

## ATTRACTIVENESS OF VOLATILE OILS AND PARAFFIN OIL TO THE ORIENTAL WASP (*Vespa orientalis* fab.) ATTACKING APIARIES

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### ABSTRACT

The oriental, *Vespa orientalis* Fab. represents a big threat to the apiaries and the mature fruits which necessitates to its control. Some volatile, each alone or mixed with paraffin oil, were tested under field conditions at two districts of Gharbia and Kaffr-Elshak Governorats as lures for capturing the hornet in the traps. The volatile; Citranellol, Geraniol, Linalool and Para-Coryophyllene were tested. These volatile proved to be attractive to *V. orientalis* but their attractiveness was greatly enhanced when mixed with paraffin oil. Results indicated that the most attractive lure was saturated sugar syrup mixed with paraffin oil, followed by only both saturated sugar syrup or paraffin oil since insignificantly difference between them. The trap catch was higher in August and September than in June and November. The population of the captured hornet was higher in 2003 than 2002.

In a conclusion, using paraffin oil as lure for capturing the hornet in the traps or it's mixed, with sugar syrup was recommended, in order to *Vespa orientalis* Fab. control in the apiaries and fruit orchards.

### INTRODUCTION

The oriental hornet, *Vespa orientalis* Fab. is a serious threat to bee-keeping industry because it frequently manages to invade the bee hives preying on the stored honey and killing the inhabitants. The adult causes serious damage in the mature fruits of Grapevine, Pear, Plum and Peach, before and after harvesting (Wafa *et. al.* 1968). Recently, this insect pest has become more dangerous to apiaries and fruit orchards in Egypt, because of reducing usage of pesticides when integrated pest management programs were adopted. This reflected greater population of wildlife organisms, from which is the oriental hornet, *V. orientalis*. Of the methods used for hornets control; (1) control of queens in the spring, (2) dusting the nest entrance with insecticides, (3) use of baited traps, and (4) use of poisoned baits. Since most of chemicals are dangerous to both humans and animals, control of hornets by traps should be encouraged. Several researchers used traps to control this pest (Ibrahim and Mazeed, 1967, Wafa, *et. al.* 1968; Kshirsagar, 1971; Longo, 1980 and Hussein 1989). Many organic chemicals and fruit baits, have been tested as lures, with varying degrees of its attractiveness (Aihara 1980 and Mishra *et al.* 1989).

Klein and Adler (1996) tested different control methods against *V. orientalis* Fab., including traps having either lures or poisons, and concluded that the insecticide, a cephalothrin applied in the poisoned meat baiting method provided an excellent control of the oriental hornet. Shoreit (1998) used fermented honey or sugar syrup in traps to control *V. orientalis* in apiaries at Cairo and Assuit. He trapped the queens during a period extending, from

January to May, and peaked during March while the wasp workers were trapped during June- December and peaked during October.

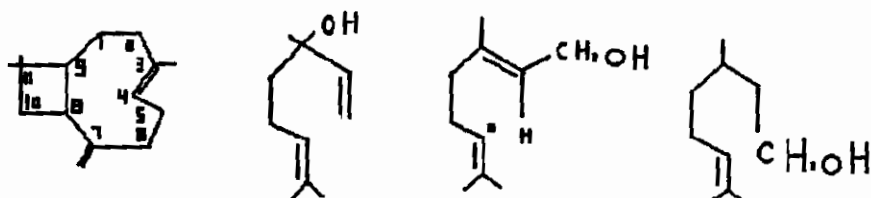
Abo-Sheasha, 1994 (unpublished data) observed that *V. orientalis* Fab. attracted to piece of filter paper wetted with a mixture of volatile oil and paraffin oil during an experiment for studying effect of these odors on *Prays citri* Mill. behaviour by electroantennogram (EAG), conducted in the Biophysics Laboratory at the Faculty of Sciences, Ain-Shams University.

Thus the current investigation was designed to explain this observation and to find out the capability of paraffin oil, and some other volatile in capturing the oriental hornet *Vespa orientalis* Fab. in traps located at apiaries Biala, Kafr El-Sheikh and Zifta, Gharbia Governorate.

