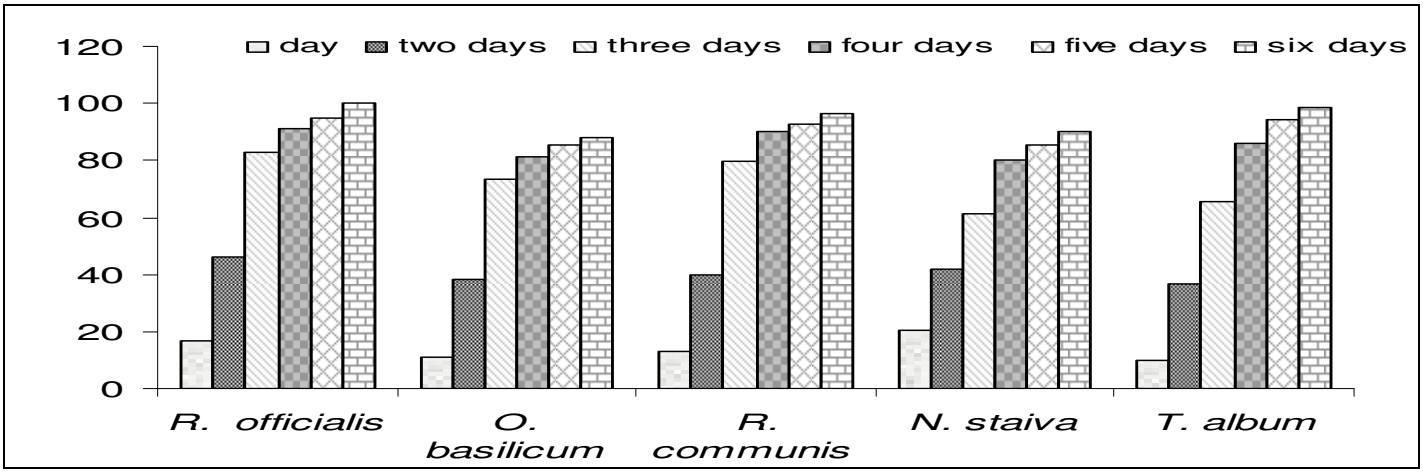

Fig. 7 : Effect of different treatments against adult *M. persicae* at different periods (days).

3. Biological studies

Volatile oils, fixed oils, and entomopathogenic fungus, exhibtited some biological activities on the adult of *M. persicae*at their LC_{50s} under laboratory conditions.

The data found in Table (9) Fig. (8) illustrated that, all treatments at their LC_{50s} concentrations decreased the duration of apterous *M. persicae* than control and so resulted in decreasing the aphids injury to potato crop. The longevity of adult aphid was highly significance decreased by all treatment compared with control, 10.96 days.

From the mean of longevity results, the lowest longevity of *M. persicae*adult were *O. basilicum* and *R. communis* 3.97days and 4.99 days respectively.While the other treatments, *R. officinalis*, *N. sativa* and biozed nearly caused the same rate 5.23 days, 5.46 days and 5.046 days respectively.

The pre-parturation periods which aperiod that adult not able to produce progenies because of they are immature adults. *O. basilicum* reduced the pre-parturation periods, *N. sativa* nearly have the same pre-parturation periodsbut *R. communis, R. officinalis* and biozed were slightly increased than control.

According to Fig. (9) the parturition period in which adult become mature and able to produce progenies decreased clearly from the control 9.33 days. *O. basilicum* and *R. communis* gave the highest effect 1.10 days and 1.87 days respectively.

Data obtained also showed that all treatments reduced the post- parturition period; the adult still alive progenies except *R. communis* and *N. sativa* were increased it and recorded 1.84 and 0.67 respectively, than the control 0.566 days.

All treatments caused clear decrease in the number of offspring ranged between 1.70 and 5.41 offspring while the normal adult recorded 18.5 offspring Fig. (10).

