Journal of

Entomology

ISSN 1812-5670

Academic
Journals Inc.

www.academicjournals.com

OPEN ACCESS
Journal of Entomology
ISSN 1812-5670
DOI: 10.3923/je.2016.84.90

Research Article

Impact of Certain Natural Plant Oils and Chemical Insecticides against Tomato Insect Pests

Ibrahim M. Ebadah, Shehata E.M. Shalaby and Sawsan S. Moawad

Department of Pests and Plant Protection, National Rrsearch Center, Dokki, Cairo, Egypt

Abstract

Evaluation role of three insecticides, acetamiprid, lambada-cyhalothrin, chlorpyrifos and two natural oils, clove, bitter orange and mixture of both (1:1) in depress infestation of tomato plant by *Liriomyza trifolli*, *Bemisia argentifolii* and *Tuta absoluta* were carried out under semi field conditions. According to general mean of mortality, clove oil was the highest (60.5%) effect against *L. trifolli* followed by mix oil (48.3%), while acetamiprid had the lowest toxic effect with 39.6% of reduction. Also, data clarified that lambada and mix oil (clove and bitter orange oils 1:1) were the highest effective against eggs of *B. argentifolii*, both caused 85.4 and 85.3% reduction in eggs count, respectively, while acetamiprid was the lowest (50.9%). Clove gave satisfactory results against *L. trifolli, B. argentifolii* and *T. absoluta*, respectively, thereby; it was concluded that the use them for control tested insects on tomato plants.

Key words: Insecticides, natural oils, *B. argentifolii*, *Liriomyza trifolli*, *Tuta absoluta*

Received: December 15, 2015 Accepted: February 04, 2016 Published: April 15, 2016

Citation: Ibrahim M. Ebadah, Shehata E.M. Shalaby and Sawsan S. Moawad, 2016. Impact of certain natural plant oils and chemical insecticides against tomato insect pests. J. Entomol., 13: 84-90.

Corresponding Author: Ibrahim M. Ebadah, Department of Pests and Plant Protection, National Rrsearch Center, Dokki-Cairo-Egypt

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The tomato *Lycopersicon esculentum* Mill (family, Solanaceae) is a major vegetable crop that has consummate huge popularity over the last century. It is planted in practically every country of the world, in outdoor fields and greenhouses. The tomato plant is very versatile and the crop can be divided into two categories; fresh market tomatoes, which we are concerned with and processing tomatoes, which are grown only outdoors for the canning industry and mechanically harvested. In cases, world production and consumption has grown quite rapidly over the past 25 years (FAO., 2000). Tomato is one the most important economic vegetables in Egypt so far as the area under vegetables and commercial value of the crop is concerned. The tomato is considered as one of the few cultures for which pests and diseases are equally important, being a host plant to about 200 species of arthropods (Anonymous, 2001). Insect pests destroy crops in the field through their biting, chewing, boring, sucking and defoliation (Shalaby *et al*., 2012). A chemical designed to keep pests and primarily insects, away from agricultural plants. The application of synthetic pesticides has caused threat to non-target organisms and the environment due to their overuse (Savary *et al*., 2006). Since the release of xenobiotic results in the increase of environmental risk, the goal should be to use such compounds carefully so that they cause least negative impact on the environment (Savary *et al*., 2012) into which they are released. In recent years, a move toward biopesticides has been observed due to concerns over health problems caused by the use of chemicals. To determine the effectiveness of pesticides, experts look at plants to see if holes have been bored in their leaves or bite-marks are found on the flowers. Some insects will leave a sticky residue on the leaves, as well, or the bugs might actually be seen on the plant. Pesticides are necessary to keep our agricultural plants safe from insect infestation (Mahmoud *et al*., 2014). Natural pesticides are increasingly preferred, as they reduce the number of chemicals that are released into the environment (Hanafy and El-Sayed, 2013). Therefore, the present work was carried out to compare the relative toxicity of some chemical insecticides with three natural oils against *Liriomyza trifolli*, *Bemisia argentifolii* and *Tuta absoluta* on tomato plants.

