

INFLUENCE OF THREE SAP-SUCKING INSECT PESTS' INFESTATIONS ON ESSENTIAL OIL OF SWEET MARJORAM (*ORIGANUM MAJORANA* L.)

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Abstract

Effects of the levels of infestations with three different sap-sucking insect pests, *Aphis gossypii*, *Empoasca descipiens* and *Thrips tabaci* on quantity and quality of Sweet marjoram essential oil planted at the Applied Research Center for Medicinal Plants (N.O.D.C.A.R.) Kafr El-Gable, Giza Governorate. From December, 2006 to June, 2007, were evaluated at Experimental farm of the Medicinal and Aromatic Plant Research Department, Horticulture Research Institute, Agriculture Research Center, Dokky, Cairo. Statistical analysis revealed that there is a highly negative significant correlation coefficient between the infestation with each insect pest and the quantity and quality of Sweet marjoram essential oil, where the correlation coefficients were -0.8, -0.7 and -0.8 for *A. gossypii*, *E. descipiens* and *T. tabaci*, respectively. In addition, there is a highly negative significant correlation between the level of infestation of these insect pests and both quantity and quality of the extracted Sweet marjoram essential oil where correlation coefficients were -0.8 and E.V. % was 72%. Also, all of the detected components of essential oil were sharply and negatively affected with different infestation levels with the three sap-sucking insects in compare with the control.

Key Words: Sweet marjoram, *Origanum majorana* L., Essential Oil, Sap-Sucking Insects, *Aphis gossypii*, *Empoasca descipiens*, *Thrips tabaci*, Infestation.

INTRODUCTION

In Egypt, medicinal & aromatic plants represent a significant source of national income. They have an economic value for local & exterior markets. The cultivated area of such plants reached about 63500 feddans, (presents less than 0.8% of total cultivated area). About 80% of the calculated areas are concentrated in EL-Fayom, Beni Sweif, El-Menia and Assiut Governorates. The total exported quantity attained about 35000 tons of dry herb and spices in 2006 (M.A.G.L.R., 2006).

Sweet marjoram, (*O. majorana* L., Fam. Lamiaceae) is a perennial herb and native from Egypt and eastern Mediterranean countries. Its aerial parts of these plants are used for extraction of essential oil, which has a lot of uses in flavor perfumery and pharmaceutical industry. In addition, Sweet marjoram possesses anti-bacterial and anti-spasmodic action. It is also used as a spice and condiment as well as a flavoring agent in food industry (Stefanini *et al.*, 2001, Leeja & Thoppil, 2007 and Mohamed *et al.*, 2008).

Under Egyptian condition, sweet marjoram plants are considered as desirable host plants to many insect pests specially, the sucking insects during growing season. The quantity and quality of its essential oil are affected with the infestation of these insects (Forrest *et al.*, 1973, El -Khouly., 1974, Abdel - Hadi., 2002 and Edris *et al.*, 2003).

The present work aimed to evaluate the effect different infestation levels of three sap-sucking insect infestations, aphid, *Aphis gossypii*, jassid, *Empoasca descipiens* and thrips, *Thrips tabaci*, on the quantity and quality of Sweet marjoram essential oil.

MATERIALS AND METHODS

The Sweet marjoram, (*O. majorana* L.) was planted in an area of 200 m² at the Applied Research Center for Medicinal Plants (N.O.D.C.A.R.) Kafr El-Gable, Giza. The experiment beginning from 28 December, 2006 to 28 June, 2007, Samples of 100 plants were labeled and examined weekly to count the sap-sucking insect species individuals using hand lens 10 xs. After four months (full grown plants) the chosen plants are classified into four groups, each group contained 25 plants according to the degree of infestation with the three sap-sucking insects aphid, *Aphis gossypii*, jassid, *Empoasca descipiens* and thrips, *Thrips tabaci* mean range between [(low (3.6, 8.8 and 0.87) moderate (8.9, 8.9 and 2.6) and high infestation (15.25, 16.97 and 2.02) as well as non infested group (control)].

The effect of the tested insect infestations on both quantity and quality of Sweet marjoram essential oil was evaluated at Experimental farm of the Medicinal and Aromatic Plant Research Department, Horticulture Research Institute, Agriculture Research Center, Dokky, Cairo. 300 gm of chosen plants of each group were cut and weighted to extract the essential oil. The oil percentage in the fresh herb taken from the first cut of the tested plants and determined by distillation of fresh herb samples, using the method described by the British pharmacopea (1963) by using Clevenger's apparatus. Satisfactory results were obtained by distillation of 30 gm of fresh herb for

3 hours. The essential oil extracted / plant calculated in proportion to the herb fresh weight / plant. Samples of the extracted essential oil were subjected to gas – liquid chromatographic analysis using a Hewlett Packard, 5890 series II apparatus to determine their main constituents, as recommended by Bunzen *et al* (1969) and Hoftman (1967).

All of the obtained data were statistically analyzed to detect the relationship between the three sap-sucking insects' infestation and quantity or quality of marjoram essential oil. The analyses were achieved using the SAS computer software by applying simple correlation and partial regression.

