

## BIOLOGICAL AND HISTOBIOLOGICAL EFFECTS OF SOME BOTANICAL OILS ON *Spodoptera littoralis* (BOISD.).

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### ABSTRACT

Commercial oils of *Pimpinella anisum* L., *Eucalyptus globulus* L., *Funiculum vulgare* L. and *Cuminum cyminum* L. plants were tested at the concentration of 2.5 % on the 4<sup>th</sup> instar larvae of *Spodoptera littoralis*. Feeding larvae on treated leaves with *Pimpinella anisum* and *Eucalyptus globulus* significantly reduced larval weight gained. There were no significant differences on fresh food consumption between all commercial oils tested and control; also between days and interaction between treatments and days. The results showed that all the tested commercial oils significantly reduced fresh weight of faeces. A 2.5 % concentration of *Cuminum cyminum* oil caused 50 % mortality, while the same concentration of *Eucalyptus globulus* oil caused 64.3 % malformation of the resulting pupae. All commercial oils treatments significantly reduced fecundity and fertility.

Histobiological activity of *C. cyminum* and / or *E. globulus* oil on the mid-gut of the treated larvae resulted in degrees of morphological abnormalities.

**Keywords:** Biological, Histobiological, *Pimpinella anisum*, *Eucalyptus globulus*, *Foeniculum vulgare*, *Cuminum cyminum*, *Spodoptera littoralis*.

### INTRODUCTION

Numerous reports exhibited that some plant components affect insect pests (Lichtenstein *et al.*, (1974), Saxena (1980), (1983) and Saxena and Khan (1985). Recently, the research for alternative insecticides emphasizes on these plant-derivatives (Arnason *et al.*, (1989). The ability of some essential oils (as secondary plant substances) to control some insects in the form of attractants, repellents, ovicides, insecticides, synergists, juvenile hormone analogues and antigonadal agents has been discussed in the literatures (Golob and Webley, 1980; Purohit *et al.*, 1983; Sharaby, 1988; Chandler *et al.*, 1992; Magd El-Din *et al.*, 1993 and Magd El-Din, 1998). Essential oils as secondary plant substances, comprising cyclic and mono cyclic monoterpenes, have been reviewed as effective repellents against many different insect species. Orphanidis and Kalmoukos (1970) demonstrated that *Dacus oleae* (Gmel) has a strong negative chemotropism toward orange essential oils, which antagonize attractants highly potent for this species. Purohit *et al.*, (1983) reported that the essential oil extracted from *Cuminum cyminum* L. had insecticidal activity against mosquito larvae (*Aedes aegypti* L.), house flies (*Musca domestica* L.) and red cotton bug (*Dysdecus cingulatus*).

The present work deals with the biological and histobiological activities of some commercial plant oils on the cotton leafworm *S. littoralis*.

### MATERIALS AND METHODS

*S. littoralis* larvae of a laboratory strain at the NRC were reared on castor oil leaves (El-Defrawi *et al.*, 1964) and maintained at  $25 \pm 2$  C. and  $65 \pm 5$  % RH. To clarify the effect of commercial plant-oils, namely *Pimpinella anisum* L., *Eucalyptus globulus* L., *Funiculum vulgare* L. and *Cuminum cyminum* L. on food consumption, larval weight gain and faeces

weight, concentration of 2.5 % was used. In this respect 75 newly moulted 4<sup>th</sup> instar larvae from the stock culture were selected for this experiment. Leaf discs of fresh castor-oil leaves ( 6 cm. dia. ) were immersed for about 5 seconds in the desired commercial plant oil, then left to dry for one hour. One treated leaf disc was placed in glass cup containing one larva, and topped with muslin. Larvae were weighed and placed individually with treated, weighed castor leaf discs. Treated leaf discs were removed after 24 hours and larvae were then fed on untreated leaf discs till the end of their larval stage. Control larvae were weighed and placed individually on weighed water-treated leaf discs. Mortality counts were taken daily till the end of the experiment and corrected according to Abbott, 1925. Surviving of the experimental and control larvae, the remaining parts of the leaf discs and faecal pellets of the larvae of each treatment were weighed daily. The effect of treatments on resulting pupae as well as on adults was also recorded. Data obtained were subjected to statistical analysis of variance. Both “ F “ value and degree of significance were computed.