MATERIALS AND METHODS

The experiment was run to compare the efficiency three of recommended insecticides and two of natural oil toward some of tomato insects under semi-field condition as follows:

Insecticides:

- Acetamiprid 20% SP (Mospilan), 15 g/100 mL/5 pots
- Lambda-cyhalothrin 5% EC (Lambda), 250 mL/100 mL/5 pots
- Chlorpyrifos 48% EC (Pestban), 0.5 L/100 mL/5 pots

Natural oils:

- Clove oil (*Syzygium aromatic* L.) 10 µL/100 L, was obtained from Sigma (Germany)
- Bitter orange (*Citrus aurantium* amara) 10 µL/100 L, was obtained from Haraz (Saudia Arbia)
- Mix (Clove: Bitter orange, 1:1) 10 mL/100 L

Each concentration of tested oils was mixed with one drop of Tween (60%) and glycerin (99%) to emulsify them with water.

Design of experiment: The test was carried out under semi-field condition. The tomato plant was planted in plastic pots (50×50×20 cm^3) and placed in isolated area at National Research Center and covered by plastic ceiling to protect plant from dewy fall (Fig. 1). Each pot was prepared by added usual fertile soil and planted with three saplings of tomato plants (two weeks old). After three weeks of plantation was started the test by spraying the plant shouts by the prepared materials. The experiment was divided into seven treatments, the 1st, 2nd and 3rd treatments were treated by the following insecticides; lambada-cyhalothrin, acetamiprid and chlorpyrifos. While, the 4th, 5th and 6th treatments were treated by clove, bitter orange and mix of both oils (1:1), using the same rate according to Moawad *et al*. (2015). Seventh treatment was left untreated to serve as control. Each test was replicated five times. The evaluations against white flies (*Bemisia argentifolii*) and leaf miner (*Liriomyza trifolli*) were conducted on 20 leaflets (Gonzalez-Cabrera *et al*., 2011) were randomly collected from each replicate before spraying as well as 3, 5, 7, 10 and 15 days after spraying. The outer plants were never sampled in order to avoid border effects. Alive and dead larvae of *L. trifolli*; eggs and nymph of *B. argentifolii* were counted using a binocular microscope. On other side, to evaluate the infestation percent tomato plants by *Tuta absoluta* was recorded after two month of treatment. Percent reduction in infestation was calculated by using study of Henderson and Tilton (1955).

Fig. 1: Design of semi-field experiment was covered by plastic ceiling barrier to protect test from dewy or rain drop out

RESULTS AND DISCUSSION

Efficiency of tested compounds against *Liriomyza trifolli*: Data in Table 1 revealed that lambada-cyhalothrin give highest mortality of *L. trifolli* larvae (69.1%) after three days of the application, followed by chlorpyrifos (59.2%) then Clove oil (56.8%). While the lowest mortality was noticed in acetamiprid insecticide (21.4%) followed by Bitter orange oil (38.2%). After 5th day the mortality percent was increased in plants treated by acetamiprid, Clove and Bitter orange (43.7, 61.4 and 40.1%), but it decreased in case of lambada, chlorpyrifos and mix oils (60.0, 53.6 and 49.1%, respectively). This trend was happened after 7 days. Obtained data after 15 days, natural oils more effective against *L. trifolli* compared with other insecticides. According to mean of mortality, clove oil was the highest (60.5%) effect on study pest followed by mix oil (48.3%), while acetamiprid had the lowest toxic effect with 39.6% of reduction (Fig. 2). These results agreement with those obtained by Sabbour and Abd-El-Aziz (2010), they reported that mustard and clove oils revealed a strong repellent activity after 7 days (89 and 71%, respectively) against *B. incarnatus* beetles.