RESULTS AND DISCUSSION

I- Effect of three sap-sucking insects on the marjoram essential oil quantity:

Results in Fig.1 & Table 1 revealed the relationship between the extracted amounts of Sweet marjoram essential oil and different infestation levels of the three sap-sucking insects aphid, *Aphis gossypii*, jassid, *Empoasca descipiens* and thrips, *Thrips tabaci*, in addition to the control (non infestation). The extracted amount of essential oil was negatively affected by different infestation levels of the three sap-sucking insect pests being 3.45, 2.92, 2.3 and 4.1 % at low, moderate, high and non infestation, respectively. Statistical analysis of simple correlation and partial regression indicated that there is a highly negative significant correlation coefficient between the effect of each insect pests on the extracted amounts of Sweet marjoram essential oil showed highly negative significant correlation coefficients $r = -0.8, -0.7$ and -0.8 for *A. gossypii*, *E. descipiens* and *T. tabaci*, respectively. In addition, the correlation between the infestation with the three sap-sucking insects together (mean number of individuals/plant) and the extracted amounts of Sweet marjoram essential oil was also high and negative, where $r = -0.84$, $b = -0.01$ and explained variance percentage (E.V. %) was 72%.

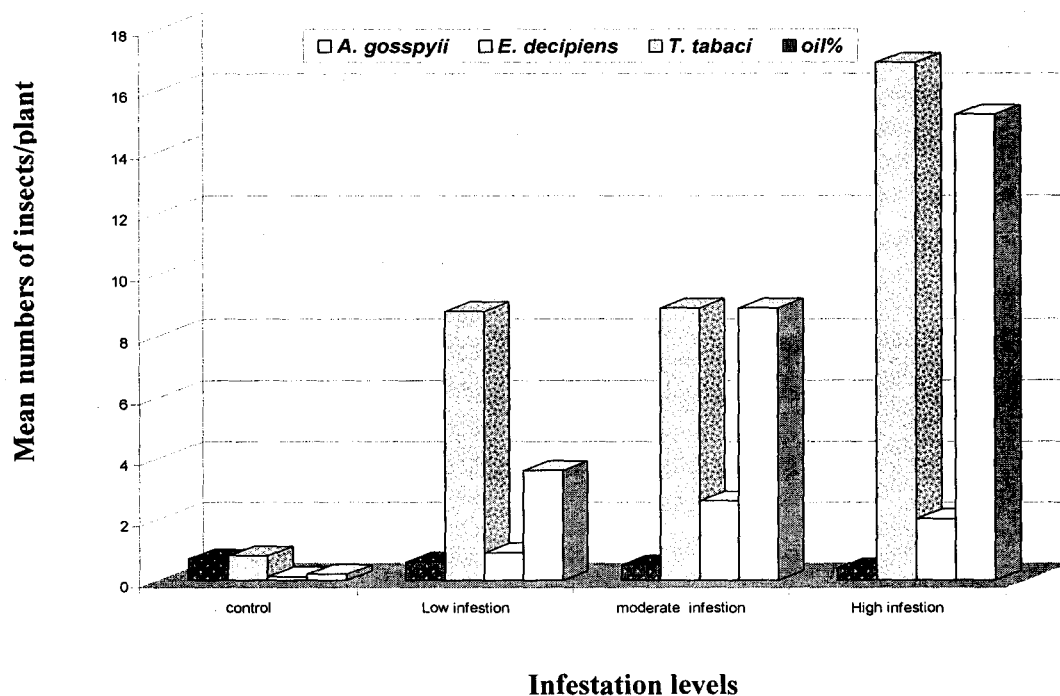


Fig. 1. Mean numbers of three sap-sucking insects with the corresponding marjoram essential oil percentages at the different infestation levels.

Table 1. Simple correlation and partial regression between the extracted amounts of marjoram essential oil and different infestation levels of three sap-sucking insects in compare with the control (non infestation).

Insect pests	r	b	S.E	T-value	E.V.%
<i>Aphis gossypii</i>	-0.8	-0.008	0.005	-1.48	72
<i>Empoasca decipiens</i>	-0.7	-0.001	0.011	-0.12	
<i>Thrips tabaci</i>	-0.8	-0.005	0.005	-0.88	
Total Infestation	-0.8	-124.55	16.59	-7.55	

II Effect of three sap-sucking insects on the marjoram essential oil quality:

Twenty-three components were detected in the essential oil extracted from marjoram using GLC mass, thirteen of them were identified while the other ten components were unidentified. All of the essential oil detected components were sharply and negatively affected by different infestation levels with the three sap-sucking insects in compare with the control (Table, 2). Statistical analysis of simple correlation and partial regression between the main two components in this oil (Terpinene-4-ol 45.8% and Limonene 20.4%) and the infestation with the three sap-sucking insects showed that there are highly negative significant correlation coefficients (-0.94 & -0.9) for Terpinene-4-ol and Limonene, respectively. While regression coefficients were -41.6 and -59.62 for the two components, respectively. (Table, 3). Also, these two components were sharply affected by the different infestation levels of the three sap-sucking insects, where the extracted amounts of Terpinene-4-ol were 41.75, 32.87, 30.75 and 45.76% for low, moderate, high and non infestation, respectively. Also, the extracted amounts of Limonene component were sharply affected by the different infestation levels of the three sap-sucking insects where the extracted amounts were 19.099, 13.59 and 13.321% at low, moderate and high infestation in compare with 20.34% at non infestation, respectively.