Histological studies :

Specimens of 4<sup>th</sup> instar larvae of *S. littoralis* which were exposed to 2.5 % conc. of these plant oils were selected for histological studies. After cutting off heads and posteriors, the treated larvae were fixed in aqueous Bouine's fluid, dehydrated through a series of ethyl alcohol dilutions, placed in xylene for clearing, and finally they were embedded in paraffin blocks. Serial sections, ( 10  $\mu$ m thick ) were cut using a manual microtome. Ribbons obtained from sectioning were adhered onto thoroughly cleaned slides, and stained with either Ehrlich's haematoxylin counter or with Eosin. To compare the histological changes, sections of normal 4<sup>th</sup> instar larvae were also prepared. The slides were examined under the microscope and selected sections were photographed to evaluate the effect of treatments on the mid-gut.

## **RESULTS AND DISCUSSION**

1- The effect of *P. anisum*, *E. globulus*, *F. vulgare* and *C. cyminum* oils on some biological parameters of *S. littoralis* larvae has been investigated. Fresh weight of food consumption, fresh weight gained / larva and fresh weight of faeces excreted by both treated and untreated larvae are shown in table (1).

### **a- Effect on food consumption:**

Data obtained in table (1) show that there were no significant differences between all the tested plant oils and / or control; also between days and interaction between treatments and days, whereas the rate of consumed food by larvae was approximately the same in all prementioned treatments. Sharaby (1988) found that the spray of 1-2 % concentration of lemon grass oil, *Cymbopogon citratus* can act as antifeedant against the newly hatched larvae of *Spodoptera littoralis*.. Also, Cubebin, Euparin and Bakkanalide materials which representing antifeedant activity of three sesquiterpene lactoses succeeded in reducing the amount of food ingested and sometimes

these compounds are moderate in preventing the larvae of *S. littoralis* to continue their feeding (Abdalla, 1986).

**b- Effect on fresh weight gained / larva:**

Oils of *P. anisum* and / or *E. globulus* significantly reduced the larval weight gained as compared to that of *F. vulgare*, *C. cyminum* and the control. There were no significant differences between the commercial oils of *F. vulgare*, *C. cyminum* and the control, between days and / or interaction between commercial oils used and days. The degree of utilization of food and in turn the growth rate of the treated larvae were affected, such results are in agreement with those of El-sayed, 1985 who found that larvae weight gain was greatly reduced when 2<sup>nd</sup>. and 3<sup>rd</sup>. larval instar of the cotton leaf worm fed for three days on leaves treated with the suspension of ground seeds of neem *Azadirachta indica*.

On the basis of the nutritional indices, the results obtained clarified that the essential oils of the two tested plants (*P. anisum* and *E. globulus*) reduced the efficiency of conversion of assimilated food (AD) leading to a reduction in weight gain as compared with control. Majoram oil induced significant reduction in growth rate, these results are in agreement with those of Arnason *et al.* 1987 who found that Limonoid extracts increased the larval mortality and reduced the growth rate of European corn borer *Ostrinia nubilalis*.

**c- Effect on fresh weight of faeces:**

Concerning the effect on fresh weight of faeces, the obtained results (table 1) clearly indicate that there were no significant differences between commercial oils of *P. anisum*, *E. globulus* and *F. vulgare*; between days and / or interaction between commercial oils used and days, while, a significant difference was detected between these three commercial oils mentioned above and *C. cyminum* & control. Although, there was a significant difference between *C. cyminum* and control.

Percent mortality at the end of larval stage was low or nil ranged from zero to 13.3 % when 4<sup>th</sup>. instar larvae of *S. littoralis* were fed on castor oil leaves treated with oils of *P. anisum* and *E. globulus*, respectively (table 2). 2- The effect of the four tested plant oils on the resulting pupae and adults as well as their histobiological effect on the mid-gut of the tested larvae are shown in table (2) and figs.(1,2,3,4 and 5)

Mortality percentages of the pupae which resulted from treated 4<sup>th</sup>. instar larvae varied from one oil to another. A concentration of 2.5 % of *C. cyminum* caused 50 % mortality of the resulting pupae (table 2). Purohit *et al.* (1983) reported that the essential oil extracted from *Cuminum cyminum* had insecticidal activity against mosquito larvae (*Aedes aegypti* L.), house flies (*Musca domestica* L.) and red cotton bug (*Dysdecus cingulatus*). However, treatment of 4<sup>th</sup>. instar larvae with 2.5 % of *E. globulus* caused 64.3 % malformation of the resulting pupae. Data exhibited that there is indication of association.

Generally, treatment of 4<sup>th</sup>. instar larvae with these commercial oils did not seem to affect malformed adults and there is no indication of association.