The damage caused by *L. trifolli* is by feeding puncture, oviposition puncture and larval mines (Tilden, 1950). Data in Table 2 revealed the reduction percent in tunnels counts after tested insecticides and natural oils. The microscopic examination of tomato leaflets revealed that the reduction percent of tunnels count after 3 days of application ranged from 28.2-49.8%. This percent was increased after 5 days and reached its peak at 7 days (ranged from 43.4-84.0%), then decreased gradually after 10 and 15 days. General mean of reduction percent indicate that chlorpyrifos more effective as compared with other compounds followed by Clove oil (52.5 and 48.7%, respectively), while mix oil (Clove and Bitter orange) had the lowest effect (39.5%) (Fig. 3).

Effect of tested compounds on *bemisia argentifolii*: Results concerning the efficiency of tested compounds against eggs and numphal stages of *B. argentifolii* infesting tomato plants are presented in Table 3 and 4. After 3 days of application tested compounds caused considerable reduction in the eggs number (Table 3) ranged from 62.3-88.7%. These percent were decreased in acetamiprid, lambada insecticides and clove oil treatments (68.9, 82.6 and 61.8%, respectively), while it was increased in other treatments. By prolonging time after application, the efficiency of acetamiprid was decreased to 15.6% after 15 days, but it was increased in other treatments, chlorpyrifos had the highest effect with 96.4% reduction, followed by clove oil with 93.2%, then lambada-cyhalothrin and mix oil with 92.4%. The obtained data clarified that lambada and mix oil (Clove and Bitter orange oils 1:1) were the highest effective against eggs of *B. argentifolii*, both caused 85.4 and 85.3% reduction in eggs count, respectively (Fig. 4), while acetamiprid was the lowest (50.9%).

Table 4 indicated that the mortality percent of *B. argentifolii* nymph was ranged from 26.5-78.0% after 3 days for application, the high toxic effect was noticed in mix oil treatment followed by lambda, while the lowest effect was happened in Bitter orange oil. The mortality percent was fluctuated during experiment period and its reached 42.7, 54.1, 75.1, 73.7, 42.8 and 34.3% after 15 days in tomato plants treated by acetamiprid, lambda, chlorpyrifos, clove, bitter orange and mix oil, respectively. Also, obtained data revealed that use of Clove oil and Bitter orange oil alone gave 43.5 and

Table 1: Effect of some insecticides and natural volatile oils on *Liromyza trifolli* infested tomato plants

	Periods (days)														
	3			5			7			10			15		
	No. larvae		Real	No. larvae		Real	No. larvae		Real	No. larvae		Real	No. larvae		Real
Treatments	Alive	Dead	mortality (%)	Alive	Dead	mortality (%)	Alive	Dead	mortality (%)	Alive	Dead	mortality (%)	Alive	Dead	mortality (%)
Acetamiprid	8	3	21.4	8	7	43.7	7	11	56.01	10	10	46.0	12	9	31.3
Lambada	2	5	69.1	6	10	60.0	24	12	42.0	18	11	33.0	12	10	34.7
Chlorpyrifos	6	10	59.2	7	9	53.6	8	7	39.7	12	10	41.1	16	12	31.5
Clove	12	18	56.8	8	14	61.4	4	10	67.3	6	11	61.9	6	10	55.1
Bitter orange	16	12	38.2	13	10	40.1	9	8	40.1	10	11	48.6	9	11	46.0
Mix	8	10	51.9	12	13	49.1	14	15	40.9	13	16	51.6	13	17	48.1
Control	37	3	0.0	33	2	-	29	4	-	25	2	-	20	4	-

Table 2: Effect of some insecticide and natural volatile oils on tunnels count/20 leaflets of infested tomato plants by *L. trifolli*

		Periods (days)									
		3		5		7		10		15	
Treatments	Pre-treatment (No. of tunnels)	No. of tunnels	Reduction (%)	No. of tunnels	Reduction (%)	No. of tunnels	Reduction (%)	No. of tunnels	Reduction (%)	No. of tunnels	Reduction (%)
Acetamiprid	32	33	29.8	24	47.8	7	84.0	31	27.3	28	30.8
Lambada	34	24	45.8	23	46.8	18	56.3	25	37.7	23	39.6
Chlorpyrifos	36	24	42.6	19	53.5	12	69.1	20	47.3	18	50.0
Clove	35	30	30.2	25	40.5	14	65.0	16	59.0	19	48.6
Bitter orange	36	30	28.2	24	41.2	17	56.3	20	47.3	22	38.8
Mix	36	21	49.8	20	51.0	22	43.4	25	34.0	29	19.4
Control	35	43	-	42	-	40	-	39	-	37	-