From these results, it could be concluded that the quality and quantity of the Sweet marjoram essential oil was affected sharply by the infestation with these sap-sucking insects and this may be due to the harmful saliva of these insects.

These results are in agreement with those obtained by Forrest *et al.* 1973, El-Khouly 1974, Novak, *et al.* 2003, Nadeem, 2004 and Harb, 2005 who reported that both marjoram oil quality and quantity was affected by the saliva of sap-sucking insects. In addition, Edris *et al* (2003) reported that terpine-4-ol, cis-sabinene hydrate, thymol and caravel are the main constituents of Marjoram, *Origanum majorana* L. Also, Abdel-Hadi (2002) studied the effect of aphid infestation, *Aphis gossypii* and *A. nerii* on chemical constituents of some ornamental plants. He found that the concentrations of the essential volatile oils, i.e. alfa- pinene, gamma-terpinene, thymol, camphor, cymene, comhene, myrecene, and geranylacetate, were decreased in these plants.

Table 2. Twenty-three components of the marjoram essential oil and their corresponding percentages at the different infestation levels with the three sap-sucking insects in compare with the control.

NO.	Oil Components	Low infestation	Moderate infestation	High infestation	Control
1	α -pinene	0.47	0.860	1.959	1.27
2	β -pinene	2.97	3.173	7.853	5.32
3	Limonene	19.099	13.59	13.321	20.4
4	1,8 cineole	2.62	1.16	9.37	8.42
5	γ -terpinene	1.33	2.05	5.63	2.45
6	Linalool	0.69	3.35	12.250	3.04
7	Terpinene-4-ol	41.759	32.877	30.751	45.761
8	α -terpineol	6.980	7.387	6.729	7.744
9	Linalyl acetate	4.377	3.164	2.483	2.073
10	Estragol	1.51	1.74	2.13	1.91
11	β -carophyllene	1.38	1.60	0.66	0.49
12	Eugenol	2.3	1.96	1.256	0.48
13	Eygenol	1.27	1.07	1.026	1.77
14	Unidentified	0.46	1.299	0.358	0.413
15	Unidentified	0.531	0.729	1.88	1.665
16	Unidentified	0.716	0.830	0.079	1.607
17	Unidentified	1.007	1.128	1.402	0.447
18	Unidentified	1.243	1.74	0.196	0.072
19	Unidentified	0.38	1.61	0.386	0.608
20	Unidentified	0.851	0.873	0.341	0.227
21	Unidentified	0.896	0.63	0.178	0.484
22	Unidentified	3.889	7.33	0.323	0.609
23	Unidentified	1.947	2.7	0.446	00

Table 3. Simple correlation and partial regression between the main two marjoram essential oil components and the infestation of the three sap-sucking insects.

Oil Components	r	b	S.E	T-VALUE	E.V. %
Terpinene-4-ol	-0.94	-59.62	13.39	4.39	99%
Limonene	-0.90	-41.6	6.97	-5.97	

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تأثير الإصابة بثلاث آفات حشرية ماصة لعصارة النبات على الزيت الطيار لنبات البردقوش

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تم تقييم تأثير مستويات الإصابة بثلاث آفات حشرية ماصة لعصارة النبات، من القطن، نطاط أوراق البطاطس و تريبس القطن *Aphis gossypii*, *Empoasca descipiens* and *Thrips tabaci* و ذلك على كمية ونوعية الزيت الطيار لنبات البردقوش المنزرع في مركز الدراسات التطبيقية لبحوث النباتات الطبية - كفر الجبل - جيزة خلال الفترة من ٢٨ ديسمبر ٢٠٠٦ الي ٢٨ يونيو ٢٠٠٧. أثبتت التحليلات الإحصائية أنه يوجد ارتباط سالب ذو معنوية عالية بين كل من الإصابة بأحد هذه الآفات و الكمية والنوعية المستخلصة للزيت الطيار لنبات البردقوش وكان معامل الارتباط = -٠,٨ ، -٠,٧ و -٠,٨ لكل من القطن، نطاط أوراق البطاطس، و تريبس القطن على التوالي. كما يوجد ارتباط سالب وعالي المعنوية بين مستويات الإصابة بالآفات الثلاثة و كمية ونوعية الزيت المستخرج حيث تأثر كل منهما شديدا بالمقارنة بالكنترول (النباتات الغير مصابة). وكان معامل الارتباط = -٠,٨ - ونسبة معامل التأثير (E. V. %) = ٧٢%.

كما تأثرت كل من مكونات الزيت المستخرج عند مستويات الإصابة المختلفة معنوياً.