OVICIDAL EFFICIENCY OF SOME BOTANICAL OILS AGAINST HATCHABILITY OF POTATO TUBER MOTH, *PHTHORIMAEA OPERCULELLA* EGGS AND THEIR SIDE EFFECT ON *CHRYSOPERLA CARNEA* UNDER LABORATORY CONDITIONS

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Abstract

Laboratory experiments were conducted to investigate the ovicidal effect of six plant oils {Cloves (*Syzygium aromaticum*), Sesame (*Sesamum indicum*) , Peppermint (*Mentha piperta*), Colocynth (*Citrullus colocynthis*), Marjoram (*Majorana hortensis*), and Orange (*Citrus sinenis*) } against *Phthorimaea operculella* eggs. And to find out the compatibility of these oils with the predator *Chrysoperla carnea* . Data indicated that the toxicity values of the tested oils based on LC_{50} values were arranged in ascending orders as follows Marjoram < cloves < Sesame < Peppermint < Orange < Colocynth. Marjoram oil revealed the highest mortality % while the LC_{50} was (0.646 ml/L) compared to other oils. Whereas Colocynth oil was the lowest toxic oil representing the highest LC_{50} (3.662 ml/L). Duncan analysis categorized the tested oils into three groups according to their negative effect on egg hatchability. Marjoram & Cloves oil came in the first category, where the hatchability % recorded 10.9 and 11.5, respectively at the concentration 1%. The study also indicated that superiority predation efficiency 96.4 % with Marjoram oil treated *P. operculella* eggs and predator lived for 15.3 days out of 16 days. Treatment with Marjoram oil was found safe to *C. carnea* in comparison to others natural oils. Data indicated that Duncan analysis categorized the tested oils into different groups at the length of biochemical analysis of fatty acid, total phenols, tannis and triglycerides. In spite of Marjoram oil recorded the highest inhibition of hatchability of *P. operculella* eggs but recorded 1866.7 µg triolein\ml. So must be used freshly extraction of Marjoram oil in IPM program. (i.e. Expire date is very important at this case). Finally, the Marjoram oil had a promise results against *P. operculla* eggs especially it had not passive effects against one of the most common arthropod predators (green lace wing). This is a primary study needs for more efforts to apply in suitable way and tactics in the field and store in broad scale.

INTRODUCTION

Potatoes are the fifth most economically important crop in the world. Egypt produces 2.6 million metric tons of potatoes and exports 411.000 metric tons to Europe and the Arab countries (FAO STAT. 2015). The potato tuber moth, *Phthorimaea operculella* (Lepidoptera, Gelechiidae) is a noxious pest of potato in both field and storage conditions (Dawood *et al.,* 1999).

The use of chemical pesticides to control potato tuber moth has resulted in harmful side effects such as health hazards from residues reduction in populations of natural enemies and the development of insect resistance to pesticides (Llanderal-Cazares *et al.* 1996).

Weinzierl and Henn (1991) reported a new interest in using natural products to control pests to reduce chemical insecticides hazards. Among these natural products, the botanical oils paid the researchers attention to reduce harmful effects of chemical insecticides on human. In recent years, crop protection based on biological control of crop pests with safe tools to recognize as a valuable tool in pest management. The appropriate use of environment-friendly products can play a significant role in sustainable crop production by providing a stable pest management program.

Therefore, there is an urgent need for safe but effective, biodegradable products with no toxic effects on non- target organisms. This has created a worldwide interest in the development of alternative strategies including the search for new types of treatments. In recent years, there has been an increased interest in natural plant derived materials as alternative pesticides to convention, broad spectrum toxicants.

The present work aimed to study the compatibility between using some plant oils as ovicidal effect and releasing of *C. carnea* against *P. operculella* eggs. The common green lacewing, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) is one of the most common arthropod predators with a wide prey range including aphids, eggs and neonates of lepidopteron insects, scales, whiteflies, mites, and other soft bodied insects (McEwen *et al*. 2001).

The present study was designed to investigate ovicidal efficiency of some botanical oils against *P. operculella* eggs and to find out the compatibility of these oils with the predator *Chrysoperla carnea* under laboratory conditions.