Table 9 : Effect of tested treatment at LC_{50} on some biological aspects against adult of *Myzus persicae*.

Treatments		Conc. Ppm	Longevity Mean±S.E.	Pre-Parturition Mean±S.E.	Parturition Mean±S.E.	Post-parturition Mean±S.E.	Offspring No. Mean±S.E.
Fixed oils	*Ricinus communis*	3960.706	4.99[b]±0.55	1.296[a]±0.038	1.87[cd]±0.32	1.84[a]±0.42	2.5567[cd]±0.4
	Niglla sativa	11128.173	5.46[b]±0.19	1.12[a]±0.09	3.37[bc]±0.21	0.6733[b]±0.05	4.5967[bc]±0.47
Volatile Oils	*Rosmarinus officinalis*	5248.146	5.23[b]±0.14	1.256[a]±0.05	2.623[bc]±0.64	0.4867[b]±0.13	2.9067[cd]±0.8
	Ocimum basilicum	2120.583	3.976[c] ±0.31	0.483[b]±0.24	1.1067[d]±0.78	0.2067[b] ±0.21	1.7067[d]±1.24
Biocide	*Trichoderma album*	3920.192	5.046[b]±0.28	1.267[a]±0.03	3.4567[b]±0.38	0.2667[b]±0.12	5.4167[b]±0.41
Cont.	-	-	10.96[a]±0.26	1.1[a]±0.06	9.33[a]±0.32	0.5667[b]±0.03	18.5[a]±0.06
F.	-	-	67.61***	7.526**	36.33***	8.348**	86.595***
$L.S.D._{0.05}$	-	-	0.94	0.344	1.5009	0.64	2.084

The same letter in the same column means significant at F < o.o5 –(**) significance – (***) highly significance.

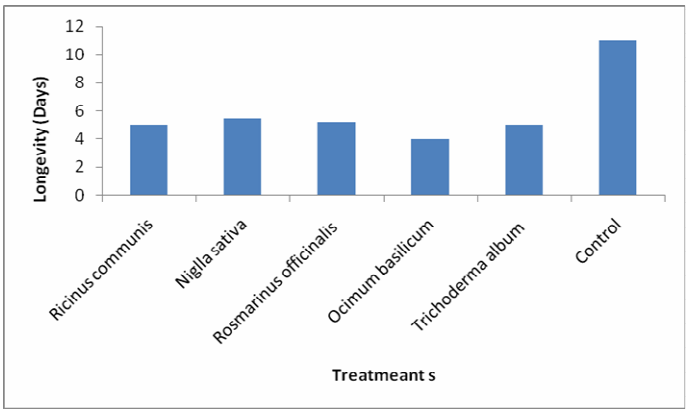

Fig. 8 : Effect of LC_{50}s concentrations of different treatments on longevity of adult of *Myzus persicae*.

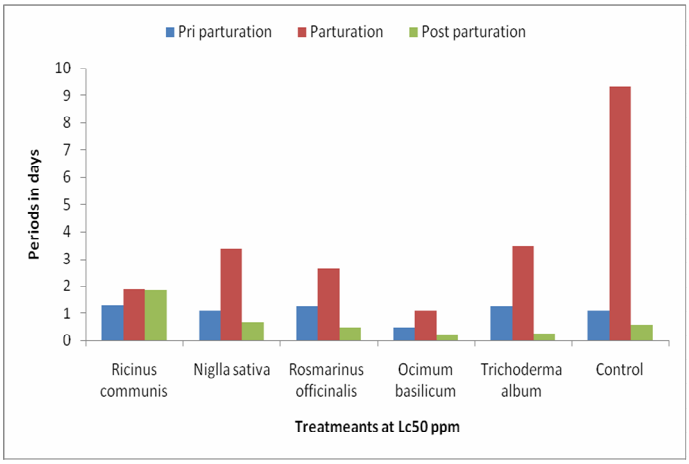

Fig. 9 : Effect of LC_{50}s concentrations of different treatments on pre- parturition, parturition and post–parturition periods of adult of *Myzus persicae*.