Table 3: Effect of some insecticide and natural volatile oils on eggs count of *B. argentifolii*/ 20 leaflets of tomato plants

		Periods (days)									
		3		5		7		10		15	
Treatments	Pre-treatment	No. of eggs	R (%)	No. of eggs	R (%)	No. of eggs	R (%)	No. of eggs	R (%)	No. of eggs	R (%)
Acetamiprid	83	14	88.7	33	68.9	49	47.6	46	33.7	48	15.6
Lambada	90	16	86.0	17	82.6	16	81.4	10	84.4	4	92.4
Chlopyrifos	84	46	62.3	28	73.3	4	95.7	3	95.6	2	96.4
Clove	80	45	64.8	42	61.8	39	59.8	20	72.2	4	93.2
Bitter orange	78	48	63.4	39	65.4	30	69.3	19	74.3	6	90.1
Mix	72	27	81.0	23	81.2	18	83.3	9	88.8	5	92.4
Control	80	128	.	110	-	97	.	72	-	59	.

Table 4: Effect of some insecticide and natural volatile oils on nymphal stage of *B. argentifolii*

	Periods (days)														
	3			5			7			10			15		
	No. of nymphal stage			No. of nymphal stage			No. of nymphal stage			No. of nymphal stage			No. of nymphal stage		
Treatments	Dead	Alive	Mortality (%)	Dead	Alive	Mortality (%)	Dead	Alive	Mortality (%)	Dead	Alive	Mortality (%)	Dead	Alive	Mortality (%)
Acetamiprid	36	38	47.5	25	30	43.3	14	25	32.7	17	22	32.8	15	18	42.7
Lambada	15	10	59.1	42	11	78.4	72	11	86.1	49	13	75	18	14	54.1
Chlorpyrifos	14	11	54.9	15	16	46.3	16	22	39.2	21	16	48.5	29	9	75.1
Clove	26	56	30.1	22	40	32.9	18	34	31.4	15	18	49.6	9	3	73.7
Bitter Orange	11	28	26.5	11	21	31.7	9	14	36.1	10	13	47.2	10	12	42.8
Mix	95	26	78.0	63	24	63.5	41	22	63.4	30	16	63.8	12	11	34.3
Control	2	85	.	3	74	-	3	61	.	2	52	-	2	40	

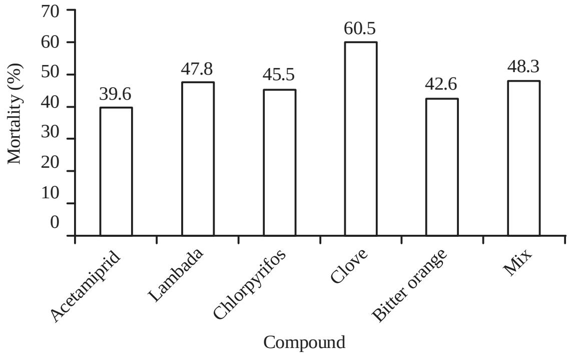

Fig. 2: General mean of mortality percent (%) of tested compounds on *L. trifolli*

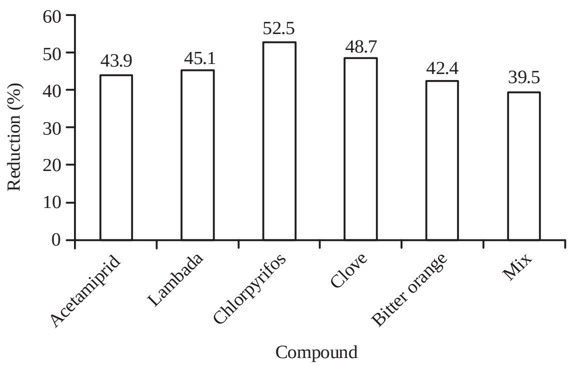

Fig. 3: General mean of reduction percent (%) of tunnels count/20 tomato leaflets infested by *L. trifolli*