MATERIALS AND METHODS

1- Insect culture:

Larvae of the potato tuber moths, *P. operculella* (PTM) were reared on clean potato tubers in the laboratory condition (26±2ºC and 70±5 R.H.) in cages (40x40x40 cm.). Potato tubers were cleaned from dust and parasites by washing and drying with clean towels or tissue papers. A thin layer of sterilized, clean fresh wood dust (exposed to high temperature in oven to kill other insects or parasites) was distributed on the bottom of the rearing cages for pupation.

The moths were fed on sugar solution 10% on cotton pieces. Infested potato tubers were introduced into breeding cages. After pupation, pupae were carefully collected, to be used for starting the experimental cultures. Newly emerged adults were sexed and allowed to mate in glass jars of one liter capacity at the ratio of 10:10 (female: male). Each jar was supplied with small cotton pieces soaked with 10% sugar solution for adult feeding and black tissue paper for egg laying. The black strip paper departed for different sizes according to the egg masses.

2-Plant oils

Six plant oils were purchased from El-Captain Company (CAP PHARM) for extracting oils, Natural plants& COSMECICS. Egypt

The selected oils were: Cloves (*Syzygium aromaticum*) Fam. Myrtaceae; Sesame (*Sesamum indicum*) Fam. Pedaliaceae; peppermint (*Mentha piperta*) Fam. Labiatae; Colocynth (*Citrullus colocynthis*) Fam. Cucurbitaceae; Marjoram (*Majorana hortensis*) Fam. Labiatae and Orange (*Citrus sinenis*) Fam. Rutaceae. Six concentrations tested through diluting 10, 5, 2.5, 1.0, 0.5 and 0.25 ml of each aforementioned oil in one liter water (to be used in dipping process of paper contain the PTM eggs).

3-Ovicidal efficacy:

To study the ovicidal effect of different plant oils against *P. opercullea* eggs. The black paper with egg masses of the *P. opercullea* moth was dipped instantly for 10 seconds into six concentrations of the aforementioned plant oils. In control group the black paper were dipped in distilled water. The treated black paper were dried at room temperature and then placed into Petri dishes (9 cm diameter) having moist filters paper at allowed to hatch. The observations of egg hatchability were recorded up to 14 days. Each treatment was replicated four times. The percentage of egg hatchability was calculated according to Abbots formula (1925).

4-Evaluation of indirect effects of plant oils on predation efficiency and predator longevity.

This experiment was carried to study the indirect effect of aforementioned plant oils on predation rate and longevity parameter of *Chrysoperla carnea* (Stephens) larvae. The black paper with egg masses of potato tuber moth was dipped instantly for 10 seconds in plant oils (at the highest concentration) or water solutions (test groups and control). After the eggs dried at room temperature, they were placed into petri dishes (9 cm diameter), inside them a single second instar larvae was released and fed with treated eggs,. Three replicates were performed per each treatment. Egg consumption was evaluated daily till the end of experiment. To assess the longevity parameter, mortality was recorded until the death of all individuals and was calculated with value of replicates per treatment.

5-Chemical analysis:

1-Quantification of total phenols according to Singelton and Rossi (1965)

2- Quantification of tannins according to Singelton and Rossi (1965)

3- Quantification of free fatty acids according to Sadasivam and Manickam (1991)

4- Quantification of triglycerides were assayed using Stanbio kit (Stanbio Laboratory, Inc.2930 East Houston Street, San Antonio, Texas 78202).

6-Statistical analysis:

The obtained results were statistically analyzed by using SAS Program Computer including F- test (SAS Institute, 2003).

Data were analyzed for determination of LC_{50} and LC_{90} using Log-Probit analysis software developed (LdP line soft ware) by Dr. Ehab Bakr, (Plant Protection Research Institute "http://www.Ehabsoft.com" according to Finney, 1971).