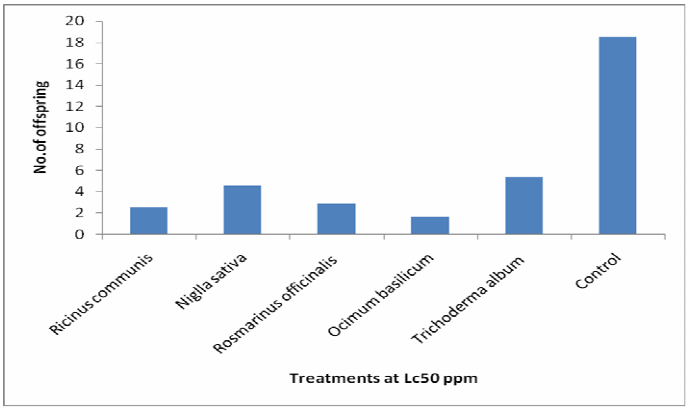

Fig. 10 : Effect of LC_{50} concentrations of different treatments on number of nymphs per adult of *Myzus persicae*.

Discussion

The green peach aphid, *M. persicae* is considered very important pest causing serious damage to vegetables, flowers and fruit crops (Erdogan and Yldrm, 2017). The whitefly *B. tabaci* is a global plant pest that has enormous losses in crop production (Oliveira *et al*., 2001).

Natural products from plants have been considered one of the most promising sources of biotational products with new modes of action to control insects (Rattan, 2010), and entomopathogenic fungi also considered one of the most recent discovered methods for pests controlling (Sabbour and Sahab, 2005). In our study, the unsaponifiable matter percentage of *R. communis*seeds oil is 0.70, these results agree with results obtained by Njoroge (2013) reported that the unsaponifiable matter in castor beans is 0.73± 0.08 and in the same trained agree with Adebayo *et al.* (2013) identified the unsaponifiable matter percentage of *R. communis* seeds oil is 0.8 while our results disagree with Jumat *et al*. (2010) reported that the unsaponifiable matter percentage of *R. communis* seeds oil is 3.4. In the present study the unsaponifiable matter percentage of *N. sativa* is 1.14, this percentage in the range of value described by previous studies by (Sultan *et al*., 2009; Hasnah *et al.,* 2014 and Zeliha and Ali 2016) reported that the unsaponifiable matter percentage of *N. sativa* is 1.1. These data are disagree with Üstün *et al*. (1990) reported that the unsaponifiable matter percentage of *N. sativa* is 0.66.

Our results showed that both adult of green peach aphid and nymphs of sweet potato whitefly are susceptible to basil (*O. basilicum*) and rosemary (*R. officinalis*) oil at LC_{50} values. Their LC_{50} were 2120.58, 5248.14 and 501.81, 2020.46 respectively. Thus, the toxicity of basil oil was higher than rosemary oil against both *M. persicae* and *B. tabaci*. Khalaf and Hussein (1997) reported that, the toxicity of terpenoid compound of *C. citratus* and *R. officinalis* related to the presence of different methyl and hydroxygroups of *R. officinalis* oil.

Our resulted showed that both adult of green peach aphid and nymphs of sweet potato whitefly were susceptible to two fixed oils *R.communis* and *N. sativa* at LC_{50} values. Their LC_{50} were 3960.70, 11128.17 and 2268.6, 3682.02 respectively. Lima*et al*. (2013) evaluated the efficiency of plant extracts *Ipomoea carnea*subsp. Fistulosa, castor bean (*Ricinus communis* L.), Tingui (*Mascagniarigida* Griseb), cardo-santo (*Argemone mexicana* L.) and the commercial oil product Natuneem Reg on the population levels of whitefly nymphs on the squash cv. Jacarezinho. All of the plant extracts were efficient in the control of the *B. tabaci* nymphs, with *R. communis* (75.49%), *M. rigida* (73.99%), *I. carnea* (72.24%), neem oil (70.4%) and *A. mexicana* (69.16%).