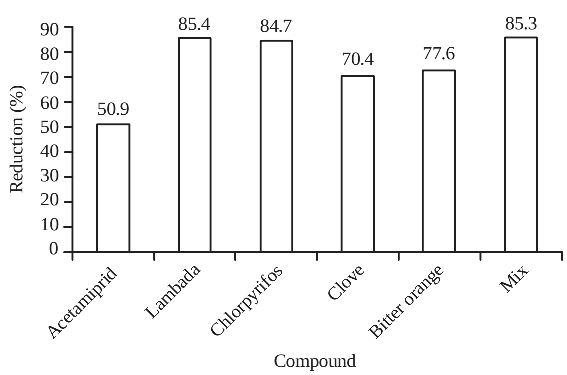

Fig. 4: General mean of reduction percent (%) in eggs count of *B. argentifolii*/ 20 tomato leaflets

36.9% reduction of nymph count, while mixture of both (1:1) induced 60.6% average of percent reduction (Fig. 5). These results agree with those obtained by Mousa *et al.* (2013), who reported that, garlic oil was the best efficient in reducing the population of leafhoppers and planthoppers by a mean reduction percentage of 68.09%, followed by the two chemical insecticides dimethoate 67.90% and pestban 64.02%

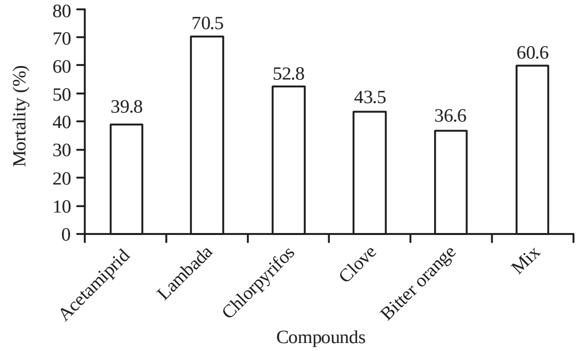

Fig. 5: General mean of mortality percent (%) of numphal stage of *B. argentifolii*/20 tomato leaflest

and Eucalyptus oil was the least in this category as 43.27%. However in controlling aphids, also garlic surpasses again by a mean overall reduction 90.96%, followed by pestban 89.44%, while eucalyptus oil came in the third rank as 80.66% before the dimethoate which achieved the least rank in controlling aphids as 76.14%.

In this context, the obtained data revealed that the toxicity of pyrithroid compound (lambada-cyhalothrin) and natural mix oil (clove and bitter orange, 1:1) was higher than that of other treatments. In this respect, one might suggest the use of both compounds as adequate treatments to achieve satisfactory control against *B. argentifolii*. Essential oils may have attractive or repellent effects and in some cases they showed insecticidal action against certain insect pests. Oils isolated from plants which consist of cyclic and monocyclic mono-terpens proved effective repellents against insects (Rodriguez and Levin, 1975). It was found that these bioactive compounds are potentially toxic to insects and mites but relatively safe to human and wildlife. Recently, there is a great need to find alternative pesticides instead the traditional chemical insecticides which proved to have toxic effect on human, animal and on the whole environment. Some essential oils are extracted from natural sources, such as eugenol which is extracted from clove fruits (Farag *et al.*, 1991).