RESULTS

Table 1. Toxicity of some botanical oils against *P. operculella* eggs under laboratory conditions

Plant oil	LC_{50} value ml/L	LC_{90} value ml/L	Slope ± S.E	*Toxicity index- LC_{50}
Marjoram (*Origanum majorana*)	0.646	16.039	0.9188 ± 0.1019	100.0
Cloves (*syzygium aromaticum*)	0.752	13.724	1.0163 ± 0.1034	85.90
Sesame (*Sesamum indicum*)	2.114	16.574	1.4332 ± 0.1119	30.56
Peppermint (*Mentha piperita*)	3.164	86.817	0.891 ± 0.1003	20.42
Orange (*Citrullus colocynthis*)	3.427	57.794	1.0445 ± 0.1043	18.85
Colocynth (*Citrus sinesis*)	3.662	28.028	1.4499 ± 0.1186	17.64

*Toxicity index = $LC_{50}$of standard X 100/ LC_{50} of a test sample

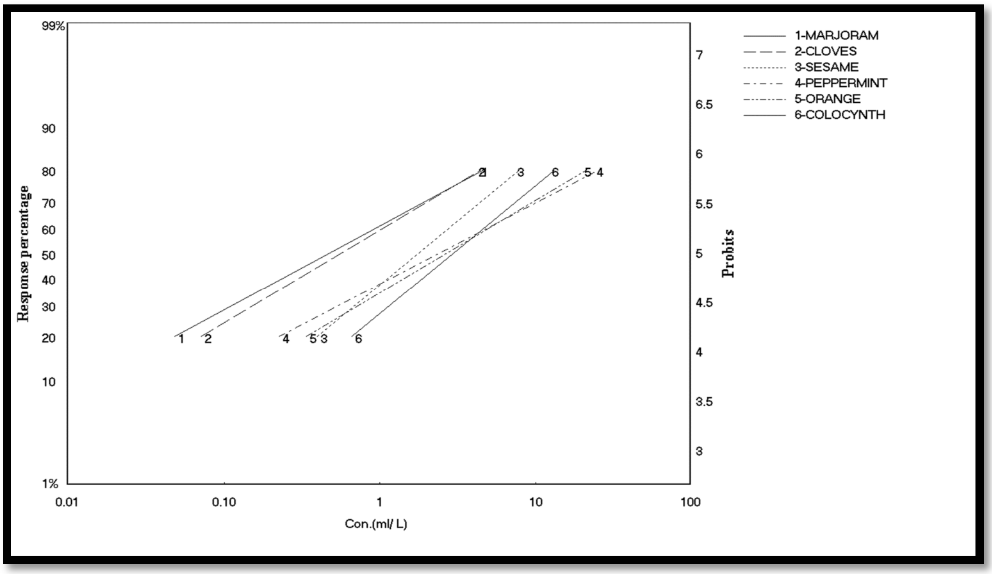

Fig. 1. LC-P lines of some tested botanical oils against *P. operculella* eggs under laboratory conditions after 14 days from treatment.

1. Ovicidal efficiency of some botanical oils against hatchability of *P. operculella* eggs under laboratory conditions.

The effectiveness of different concentrations of six plant oils on egg hatchability of the potato tuber moth is given in Table (1) Results obtained indicated that all the tested oils had ovicidal activity against *p. operculella* eggs and percent egg hatchability was concentration dependent. Also, data revealed that the percent of egg hatching decreased significantly with increasing oil concentrations. Data in table (2) indicated that ovicidal effect of six botanical oils against potato tuber eggs under laboratory conditions. Dancun analysis categorized the tested oils into three groups according to their efficiency of decreasing egg hatchability. Marjoram &Cloves oil came in the first category, where the hatchability % recorded 10.9 and 11.5, respectively at the concentration 1%. While, Sesame & Colocynth oil were recorded the second category, with hatchability % 19.2 and 20.5, respectively at the highest concentration (1%). On the other hand, both orange oil & peppermint oil showed hatchability %31.5 and 36.4 in the third category at the same previous concentration.

The LC_{50} values are shown in Table1. With corresponding slopes and toxicity indexes for each plant oil tested against eggs of potato tuber moth. According to LC_{50} values Marjoram oil was the most effective all among the tested oils followed closely by cloves oil. LC_{50} values recorded 0.646 ml/L for Marjoram oil and 0.752 ml/ L for cloves oil. Main while Colocynth oil appeared to be the least effective oil against the eggs of potato tuber moth followed descending by orange, peppermint and sesame oils. The respective values of LC_{50} of those oils were 3.427 ml/L, 3.164 ml/L and 2.114 ml/L respectively.