### Materials And Methods

The present experiment was conducted in six apiaries each contained about 100 colonies, three apiaries at Zifta, Gharbia Governorate and three ones at Biala, Kafr El-Sheikh Governorate. Eleven treatments for attracting the oriental hornet *Vespa orientalis* Fab. were tested at each apiary; one treatment per one trap (Table 1). The traps were distributed at nearly equal distances.

The chemical name, chemical structure, physical properties (According to Finar, 1968 and Ernest, 1975) and the used concentration of the tested volatile oils obtained as synthetic compounds from commercial sources are shown as follows:



(1) Caryophylline

(2) Linalool

(3) Geraniol

(4) Citronelol

- 1- Caryophyllen: Colorless to pale yellow oily liquid; Mol.Wt. 204.3546 (C<sub>15</sub> H<sub>24</sub>); Specific Gravity 0.897 at 25 C° ,7.464 –7.572 Pounds per Gallon; B.p.129–130 C° at 14 mm and 254 – 257 C° at 760 mm; Soluble in Alcohol and insoluble in water. Caryophyllen is a bicyclic sesquiterpene containing a fused system of a four- and a nine- membered ring. The main source of this compound is the sesquiterpene fraction of clovers oil, and there is three isomeric hydrocarbons have been isolated. Para – isomer, is the main hydrocarbon and called caryophyllene.
- 2- Linalool: Colorless oily liquid; Mol.Wt. 154.25 (C<sub>10</sub> H<sub>18</sub> O); B.p.199 C° this is an optically active compound; the (-)- form occurs in rose oil and the (+)- form is in orange oil.
- 3- Geraniol: Colorless oily liquid; Mol.Wt. 154.2516 (C<sub>10</sub> H<sub>18</sub> O); Specific Gravity 0.8757 at 25 C° ,7.287 Pounds per Gallon; B.p.229–230 C° at760 mm and 111-112 C° at 10 mm; Soluble in Alcohol, Paraffin oil , Kerosene

and insoluble in water. This is found in many essential oils particularly rose oil.

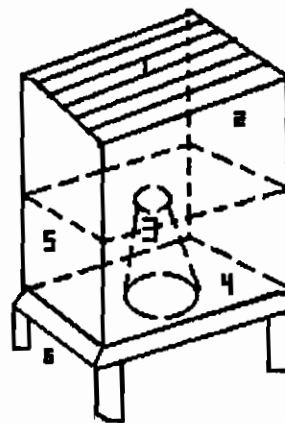
4- Citronellol: Colorless to Pale Yellow oily liquid; Mol.Wt. 156.2674 (C<sub>10</sub> H<sub>20</sub> O); Specific Gravity 0.8534 at 25 C° ,7.101 Pounds per Gallon; B.p. 225 C° at 760 mm and 105-105.5 C° at 15.0 mm; Soluble in Alcohol, Kerosene and insoluble in water. This compound occurs in rose and geranium oils and it is a mixture of two forms.

5-Paraffin, as a saturated hydrocarbon oil.

**Table (1): Concentration of the compounds used as lures to *Vespa orientalis* Fab. in the traps.**

Lures	Volume
Para-caryophylline	0.2 ml.
Para-caryophyllin + Paraffin	0.2 ml. + 0.2 ml.
Linalool	0.2 ml.
Linalool + Paraffin	0.2 ml. + 0.2 ml.
Geraniol	0.2 ml.
Geraniol + Paraffin	0.2 ml. + 0.2 ml.
Citronelol	0.2 ml.
Citronelol + Paraffin	0.2 ml. + 0.2 ml.
Saturated sugar syrup (check)	1 litre
Saturated sugar syrup + Paraffin	1 litre + 2.0 ml.
Paraffin	0.2 ml.

A modified Abou El-Enain trap (1999), was used. Each hive used for trapping *V. orientalis* consisted of two Langstroth breeding chambers. In the board of the lower chamber a 25 cm circular opening was done, in which an inverted screen cone was fixed on the top of the cone (trap) and a piece of queen excluders was fixed in order to allow the drifting bees pass through as indicated in Fig. (1).