In the present data indicated that *M. persicae* and *B. tabaci* were susceptible to biozed (biocide) at their LC_{50}. The LC_{50} were determined by 24.73 and 27.75 respectively. El-Gendy (2015) found that LC_{50} of biozed against *Brevicoryne brassicae* was 55.8 ppm. Ibrahim *et al*. (2011) found that the LC_{50} values were 103.88 and 104.75 conidia for the entomopathogenic fungi *M. anisopliae* and *B. bassiana*, respectively against *M. persicae*. 100% of aphids have died after 7 days of fungul treatment. In the present study, the mortality percentage increased by the time to reach its maximum after 6 days, where the *O. basilicum* volatile oil, *R. communis* and biozed (*T. album*) gave the highest effect 100%, 96.43% and 98% respectively, after 6 days of experiments on *M. persicae*, while the effect on *B. tabaci* 100%, 100% and 100%.On the other hand *R. officinalis* volatile oil and *N.sativa* fixed oil gave the lowest effect 87.93% and 90.17% respectively on *M. persicae*, while the effect on *B. tabaci* 67.66% and 86.42% respectively. LC_{50} at 10^7spore ml^{-1} of *B. bassiana* against aphid caused 90% mortality after 4.4 days and *M. anisopliae* caused 64% after 3.8 days reported by Araujo *et al*. (2009). Saranya *et al*. (2010) reported that *L. lecanii*, *M. anisopliae* and *B. bassiana* strains caused 100, 83.3 and 61.5% mortality, respectively of cow pea aphid, *Aphis craccivora* after 7 days at 10^7spore ml^{-1}.

El-Gendy (2015) reported that, the spores of *T. album* germinate on the cabbage aphid cuticle and legs, penetrate them and spread through the body and lytic enzymes secreted by the fungus may be played a role in the process of damage. In the present study, we found that all treatments affected the biology of adult *M. persicae* where the longevity of adult aphid was highly significance decreased by all treatment compared with control, 10.96 days.

All treatments caused clear decrease in the number of offspring ranged between 1.70 and 5.41 offspring while the normal adult recorded 18.5 offspring. It was clear that the volatile oils and fixed oils decrease in longevity fecundity and offspring number these results are parallel with results which recorded by Tomova *et al*. (2005) who showed that fractionated targets volatile oils reduced the fecundities of three species of aphids (*Acyrthosiphon pisum* (Harris), *M. persicae* (Sulzer) and *Aulacorthum solani* (Kaltenbach)). Also, these results are in harmony with results which recorded by Mondědji *et al*. (2014) who found that, neem leaves extract reduced survival and reproductive potential of the green peach aphid *M. persicae*. Urvi *et al*. (2016) revealed that aqueous extracts of neem seed kernels and darek drupes reduced the reproductive period, fecundity and adult longevity of *M. persicae*.

Conclusions

The present work aims to evaluate the efficiency of plant extracts, volatile oils of *Ocimum basilicum* and *Rosmarinus officialis*, fixed oils of *Ricinus communis* and *Nigella sativa* and entomopathogenic fungus *Trichoderma album* as alternative to chemical insecticides on pests of economic crop, potato *Solanum taberosum* in Egypt. *Myzus persicae* and *Bemisia tabaci* under laboratory conditions. All LC_{50} treatments showed highly toxic and repellency effect against the adult of green peach aphid and the nymphs of sweet potato whitefly. The treatments affect some biological aspects and decrease the duration of *M. persicae* than control.

References

A.O.A.C. (1995). Official Methods of Analysis of AOAC international 18th Ed. Association of Official Analytical Chemists, Washington, D.C., 1-14.

Abbott, W.S. (1925). Methods for computing the effectiveness of insecticide. J. Econ. Entomol., 18(2):256-267.