The toxicity parameters are toxicity index developed by Sun (1950). As for the toxicity index it is obtained by comparing the toxicity or efficiency of a fixed level (LC_{50} or LC_{90}) to their most effective oils. Since Marjoram was the most toxic oil among the tested ones, it was used as a standard in calculating the toxicity index, which can be determined by the following equation:

Sun׳s toxicity index = LC_{50} or LC_{90} of the standard material/ LC_{50} or LC_{90} of a test sample X100.

Table 2. Evaluation of ovicidal efficiency of some botanical oils against *P. operculella* eggs

Treatment	Conc./ L.	Aveg. No. of eggs pre-teat.	Aveg. No. of hatched larvae	%egg hatch	% of inhibition
Colocynth oil	10ml	24.3	5.0	**20.5 c**	79.5
	5 ml	26.3	9.7	36.7	63.3
	2.5 ml	22.7	14.0	61.8	38.2
	1 ml	18.3	14.0	76.4	23.6
	0.5 ml	20.7	17.7	85.5	14.5
	0.25 ml	23.7	20.7	87.3	12.7
Marjoram oil	10ml	18.3	2.0	**10.9 d**	89.1
	5 ml	12.0	2.7	22.2	77.8
	2.5 ml	22.3	6.0	26.9	73.1
	1 ml	24.3	10.0	41.1	58.9
	0.5 ml	21.0	10.0	47.6	52.4
	0.25 ml	24.7	14.7	59.5	40.5
Orange oil	10ml	24.3	7.7	**31.5 b**	68.5
	5 ml	18.3	7.0	38.2	61.8
	2.5 ml	16.3	9.0	55.1	44.9
	1 ml	23.0	13.7	59.4	40.6
	0.5 ml	19.7	15.0	76.3	23.7
	0.25 ml	20.7	17.7	85.5	14.5
Cloves oil	10ml	29.0	3.3	**11.5 d**	88.5
	5 ml	24.0	5.3	22.2	77.8
	2.5 ml	25.0	6.0	24.0	76.0
	1 ml	17.0	7.3	43.1	56.9
	0.5 ml	16.7	8.0	48.0	52.0
	0.25 ml	14.7	9.7	65.9	34.1
Sesame oil	10ml	40.0	7.7	**19.2 c**	80.8
	5 ml	15.0	4.7	31.1	68.9
	2.5 ml	19.3	7.0	36.2	63.8
	1 ml	20.0	11.3	56.7	43.3
	0.5 ml	17.0	14.0	82.4	17.6
	0.25 ml	10.3	9.0	87.1	12.9
Peppermint oil	10ml	22.0	8.0	**36.4 b**	63.6
	5 ml	18.3	7.7	41.8	58.2
	2.5 ml	29.0	13.0	44.8	55.2
	1 ml	16.3	8.0	49.0	51.0
	0.5 ml	22.0	16.7	75.8	24.2
	0.25 ml	13.3	11.3	85.0	15.0
Control		24.0	22.7	**94.4 a**	5.6

Within columns, means followed by the same letter are not significantly different at 5% level (P>0.05)

2. Evaluation of indirect effects of plant oils on predation efficiency and predator longevity.

Data presented in table (3) showed that predation efficiency of *Chrysoperla carnea* larvae recorded 66.1 and 61.0 % when fed on potato tuber moth eggs treated with cloves and orange oils respectively and the larvae lived only 2 days out of a potential 16.0 days when fed on untreated eggs. Also, data revealed that predation efficiency and longevity of larvae recorded 81.0 % and 10.0 days respectively for sesame oil and recorded 77.9 % and 5.3 days respectively for peppermint oil. When the larvae were fed on eggs treated with colocynth oil their predation efficiency was slightly affected (95.6 %) but their longevity was greatly reduced (7.3 days). On the other hand, predation efficiency and longevity were slightly diminished in comparison with control treatment (100% and 16 days respectively) when fed on eggs treated with Marjoram oil (96.4% and 15.3 days respectively). Thus it can be concluded that Marjoram oil has little adverse effects on *Chrysoperla carnea* larvae in comparison to other plant oils.