**Fig. (1) Hive wasp trap**

- (1) Queen excluder
- (2) Empty hive chamber
- (3) Wire screen cone
- (4) Wooden roof
- (5) Empty hive chamber
- (6) Hive stand

On the ground and next to the trap opening, a plastic pan was located, and in which vials having the substances used as lures were put. In each vial, a piece of absorbent cotton provided with the lure was introduced. One week after baiting the traps with different lures, the traps were examined. The collected wasps were killed and counted weekly, and the traps were then provided with new fresh lures at each examination. Data were adjusted for the daily catch. Statistical analyses were computed for ANOVA and "F" test and the significantly differed means were compared by L.S.D. values.

## **RESULTS AND DISCUSSION**

Data in Tables (2 – 5) present the efficiency of the tested lures in trapping *Vespa orientalis*. In 2002 at Zefta ( Gharbia ) , the most attractive lure was the saturated sugar syrup provided with paraffin oil, which trapped  $5.68 \pm 2.27$  wasps / trap / day (Table 2). This treatment exceeded significantly all other treatments except that of the check (saturated sugar syrup) which trapped  $4.78 \pm 1.90$  wasps/trap / day. Insignificant difference was observed between the traps lured with only paraffin or saturated sugar syrup (LSD = 1.5 at 5% ). The tested volatile oil proved to attract the hornet to some extent; since the superior one was Citronelool ( $0.38 \pm 0.04$ ), followed by Geraniol ( $0.35 \pm 0.14$ ), Para- Caryophylline ( $0.25 \pm 0.01$  ), and then Linalol ( $0.23 \pm 0.09$  wasps/trap /day). The difference may be due to the modifications in behavioral response of the hornet wasp to these compounds according to their chemical structure and physical properties (Schoonhoven 1992). However, the capability of these volatile in trapping the hornet was greatly enhanced when paraffin oil mixed with each volatile oil in the trap . In 2003 Zifta also (Table 3) , the similar trend was observed, as the saturated sugar syrup provided with paraffin was superior in attracting the hornet ( $11.8 \pm 4.79$  wasps /trap/day ), followed by both the check (saturated sugar syrup ) and the paraffin oil only ( $8.31 \pm 3.35$  and  $6.52 \pm 2.65$  wasps /trap/day respectively). Highly significant differences, in trapping the hornet, were detected between the treatment of sugar syrup plus paraffin and any other treatment. However insignificant differences in trapping this pest was detected between treatment of paraffin only and the check (saturated sugar syrup ) in both years 2002 and 2003. The volatile became more attractive to the hornet, *V. orientalis* when mixed with paraffin oil.

In general the collected wasps were more in August and September than in other months with the lowest number during June and November. Shoreit (1998) recorded peak of *V. orientalis* queen (collected by traps) during March, while that of workers was during October.

At Biala ( Kafr El-Sheik Governorat) Table (4) , similar results were obtained in 2002. The most attractive trap was that lured by saturated sugar syrup plus paraffin ( $5.45 \pm 2.17$  wasps / trap /day) followed by that lured with the only sugar syrup ( $4.45 \pm 1.77$  wasps/ trap / day ). The two treatments were significantly the same in capturing this hornet. However, all other treatments were significantly less than that lured by sugar syrup plus paraffin. Despite the volatile attracted *V. orientalis* , the traps became more efficient when provided with paraffin oil. Results of 2003 at the same location ( Table 5 ) took the same trend.

**Table(2): Daily mean number of *V. orientalis* collected in traps lured by different substances ( in Apiaries at Zifta, Gharbia Governorate 2002 ).**

Substances	Mean No of <i>V. orientalis</i> / Trap / Day						Mean
	June	July	Aug.	Sept.	Oct.	Nov.	
Para-Caryophylline	0.3	0.2	0.3	0.3	0.2	0.2	0.25 + 0.01
Para-Caryophyllin + Paraffin	1.3	2.9	3.6	1.9	1.7	0.8	2.03+ 0.81
Linalool	0.3	0.2	0.3	0.2	0.2	0.2	0.23+ 0.09
Linalool + Paraffin	0.9	1.8	1.9	1.9	1.2	0.7	1.40+0.59
Geraniol	0.2	0.4	0.6	0.4	0.3	0.2	0.35+0.14
Geraniol + Paraffin	1.4	2.9	3.9	2.1	1.6	0.7	2.10+0.84
Citronelol	0.4	0.3	0.5	0.3	0.5	0.3	0.38+0.04
Citronelol + Paraffin	2.0	4.1	4.1	4.2	1.6	1.1	2.85+1.4
Saturated sugar syrup (check)	3.1	6.5	7.1	7.6	3.1	1.3	4.78+1.90
Saturated sugar syrup + Paraffin	4.0	7.6	8.3	8.9	3.5	1.8	5.68+2.27
Paraffin	2.8	5.7	5.0	5.5	2.2	1.4	3.77+1.51