Abd El-Fattah, M.H.; Haydar, M.F.; Abd El-Rahman, H. and Badr, El-Sabah, A.F. (2000). Seasonal abudance of potato aphids and associated natural enemies. Eygpt J. Agric. Res., 78(1):121 – 131.

Adebayo, T.B.; Rofiat, T.A.; Damilala, T.O. and Victoria, T.B. (2013). Fatty acid composition and physicochemical properties of castor (*Ricinus communis* L.) seed obtained from Malete, Morolocal Government Area, Kwara State, Nigeria. Chemistry and Materials Research, 3(12): 11-13.

Ail-Catzim, C.E.; Garcia-Lopez, A.M.; Troncoso-Rojas, R.; Gonzalez-Rodriguez, R.E. and Sanchez-Segura, Y. (2015). Insecticidal and repellent effect of extracts of *Pluchea sericea* (Nutt.) on adults of *Bemisia tabaci* (Genn.). Revista Chapingo. Serie Horticultura;. 21(1): 33-41.

Ali, Sh. A.M. (2008). Relationship between aphids and aphidophagous insects in El-Khattara district. Ph.D. Thesis, Agric. Fac., Zagazig Univ. 191 p.

Araujo, J.R.; Edmilson, J.M. and Oliveira, J.V. (2009). Potencial de solados de *Metarhizium anisopliae* et *Beauveria bassiana* do Óleo de Nim no Control do Pulgão *Lipaphiserysimi* (Kalt.) (Hemiptera: Aphididae). Neotropical Entomol, 38(4): 520-525.

Arens, M.; Schulte, E. and Weber, K. (1994). Fatty acid methyl esters, transesterification with trimethylsulfonium hydroxide. Fat Sci. and Technol., 96(2): 67-68.

Belmain, S.R.; Neal, G.E.; Ray, D.E. and Golop, P. (2001). Insecticidal and vertebrate toxicity associated with ethnobotonicals used as post harvest protectants in Ghana. Food chemistry and Toxicolog, 39: 287-291.

Bernhard, R.A.; Shibamoto, T.; Yamaguchi, K. and White, E. (1983). The volatile constituents of Schinusmolle. L. J. Agric Food Chem., 31: 463-466.

Billal, N.; Naama, F. and Imane, A. (2015). Insecticidal activityof three plants extracts against *Myzus persicae* (sulzer) and their phytochemical screening. Acta agricultural Solvenica, 105(2): 261-267.

Butt, T.; Jackson, C. and Magan, N. (2001). Fungi as biocontrol agents. CAB International, London, UK, 24-48.

CoStat Statistical Software (2005). Microcomputer program analysis, version 6.311.CoHort Software, Monterey, California, USA.

El-Maghraby, M.M.A. (1993). Seasonal abundance of the cruciferous aphid *Brevicoryne brassiae* L. (Homoptera, Aphididae) in relation to the primary and hyperparasitoids on cauliflower in Zagazig Region, Egypt. Zagazig J. Agric. Res. 20(5): 1627-1639.

Gendy, R.M. (2015). Application of some Recent Techniques to Control the Cabbage Aphid, *Brevicoryne brassicae* (L.) (Homoptera: Aphididae).Thesis PH, Scie. Zagazig Unvi. Fac. Sci., 257.

El-Malak, V.S.G.A.; Bachatly M.A. and Doss S.A. (2000). Relative susceptibility of nine potato varieties to aphid *Myzus persicae* Sulzer and potato tuber moth *Phthorimaea operculella* (Zeller) infestation. Ann.of Agric. Sci., Moshtohor. 38(3):1781-1788.

Erdogan, P. and Yldrm, A. (2017). Insecticidal effect some plant extracts on *Myzus persicae* Sulzer (Hemiptera : Aphididae) munis entomology & Zoology, 12(1): 217-223.

Finney, D.J. (1952). Probit analysis a statistical treatment of the sigmoid response curves. 2nd, Ed., Cambridge Univ., 318.