Effect on *tuta absoluta*: The results indicated that the infestation percentage of *T. absoluta* to tomato plant affected by all treatment; although the investigation was carried out after month of application (Table 5). There is no observed big variation between treatments by chemical insecticide and natural oils, i.e., the reduction% of infestation ranged between 60-50% and real mortality percentage ranged between 88-77%; except in case of spraying with mixture of oils and Lambada. The most of application able to protect tomato plant from early attack of tomato leafminer, especially treatment by clove oil which caused reduction in infestation

Table 5: Effect of some insecticide and natural volatile oils on *Tuta absoluta*

Treatments	Mean No. of investigated leaflets/plant	Mean No. of tunnels/plant	Iinfested (%)	*Reduction infestation (%)	Mean number of larval stage/plant		Real mortality (%)
					Alive	Dead	
Acetamiprid	210	12	5.7	50.0	1	9	88.95
Lambada	223	13	5.8	45.8	7	4	29.70
Chlorpyrifos	260	10	3.8	58.3	3	7	77.30
Clove	255	9	3.5	62.5	1	8	87.30
Bitter orange	125	10	8.0	58.3	6	3	26.30
Mix	330	16	4.8	33.3	4	11	70.50
Control	165	24	14.5	..	19	2	-

*Reduction(%) = T-C/C X100

reached to 62.5% and mortality 87.3%. In the same respect, Moawad *et al*. (2015) reported that mixed clove, bitter orange and zinc sulfate together had ability to cause highest mortality to *T. absoluta* larvae reached 97.0%.

Pest management is facing economic and ecological challenge worldwide due to human and environmental hazards caused by majority of the synthetic pesticide chemicals. The obtained results were spot light about the ability of natural oils to relatively protect tomato plant and serving as an alternative to insecticide. There are many authors evaluated efficacy of essential oils and agree with the achieved of present results as (Dos Santos *et al*., 2010; Regnault-Roger *et al*., 2012; El-Wakeil, 2013; Ootani *et al*., 2013; Regnault-Roger, 2013; Cavalcanti *et al*., 2015). Moawad *et al*. (2013) recorded that Clove, eugenol and isoeugenol caused highly reduction percentage of penetration and accumulative mortality of larvae and caused ovipositional deterrence reaction towards adult stage of *T. absoluta* under lab. conditions.

Generally, the extensive and unwise use of synthetic pesticides in the control programmers against agricultural pests often creates in major deleterious side effects. Fortunately, natural oils (Clove) gave satisfactory results against *L. trifolli B. argentifolii* and *T. absoluta*, respectively, thereby; it was concluded that the use them for control mentioned tomato insect pests as alternatives to the classic pest control agents.

ACKNOWLEDGMENT

This study in the part of the project No. 10120614 (2013-2016) funded by National Research Centre (NRC), Cairo, Egypt.

REFERENCES

Anonymous, 2001. Professional recommendation in agriculture pest control. Ministry of Agriculture and Land Reclamation, Cairo, Egypt, pp: 1-76.

Cavalcanti, A.D.S., M.D.S. Alves, L.C.P. da Silva, D.D.S. Patrocinio, M.N. Sanches, D.S.D.A. Chaves and M.A.A. de Souza, 2015. Volatiles composition and extraction kinetics from *Schinus terebinthifolius* and *Schinus molle* leaves and fruit. Revista Brasileira de Farmacognosia, 25: 356-362.

Dos Santos, A.C.A., M. Rossato, L.A. Serafini, M. Bueno and L.B. Crippa *et al*., 2010. Antifungal effect of *Schinus molle* L., Anacardiaceae and *Schinus terebinthifolius* Raddi, anacardiaceae, essential oils of Rio Grande do Sul. Revista Brasileira de Farmacognosia, 20: 154-159.

El-Wakeil, N.E., 2013. Botanical pesticides and their mode of action. Gesunde Pflanzen, 65: 125-149.

FAO., 2000. Tomato integrated pest management-An ecological guide. FAO Inter-Country Programme for IPM in vegetables in South and Southeast Asia, FAO-RAP, Bangkok, Thailand, pp: 200. http://www.share4dev.info/ffsnet/documents/3516.pdf

Farag, R.S., S.H. Abu-Raiia, G.E. El-Desoky and G.S.A. El-Baroty, 1991. Safety evolution of thyme and clove essential as natural antioxidants. Afr. J. Agric. Sci., 18: 169-176.