Duncan analysis categorized the tested plant oils according to the longevity of the predator when fed on the potato tubers egg treated with tested as following : Orange ≤ cloves < Peppermint < Colocynth < Sesame < Marjoram oil < control with 2, 2, 5.3, 7.3, 10, 15.3 and 16 days , respectively.

Table 3. Efficiency of some botanical oils on the predation efficiency of *C. carnea* to *P. operculella* eggs.

Treatment	Mean No. of eggs	Mean No. of Consumed eggs	predation Efficiency %	Longevity parameter
Colocynth oil	59.3	56.7	95.6	7.3 **ab**
Marjoram oil	112.0	108.0	96.4	15.3 **a**
Orange oil	21.3	13.0	61.0	2.0 **c**
Cloves oil	22.7	15.0	66.1	2.0 **c**
Sesame oil	56.6	46.0	81.0	10.0 **b**
Peppermint oil	42.0	32.7	77.9	5.3 **ab**
Control	121.3	121.0	100.0	16.0 **a**

Within columns, means followed by the same letter are not significantly different at 5% level (P>0.05)

Table 4. Biochemical analysis of the tested oils against *P. opercula* eggs

	Acid value (fatty acids)	Triglycerides	Total phenols	Tannis
	μg triolein\ml	mg%	μg GAE\ml	μg tannic acid\ml
Marjoram	1866.7 **b**	209.0 **a**	329.7 **c**	124.3 **b**
Orange	1847.7 **b**	63.3 **d**	250.0 **d**	71.7 **d**
Colocynth	987.7 **d**	210.0 **a**	400.7 **b**	148.0 **a**
Peppermint	435.3 **e**	80.3 **c**	245.3 **d**	75.3 **d**
Sesame	1673.0 **c**	212.3 **a**	372.3 **b**	130.3 **b**
Cloves	2100.0 **a**	112.3 **b**	606.7 **a**	108.7 **c**

Within columns, means followed by the same letter are not significantly different at 5% level (P>0.05)

Data tabulated in table (4) indicated that Duncan analysis categorized the tested oils into five groups at the length of biochemical analysis of fatty acids. Cloves came in the first category with 2100.0 µg\triolein\ml. Both Marjoram and Orange oil categorized in the second arrangement. Each Sesame, Colocynth and Peppermint categorized in three separated groups. The peppermint had the lowest fatty acids values with 435.3 µg triolein\ml.

In respect to, triglycerides values in the tested oils, Duncan analysis showed four groups. Each Sesame, Colocynth and Marjoram oil were in the first category with 212.3, 210.0 and 209.0 mg%, respectively. Cloves, Peppermint and orange recorded the 2^{nd}, 3th and 4^{th} arrangement, with the triglycerides values were 112.3, 80.3 and 63.3 mg%, respectively.

Biochemical and statistical analysis categorized the tested oils into four groups according to the total phenols values. The following are the descending arrangement: Cloves> Colocynth, Sesame> Marjoram >Orange> Peppermint with total phenols values were 606.7>400.7, 372.3>329.7>250.0>245.3 µg GAE\ml, respectively.

Also, the biochemical and statistical analysis showed the tested oils in four groups based on the Tannis values were Colocynth> Sesame, Marjoram> Cloves> Peppermint, Orange with Tannis values, were 148.0>130.3, 124.3>108.7> 75.3, 71.7 µg tannic acid\ml, respectively.

DISCUSSION

Insecticides, since long time ago, is considered as the backbone in crop protection, while biocontrol has gained more credibility in the last decades as safely alternative control measures (Senior & McEwen 2001). Under such conditions, the use of botanical oils is alternate chosen instead of using insecticides. The present study has therefore been undertaken to study the ovicidal effect of some natural oils against the potato tuber moth under laboratory conditions, so that information may be utilized for the management of this pest under field/store conditions. Also, the present work is aim to study the harmony between using some plant oils as ovicidal effect and releasing of *C. carnea* against *P. operculella* eggs. *C. carnea* has long been considered as a promising candidate for pest management programs worldwide (McEwen *et al.* 2001) due to its wide prey range and geographical distribution, resistance/ tolerance to pesticides, voracious larval feeding capacity, as well as, commercial availability (Medina *et al.* 2003). Inundative releases of *C. carnea* were effective in controlling populations of pest complexes in various crops.