Hasnah, H.; Chong, G.L. and Suzana, S. (2014). Comparison of physicochemical analysis and antioxidant activities of *Nigella sativa* seeds and oils from Yemen, Iran and Malaysia. Sins Malaysiana, 43(4): 535-542.

Hossaina, M.A.; Ismail, Z.; Rahman, A. and Kang, S.C. (2008). Chemical composition and anti-fungal properties of the essential oils and crude extracts of *Orthosiphon stamineus* Benth. Industrial crops and products, 27: 328-334.

Ibrahim, L.; Hamieh, A.; Ghanem, H.; and Ibrahim, S.K. (2011). Pathogenicity of entomopathogenic fungi from Lebanese soils against aphids, whitefly and non-target beneficial insects. International Journal of Agriculture Sciences. 3(3):156-164.

Isman, M.B. (2006). Botanical insecticides, deterrents and repplents in modern agriculture and increasingly regulated World. Ann. Rev. of Ent., 51: 45-66.

Jones, D.R. (2003). Plant viruses transmitted by whiteflies. Eur J Plant Pathol. 109:195-219.

Jumat, S.; Dina, A.M.N.; Nazrizawati, A.T.; Mohd, F.M.Y. and Noraishah, A. (2010). Fatty acid composition and physicochemical properties of Malaysian Castor Bean (*Ricinus communis* L.) seedoil. Sains Malaysiana, 39(5): 761-764.

Khalaf, A.A. and Hussein, K.T. (1997). Biocidal activity of selected volatile oils of plant origin against *Muscina stabulans* (FALLEN) (Diptera- Muscidae). Ain Shams Sci. Bull., 35: 307-329.

Likenes, S.T. and Nickerson, G.B. (1966). Isolation and identification of volatiles. J. Chromatogr., 21: 1-8.

Lima, B.M.F.V.; Moreira, J.O.T. and Aragao, C.A. (2013). Evaluation of plant extracts in the control of whitefly *Bemisiatabaci* biotype B in squash. [Portuguese] Revista Ciencia Agronomica; 44(3): 622-627.

Lima, B.M.F.V.; Moreira, J.O.T. and Pinto, H.C. (2011). Evaluation of plant extracts in the control of white fly in tomato. [Portuguese] RevistaCaatinga, 24(4): 36-42.

Maurya, P.; Sharma, P.; Mohan, L.; Batabyal, L. and Srivastava, C.N. (2009). Evaluation of the toxicity of different phytoextract of *Ocimum basilicum* against *Anopheles stephensi* and *Culex quinquiefasciatus*, J. Asia –Pacific Entomol., 12: 113-115.

Mondédji, A. D.; Kotoh, G. K.; Amévoin, K.; Ameline, A.; Giordanengo, P. and Glitho, I. A. (2014). Evaluation of neem leaves based preparations as insecticidal agants against the green peach aphid, *Myzuspersicae*. African J. of Agric.Res.; 9(17): 1344-1352.

Mound, L.A. and Halsery, S.H. (1978). Whiteflies of the world, asystemic catalogue of the Aleyrodidae (Homoptera) with host plant and natural enemy data. British Museum (Natural History), London, UK. 340.

Murati, G.; Duraj, N. and Nepravishta, A. (2013). The inventory of aphids species in potato culture. Albanian Journal of Agricultural Sciences, 12(4): 765-768.

Njoroge, J.M. (2013). Physicochemical characteristics of crude and dehydrated Castor oil from local wild plants (*Ricinus communis* L.) from five selected Regions in Kenya. M. Sc. Thesis, Fac. Sci. Nairobi Univ. Kenya, 139pp.

Oliveira, M.R.V.; Hanneberry, T.J. and Anderson, P. (2001). History, current status and collaborative research projects for *Bemisia tabaci*. Crop Protection., 29(9): 913-920.

Pedrini, N.; Crespo, R. and Juarez, M.P. (2007). Biochemestry of insect epicuticle degradation by entomopathogenic fungi. Comp. Biochem. Physiol. CToxicol. Pharmacol. 146: 124 137.