The fecundity and fertility were affected as a result of treating 4<sup>th</sup> instar larvae with these commercial oils. All commercial oils treatments significantly reduced fecundity and hatchability than the control by 31.6 - 100 % and by 39.3 - 100 %, respectively (table 2).

Sections obtained from mid-gut of fourth instar larvae resulted from treated leaves at 2.5 % conc. of *E. globulus* oil, showed microscopically, elongation and detachment of epithelial cells from the basement membrane. The epithelial cells sloughed off into the lumen and were nearly completely detached from the basement membrane as compared with the check (Fig. 1 & 2). On the other hand, there are no microscopically differences between sections obtained from mid-gut of fourth instar larvae resulted from treated leaves at 2.5 % conc. of commercial oils of *P. anisum* and *F. vulgare* and the check (Fig. 3 and 4 ). Few discriminative microscopically differences were observed with sections obtained from mid-gut of fourth instar larvae resulted from treated leaves with same conc. of *C. cyminum* as compared with the check (Fig. 5).

It was noticed that each of epithelial cells, peritrophic membrane and the basement membrane were affected as a result of Melia treatment in the diet of the cotton leaf worm *Spodoptera littoralis* (Boisd.). Cross section in mid-gut of treated larvae with 100 ppm extract showed that the columnar cells were destroyed, the basement membrane and peritrophic membrane were completely degenerated, the circular and longitudinal muscles were seen separated largely from the epithelial layer and it can be used as stomach poison. Schmidt *et al.* ..(1997).

In general it could be said that the essential oils of the medicinal and aromatic plants at 2.5 % concentration can act as growth disruptors against the 4<sup>th</sup> instar larvae of *Spodoptera littoralis* .

**Fig (1):** Cross section in the mid-gut of untreated fourth larval instar of *S. littoralis* shows the normal shape of the mid-gut tissues (130 x).

**Fig (2):** Cross section in the mid-gut of fourth larval instar of *S. littoralis* treated with 2.5% conc. of *E. globulus* after 24 hours (130 x).

**Fig (3):** Cross section in the mid-gut of fourth larval instar of *S. littoralis* treated with 2.5% conc. of *P. anisum* after 24 hours (130 x).

**Fig (4):** Cross section in the mid-gut of fourth larval instar of *S. littoralis* treated with 2.5% conc. of *F. vulgare* after 24 hours (130 x).

**Fig (5): Cross section in the mid-gut of fourth larval instar of *S. littoralis* treated with 2.5% conc. of *C. cyminum* after 24 hours (130 x).**

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**دراسة تأثير بعض المركبات النباتية الطبيعية على حيوية وانسجة دودة ورق القطن  
منى مجد الدين و زكية عبد السميع رجب  
المركز القومي للبحوث- قسم الآفات ووقاية النبات - ش التحرير - الدقى - الجيزة - مصر**

- تمت دراسة تأثير 4 زيوت تجارية لنباتات الينسون والكافور والشمر والكمون بتركيز 2 و5% على العمر الرابع لدودة ورق القطن وكانت النتائج كما يلي :-
- 1- وجد ان استخدام زيت الينسون والكافور بتركيز 2 و5% ادى الى نقص وزن اليرقات بدرجة معنوية.
  - 2- ليس هناك فروق معنوية بين جميع الزيوت التى تمت دراستها على كمية الغذاء التى تلتهمها اليرقات والمقارنة. وكذلك بين الايام التى تلت المعاملة وكذلك بين المعاملات والايام.
  - 3- وجد ان جميع الزيوت المستعملة ادت الى نقص البراز بدرجة معنوية عن المقارنة.
  - 4- ادى استخدام زيت الينسون الى موت 50% من العذارى الناتجة بينما ادى استخدام زيت الكافور الى تشوه 3 و64% من العذارى الناتجة.
  - 5- جميع الزيوت المستخدمة ادت الى خفض كفاءة اناث الفراشات الناتجة فى وضع البيض وكذلك الى خفض نسبة الفقس بدرجة معنوية عن المقارنة.
  - 6- اظهرت دراسة الانسجة على القناة الهضمية الوسطى لليرقات للمعاملة ان زيوت الكافور والكمون كانت سببا - بدرجات متفاوتة - فى ظهور بعض الصفات المورفولوجية الغير عادية عن المقارنة. وكان زيت الكافور اشد اثارا.
- يتضح مما سبق ان رش زيت الكافور بتركيز 2 و5% له تاثير فعال فى مكافحة دودة ورق القطن ويمكن ادخاله ضمن برامج مكافحة المتكاملة لهذه الآفة.