Prates *et al,* (1998) showed that essential oils reveal contact toxicity through the insect cuticle and caused fumigant toxicity through the respiratory and digestive systems. Moreover, Lamiri *et al.,* (2001) demonstrated that the insecticidal activity of an essential oil could be attributed either to the major compound present in the oil or to the synergistic and/or antagonistic effects of all the components of the oil. Our data exhibited, Marjoram oil at the conc. 10 ml\20 L represented inhibition % of *P. operculla* eggs up to 89.1; and also recorded the highest of predation efficiency (96.45%) of *C. carena*, when fed on treated *P. operculla* eggs. Marjoram oil has little difference in longevity of predator (15.3days) compared to control treatment (16 days). The previous data clearly indicated that Marjoram oil had highly selective against *P.operculla* eggs and safe effect on predator *C. carena*. The major constituents of the essential oil of *M. hortensis* plant growing in Egypt are 4-terpineol (29.96%) and B-terpinene (11.34%) Mohamed and Abd El galeil (2008) & Koschier *et al.,* (2002) stated that 4-terpineol and B-terpinene exhibited insecticidal effects. Also Nowak and Ogonowskl 2010 mentioned that among the most important biological active components of marjoram herbs is tannis-up to 10%. Our data indicated that marjoram oil came in the second category among the tested oils with 124.3 ug tannic acid/ml. The components balance of marjoram oil promote the highly toxic effect against *P. operculla* eggs and safe effect on *C. carena* predator, where the total phenol came in the fourth category with 329.7 ug GAE/ml. In spite of, Clove oil demonstrated highly significant effect against *P. operculla* eggs reached to 88.5%, but recorded moderate efficiency predaceous % (61.1) of *C. carena* on egg treated with clove oil and also showed the lowest longevity of predaceous (2 day of 16 days compared with control treatment). Alma *et al.,* (2007) showed the major components of clover oil were Eugenol 87.0% and Eugenl acetate 8.0%. This explain the Eugenol and Eugenl acetate had the same significant toxic effect on both *P. opercula* eggs and the predator *C. carena* . Also the highest value of total phenols of clove oil was (606.7 ug/ml) promote the highly toxic effect in both *P. operculla* eggs *C. carena* predator. The inhibition % of egg hatchability of colocynth oil and sesame oil are categorized in the same group with 79.5 and 80.8%, respectively. Also the colocynth oil had the second category, and followed by sesame oil in respect to efficiency predaceous% and length of lifetime with (95.6&81.3%) & (7.3& 10.0 day), respectively. The closed arrangement can be explained in light of the value of total phenols and tannis of colocynth (400.7 ug GAE/ml, 148.0 ug tannic acid/ml) and sesame oil (372.3 ug GAE/ml, 130.0 ug tannic acid/ml), respectively. On the other hand, Nzikou *et al.,* (2009) mentioned that, sesame oil was found contain high levels of unsaturated fatty acids, especially Oleic (up to 38.84%) and Linoleic (up to

46.26%). *Sesame indicum* L. oil can be classified in the oleic-linoleicacid group. In the same trend, Abdul Rahuman and Venkatesan, 2008 mentioned that oleic and linoleic acids on the seed of *Citrulls colocynthis* were quite potent against fourth instars of larvae of *Aedes aegypti* L.

The acid value (AV) is a common parameter in the specification of fats and oils. It is defined as the weight of KOH in mg needed to neutralize the organic acids present in 1g of fat and it is a measure of the free fatty acids (FFA) present in the fat or oil. FFA are a source of flavors and aromas. On one side, we have short chain FFA which tend to be water soluble and volatile with characteristic smell. On the other side, we have long chain saturated and unsaturated fatty acids. The later are more prone to oxidation in their free form and their breakdown products (aldehydes, ketones, alcohols, and organic acids) provide characteristic flavors and aromas. In most cases these flavors and aromas are considered a defect in oils, fats, and foods that contain them. In spite of Marjoram oil recorded the highest inhibition of hatchability of *P. operculella* eggs which recorded 1866.7 µg triolein\ml. So must be used freshly extraction of Marjoram oil in IPM program. (i.e. The expire date is very important at this case).