Prowse, G.M.; Galloway, T.S. and Foggo, A. (2006). Insecticidal activity of monoterpenes against *Rhyzopertha dominica* (F.) and *Tribolium castaneum* (Herbst). J. Stored Prod. Res., 34: 243-249.

Ramadan, M.F. and MÖrsel, J.T. (2003). Crude lipids Golden berry (*Physalis peruviana* L.). J. of Agric. and Food Chem., 51: 969-974.

Rattan, R.S. (2010). Mechanism of action of insecticidal secondary metabolites of plant origin. Crop Protection, 29(9): 913-920.

Regnault, R.C.; Vincent, C. and Anasan, J.T. (2012). Essential oil in insect control: low-risk products in a high. Stakes world. Annual Review of Entomology, 57: 405-424.

Russo, S.; Rodriguez, S.; Michetti, M.; Delfino, S. and Pelicano, A. (2001). Use of natural extracts of basil, dill and fennel as an alternative measure of control of *Macrosiphum euphorbiae* Thomas (Homoptera: Aphiaidae). IDESIA. 19(1/2):17-24.

Sabbour, M.M. and Sahab, A.F. (2005). Efficacy of some microbial control agents against cabbage pest in Egypt. Pakistan J. boil. Sci., 8: 1351-1356.

Santana, O.; Andres, M.F.; Sanz, J.; Errahmani, N.; Abdeslam, L. and Gonzalez-Coloma, A. (2014). Valorization of essential oils from Moroccan aromatic plants.Natural Product Communications. 9(8): 1109-1114.

Saranya, S.R.; Ushakumari, S.; Jacob and Philip, B.M. (2010). Efficacy of different entomopathogenic fungi against cowpea aphid, *Aphis craccivora* (Koch). J. of Biopesticides, 3(1): 138-142.

Singh, A.; Kataria, R. and Kumar, D. (2012). Repellence property of traditional plant leaf extracts against *Aphis gossypii* Glover and *Phenacoccus solenopsis* Tinsley. African J. of Agric. Res., 7(11): 1623-1628.

Sultan, M.T.; Butt, M.S.; Anjum, F.M.; Janail, A.; Akhtar, S. and Nasir, M. (2009).Nutritional profile of indigenous cultivar of black cumin seeds and antioxidant potential of its fixed and essential oil. Pak. J. Bot. 41(3): 1321-1330.

Sun, Y.P. (1950). Toxicity index an improved method of comparing the relative toxicity of insecticides. J. Econ. Entomol, 43: 45-53.

Tomova, B.S.; Waterhouse, J.S. and Doberski, J. (2005). The effect of fractionated Tagetes oil volatiles on aphid reproduction. Entomologia Experimental set Applicata, 115: 153-159.

Urvi, S.; Chandel, R.P.S. and Sharma, P.L. (2016). Effect of botanicals on biological parameters of green peach aphid, *Myzus Persicae* (Sulzer). Journal of Insect Science (Ludhiana), 29(1):170-171.

Üstün, G.; Kent, L.; Cekin and CiveleKoglu, H. (1990). Investigation of the technological properties of *Nigella sativa* (Black cumin) seed oil. JAOCS. 67(12): 958-960.

Verma, M.; Brar, S.K.; Tyagi, R.D.; Surampalli, R.Y. and Val' ero, J.R. (2007). Antagonisitic fungi, *Trichoderma* ssp.; Panoply of biological control. Biochemical Engineering J. 37: 1-20.

Zeliha, U.A. and Ali, G. (2016).Determination of physicochemical properties of *Nigella sativa* seed oil from Bahkesir Region, Turkey. Chemical and process Engineering Research, 41: 2224-7467.

Zidan, Z.H. and Abdel-Maged, M.I. (1988). New approaches in pesticides and insect control. Arabic publishing House and Delivery. Cairo: 605p.