L.S.D. = 1.9 & 1.5 at 1% & 5% respectively

**Table(3):Daily mean number of *V. orientalis* collected in traps lured by different substances (Apiaries at Zifta District, Gharbia Governorate 2003 ).**

Substance	Mean No of <i>V. orientalis</i> / Trap / Day Through						Mean
	June	July	Aug.	Sept.	Oct.	Nov.	
Para-Caryophylline	0.2	0.2	0.4	0.2	0.3	0.2	0.25+0.10
Para-Caryophyllin + Paraffin	2.1	4.5	4.5	3.4	2.8	2.7	3.30+1.35
Linalool	0.2	0.2	0.3	0.3	0.3	0.2	0.25+0.01
Linalool + Paraffin	1.4	3.0	2.4	3.2	2.7	1.9	2.43+0.99
Geraniol	0.7	1.0	0.8	0.6	0.5	0.4	0.66+0.23
Geraniol + Paraffin	2.4	5.3	4.1	5.3	3.7	2.9	3.95+1.60
Citronelol	0.7	0.8	1.0	0.5	0.5	0.4	0.65+0.26
Citronelol + Paraffin	3.4	7.2	7.5	6.2	5.6	2.3	5.36+2.16
Saturated sugar syrup (check)	3.8	10.5	12.3	10.2	8.5	4.6	8.31+3.35
Saturated sugar syrup + Paraffin	5.0	11.6	15.5	12.0	11.8	15.1	11.83+4.79
Paraffin	3.6	6.9	7.7	7.0	8.5	5.4	6.52+2.65

L.S.D. = 2.8 & 2.1 at 1% & 5% respectively.

On the other hand, the population of *V. orientalis* trapped to the different treatment was higher in 2003 than in 2002 and at Zifta than Biala could be explained as following:

- 1- Decreasing in cotton area and using IPM programs .
- 2- Increasing in fruit orchards at Zifta District.
- 3- The successive establishments of apiaries and lack of experience of the honeybee keepers in the last years encouraged the invasion of hornet to such apiaries .

It was found that *V. orientalis* was highly captured during August and September but least during June and November. Over the two locations and two years of study, it could be concluded that the hornet *V. orientalis* was captured as the highest numbers in traps lured by saturated sugar syrup, particularly when mixed with paraffin oil. The tested volatile attracted the hornet where Citronelol was the most efficient one . however , these volatile usually became more efficient when provided with paraffin oil. Several

authors reported capturing the hornets when used organic chemicals or fruit baits in the traps (Aihara 1980 and Mishra *et al.*, 1989). Klein and Adler (1996) found that baiting the traps with meat can improve the capability of the traps in capturing *Vespa orientalis*.

**Table(4): Daily mean number of *V. orientalis* collected in traps lured by different substances (Apiaries at Biala District, Kafr El-Sheih Governorate2002).**

Substance	Mean No of <i>V. orientalis</i> / Trap / Day						Mean
	June	July	Aug.	Sept.	Oct.	Nov.	
Para-Caryophylline	0.2	0.2	0.3	0.2	0.2	0.2	0.22+0.07
Para-Caryophyllin + Paraffin	1.2	2.9	3.6	2.0	1.5	0.7	1.98+0.79
Linalool	0.2	0.2	0.2	0.2	0.2	0.2	0.20+0.07
Linalool + Paraffin	0.8	1.7	1.9	1.8	1.2	0.7	1.35+0.54
Geraniol	0.2	0.4	0.4	0.4	0.4	0.2	0.33+0.08
Geraniol + Paraffin	1.2	2.8	3.6	2.1	1.5	0.6	1.97+0.78
Citronelol	0.3	0.4	0.4	0.4	0.4	0.3	0.37+0.09
Citronelol + Paraffin	2.0	3.9	3.7	4.1	1.6	0.9	2.70+1.08
Saturated sugar syrup (check)	2.9	6.0	6.9	6.7	3.0	1.2	4.45+1.77
Saturated sugar syrup + Paraffin	3.9	7.5	8.0	8.5	3.3	1.5	5.45+2.17
Paraffin	2.5	5.4	4.3	5.4	2.1	1.1	3.47+1.38