Gonzalez-Cabrera, J., O. Molla, H. Monton and A. Urbaneja, 2011. Efficacy of *Bacillus thuringiensis* (Berliner) in controlling the tomato borer, *Tuta absoluta* (Meyrick) (Lepidoptera: Gelechiidae). BioControl, 56: 71-80.

Hanafy, H.E.M. and W. El-Sayed, 2013. Efficacy of bio-and chemical insecticides in the control of *Tuta absoluta* (Meyrick) and *Helicoverpa armigera* (Hubner) infesting tomato plants. Aust. J. Basic Applied Sci., 7: 943-948.

Henderson, C.F. and E.W. Tilton, 1955. Tests with acaricides against the brown wheat mite. J. Econ. Entomol., 48: 157-161.

Mahmoud, Y.A., H.A. Salem, S.E.M. Shalaby, A.S. Abdel-Razak and I.M.A. Ebadah, 2014. Effect of certain low toxicity insecticides against tomato leaf miner, *Tuta absoluta* (Lepidoptera: Gelechiidae) with reference to their residues in harvested tomato fruits. Int. J. Agric. Res., 9: 210-218.

Moawad, S.S., I.M. Ebadah and Y.A. Mahmoud, 2013. Biological and histological studies on the efficacy of some botanical and commercial oils on *Tuta absoluta* Meyrick (Lepidoptera: Gelechiidae). Egypt. J. Biol. Pest Control, 23: 301-308.

Moawad, S.S., A. Sharaby, I.M. Ebadah and H. El-Behery, 2015. Efficiency of zinc sulfate and some volatile oils on some insect pests of the tomato crop. Global Adv. Res. J. Agric. Sci., 4: 182-187.

Mousa, K.M., I.A. Khodeir, T.N. El-Dakhakhni and A.E. Youssef, 2013. Effect of garlic and eucalyptus oils in comparison to organophosphat insecticides against some piercing-sucking faba bean insect pests and natural enemies populations. Acad. J. Biol. Sci., 5: 21-27.

Ootani, M.A., R.W. Aguiar, A. Carlos, C. Ramos, R. Brito, J. Batista and P. Cajazeira, 2013. Use of essential oils in agriculture. J. Biotechnol. Biodivers., 4: 162-175.

Regnault-Roger, C., 2013. Essential Oils in Insect Control. In: Natural Products, Ramawat, K.G. and L.M. Merillon (Eds.). Springer, Berlin, Heidelberg, pp: 4087-4107.

Regnault-Roger, C., C. Vincent and J.T. Arnason, 2012. Essential oils in insect control: Low-risk products in a high-stakes world. Annu. Rev. Entomol., 57: 405-424.

Rodriguez, E. and D.H. Levin, 1975. Biochemical Parallelism of Repellents and Attractants in Higher Plants and Arthropods. In: Recent Advances in Phytochemistry Biochemical Interaction between Plants and Insects, Wallace, J.M. and L.R. Mansell (Eds.). Plenum Press, New York, pp: 215-270.

Sabbour, M.M. and S.E. Abd-El-Aziz, 2010. Efficacy of some bioinsecticides against *Bruchidius incarnates* (Boh.) (Coleoptera: Bruchidae) infestation during storage. J. Plant Prot. Res., 50: 28-34.

Savary, S., F. Horgan, L. Willocquet and K.L. Heong, 2012. A review of principles for sustainable pest management in rice. Crop Protect., 32: 54-63.

Savary, S., P.S. Teng, L. Willocquet and F.W. Nutter Jr., 2006. Quantification and modeling of crop losses: A review of purposes. Ann. Rev. Phytopathol., 44: 89-112.

Shalaby, S.E.M., M.M.M. Soliman and A.E.M.A. Ei-Mageed, 2012. Evaluation of some insecticides against tomato leaf minor (*Tuta absoluta*) and determination of their residues in tomato fruits. Applied Biol. Res., 14: 113-119.

Tilden, J.W., 1950. Oviposition and behavior of *Liriomyza pusilla* (Meigen). Pan. Pac. Entomol., 26: 119-121.