Finally, the marjoram oil has a promise results against *P. operculla* eggs especially it had no passive effects on the predators (green lace wing) and suitable for use to integrated pest management of potato tuber moth. This is primary study need more efforts to apply in suitable method and tactics in the field and store in broad scale.

CONCLUSION

Marjoram oil and common green lacewing, *Chrysoperla carnea* (Stephens) are biological agents had harmony effect against *P. operculella* eggs. Taking in consideration the freshly extraction of Marjoram oil and expire date is very important in IPM program.

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فاعلية بعض الزيوت النباتية ضد فقس بيض فراشة درنات البطاطس واثارها الجانبية على اسد المن تحت الظروف المعملية

همام بخيت همام ، مها صبرى الغنام

- قسم افات الخضر والنباتات الطبية والعطرية و الزينة - معهد بحوث وقاية النبات - مركز البحوث الزراعية -٧ شارع نادى الصيد - دقى - جيزة -ص.ب(١٢٦١٨)- مصر.

تم اجراء تجارب معملية لدراسة تاثير ٦ من الزيوت الطبيعية (القرنفل والسمسم والنعناع والحنظل والبردقوش والبرتقال) ضد فقس بيض فراشة درنات البطاطس كما تضمن البحث دراسة تاثير تلك الزيوت على اطلاق اسد المن.

وقد اشارت نتائج السمية للزيوت المختبرة بناءا على LC_{50} مرتبة تصاعديا على النحو التالى:-

البردقوش < القرنفل < السمسم < النعناع < البرتقال < الحنظل .كما اظهرت النتائج ان زيت البردقوش سجل اقل فقس % لبيض فراشة درنات البطاطس من الزيوت الاخرى حيث سجلتLC_{50} (٠,٦٤٦مل / لتر). فى حين ان زيت الحنظل سجل اقل الزيوت سمية واقل معدل فقس % واعلى LC_{50} (٣,٦٦٢ مل/ لتر).

تم ترتيب الزيوت المختبرة طبقا للتحليل الاحصائى بواسطة (Duncan analysis)

الي ثلاث مجموعات وفقا للنسبة المئوية لفقس البيض .وجاء زيت البردقوش وزيت القرنفل فى الفئة الاولى حيث سجلت نسبة الفقس ١٠,٩% & ١١,٥% على التوالى عند تركيز ١%.

وهكذا اشارت الدراسة ان كفاءة المفترس(اسد المن) سجل ٩٦,٤ % مع بيض فراشة درنات البطاطس المعامل بزيت البردقوش واستمرت حياة المفترس لمدة ١٥,٣ايام من اصل ١٦ يوم. اظهرت النتائج ان المعاملة بزيت البردقوش امنة على المفترس مقارنة بالزيوت الطبيعية الاخرى.

واشارت نتائج التحليل الاحصائى (Duncan analysis) للتحليل الكيميائى لل , fatty acid , tannis triglycerides and total phenols بتصنيف الزيوت المختبره الى مجموعات مختلفة

واخيرا ان النتائج الواعدة كانت لزيت البردقوش ضد بيض فراشة درنات البطاطس خاصا انها لم تؤثر بالسلب ضد احد المفترسات الاكثر شيوعا وهو اسد المن وتعد هذه الدراسة من الدراسات الاولية بحاجة لبذل مزيد من الجهود لتطبق بطريقة مناسبة فى الحقل والتخزين. وعلى الرغم من ان زيت البردقوش سجل اعلى تثبيط لنسبة الفقس لبيض فراشة درنات البطاطس ولكنها سجلت ٧ , ١٨٦٦مل Triolein / مل. لذلك يجب ان يستخدم زيت البردقوش المستخرج طازجا فى برنامج الادارة المتكاملة للافات (يجب مراجعة تاريخ الصلاحية).