L.S.D. = 2.2 & 1.8 at 1% & 5% respectively

**Table(5): Daily mean number of *V. orientalis* collected in traps lured by different substances (Apiaries at Biala District, Kafr El-Sheih Governorate2003).**

Substance	Mean No of <i>V. orientalis</i> / Trap / Day						Mean
	June	July	Aug.	Sept.	Oct.	Nov.	
Para-Caryophylline	0.2	0.4	0.3	0.3	0.3	0.2	0.28+0.12
Para-Caryophyllin + Paraffin	2.0	3.9	4.5	3.8	2.9	2.6	3.28+1.33
Linalool	0.3	0.3	0.3	0.4	0.3	0.3	0.32+0.13
Linalool + Paraffin	1.2	2.8	2.9	3.0	2.3	2.0	2.37+0.96
Geraniol	0.6	0.7	0.6	0.4	0.4	0.3	0.50+0.20
Geraniol + Paraffin	1.9	4.7	4.8	5.0	2.9	2.6	3.65+1.47
Citronelol	0.7	0.7	0.6	0.5	0.5	0.4	0.57+0.23
Citronelol + Paraffin	3.1	7.9	7.4	7.3	4.3	3.7	5.62+2.28
Saturated sugar syrup (check)	4.0	8.6	11.2	9.7	8.6	8.1	8.37+3.39
Saturated sugar syrup + Paraffin	4.6	10.0	11.7	12.8	13.4	10.1	10.40+4.23
Paraffin	3.5	7.5	8.2	8.7	8.2	6.8	7.15+2.90

L.S.D. = 2.4 & 1.8 at 1% & 5% respectively.

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### جذب الزيوت الطيارة وزيت البارافين لزنبور الأحمر عند مهاجمته للمناحل

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تشكل حشرة الزنبور الأحمر *Vespa orientalis* F تهديدا خطيرا لطوائف نحل العسل وللثمار الناضجة من الفاكهة المختلفة قبل الجمع وبعده و يجب اتخاذ الاجراءات الضرورية لمكافحة هذه الآفة. يهدف هذا البحث الي تفسير انجذاب الزنبور الأحمر للزيوت الطيارة مع زيت البارافين أثناء تنفيذ تجريره سابقه لأحد المؤلفين. بهذا البحث لذلك تم اختبار كفاءة بعض الزيوت الطيارة كوسائل جذب داخل مصائد الزنبور في مركزى زفتى بمحافظة الغربية و بيلا بمحافظة كفر الشيخ خلال عامى ٢٠٠٢، ٢٠٠٣ م

وضعت الزيوت الطيارة : سترانيول، جيرانيول ، لينالول ، وباراكاريفوللين. داخل المصائد إما بمفردها أو مخلوطة بزيت البارافين .

أوضحت النتائج أنه برغم قدرة هذه المواد ( خصوصا السترانيول) على جذب الزنبور ، إلا أن كفاءتها زادت كثيرا عندما أضيف إليها زيت البارافين. وعموما كانت أكثر المصائد كفاءة فى جذب الآفة هى تلك المغمومه بالمحلول السكرى المشبع مضافا اليه زيت البارافين. لذلك يتضح أن لزيت البارافين دور فعال فى جذب الزنبور الأحمر. كما كانت أعداد الزنبور المصاده أعلى فى عام ٢٠٠٣ عنها فى عام ٢٠٠٢ خصوصا خلال شهرى أغسطس وسبتمبر.

من نتائج هذا البحث يمكن التوصية باستخدام مصائد مغمومه بزيت البارافين بمفرده أو مضافا لمحلول سكرى مشبع لمكافحة الزنبور الأحمر *Vespa orientalis* F فى المناحل وحدائق الفاكهة.