



## Effects of Different Essential Oils on *Aphis fabae* (Hemiptera: Aphididae)

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**Abstract** In this study, the effect of eucalyptus, garlic and thyme essential oils on second stage nymphs of *Aphis fabae* (Hemiptera: Aphididae) was investigated. Mortality rates were recorded as 84.80, 91.20 and 97.60% and 98.40, 100.00 and 100.00% at day 5 counts after the application of eucalyptus essential oil in different concentrations. In the 3<sup>rd</sup> day counts of garlic essential oil application, 90.40, 91.20 and 96.00% mortality rates were determined. In the 5<sup>th</sup> day counts of the same essential oil, 100.00% mortality was recorded for all applied concentrations. In the 3<sup>rd</sup> day counts of thyme essential oil application, 80.80, 87.20 and 90.40% mortality was recorded, while 84.00, 97.60 and 100.00% death rates were determined in the 5<sup>th</sup> day counts. In the seventh day counts, a mortality rate of 100.00% was recorded for all doses of all three essential oils. It is concluded that it may be beneficial to test these essential oils in greenhouse and field conditions in order to create the potential of using these essential oils in the methods of struggle against pests.

**Keywords** Black bean aphid, essential oil, eucalyptus, garlic, thyme

### 1. Introduction

Aphids are one of the essential insect groups that cause economic damages to cultivated plants. *Aphis fabae* (Hemiptera: Aphididae) is a small, soft-bodied, and black-colored aphid [1], which sucks the sap from plants, cause deformities and infect plants with important viral diseases. Besides, it causes negative impact on the development and plant growth and formation of fumagine on the surface with the sticky and sweetish substance they secrete as well. It also provides the transmission of many viral diseases in plants [2].

The importance of aphids is increasing due to their reproduction by parthenogenetic reproduction, the number of offspring and the high number of host plant species. As a result of these effects of aphids, both production amount and product quality decrease [3,4]. The use of chemicals is generally preferred in the control and the number of these chemicals is increasing every day. These chemicals used cause resistance development in the target organism over time, and negative effects are observed on non-target organisms, including humans [5]. Because of these negative effects, alternative control methods have been started to be researched and developed [6]. One of these is the use of plant extracts and essential oils in the control [7,8].

These essential oils obtained from plants are rich in terms of bioactive components such as alkaloids, flavonoids and terpenoids and create toxic effects that prevent nutrition, growth and reproduction in harmful organisms [9,10,11,12,13,14]. In this study, it was aimed to determine the lethal effects of eucalyptus, garlic and thyme essential oils on this pest and the possibilities of using them in pest control programs.



## 2. Materials and Methods

In this study, second instar nymphs of *A. fabae* and the essential oils given in Table 1 were used. The bean plants (*Vicia faba* L.) selected as the host plant were planted in plastic pots contains the same amount of soil and peat mixture at a depth of 3-4 cm. These planted pots were irrigated at certain intervals by ensuring the plant growth. When the lengths of bean plants reached 15-20 cm, they were transferred to the mass production rooms of *A. fabae*. These individuals, which were also reproduced in a different climatization room, were left on the bean plants for the infestation process. Both host plant production and *A. fabae* production were carried out in climatic chambers which are  $25\pm 1^\circ\text{C}$  temperature,  $60\pm 5\%$  proportional humidity and 16:8 photoperiod conditions.

**Table 1.** Essential oils used in the experiment

Name	Scientific name
Eucalyptus	<i>Eucalyptus globulus</i> Labill
Garlic	<i>Allium sativum</i> L.
Thyme	<i>Thymus vulgaris</i> L.

\*Biorganix life<sup>®</sup> commercial essential oils belonging to NTR Herbal Products Wholesale Marketing were used in the experiments

The diameter of petri dishes used in the applications are 6 cm and moistened blotting paper is placed on the bottom of the bean leaf to preserve its freshness. Afterwards, a clean bean leaf was placed on it and the second period aphids of *A.fabae* were transferred to the leaf with the help of a sable brush and the applications were started. The essential oil solutions prepared in different doses were sprayed three times from a distance of 15-20 cm into the prepared petri dishes by using a hand spray. Pure water was applied to the control group using the same method. Experiments were conducted in 5 replications for each essential oil and dose application, with 25 individuals in each replication.  $25\pm 1^\circ\text{C}$  temperature,  $60\pm 5\%$  proportional humidity and 16:8 photoperiod conditions are provided for the air-conditioning cabinets of experiments.

Evaluations were made by counting live individuals on the 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> days of the experiments. In the study, the Abbott formula was used, and the mortality percentages was calculated  $([(A-B)/A] \times 100)$ ; A: % live in control, B: % live in treatment [15]. One-way analysis of variance (One-Way ANOVA) was applied to the data obtained from calculations and the differences were determined according to the Tukey multiple comparison test [16]. In the analysis of the data IBM SPSS<sup>®</sup> Statistics (Version 20.0, August 2011, SPSS Inc., Chicago, IL, USA) program was used.

## 3. Results and Discussion

The effects results from the application of 1%, 3% and 5% doses of different essential oils to *Aphis fabae* nymphs are given in Table 2.

The effects of thyme, eucalyptus, and garlic essential oils on *Aphis fabae* nymphs for 1% dose applications were recorded. A statistical difference in mortality rates was occurred only in the 1<sup>st</sup> and 5<sup>th</sup> day counts. In the 1<sup>st</sup>, 3<sup>rd</sup>, and 5<sup>th</sup> day counts of the application, the highest mortality rates were recorded in garlic essential oil with 29.60%, 90.40% and 100.00%, respectively. In the 7<sup>th</sup> day counting results, 100.00% mortality rate was calculated for all essential oils (Table 2).

The effects of 3% doses of different essential oils on *Aphis fabae* nymphs were recorded. No statistically significant difference was found between the death rates in the 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> day counts in the application. Garlic essential oil had the highest effect with a 40.00% mortality rate in the 1<sup>st</sup> day counting results. In the 3<sup>rd</sup> day counting results, eucalyptus and garlic essential oils were recorded as the essential oils with the highest effect with a mortality rate of 91.20%. 100.00% mortality rate was found for all essential oils in the 7<sup>th</sup> day counting results (Table 2).

The effects resulting from different essential oils to *Aphis fabae* nymphs in 5% dose were recorded. In the 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> day counts, no statistical difference was found between the mortality rates among the essential oils. According to the 1<sup>st</sup> day count results, thyme essential oil had the highest effect with a mortality rate of 50.40%. In the 3<sup>rd</sup> day counting results, the mortality rate of 97.60% was recorded as the essential oil with the



highest effect of eucalyptus essential oil. In the 7<sup>th</sup> day counting results, 100.00% mortality rate was found in all essential oils (Table 2).

**Table 2:** Mortality rates (%)\* at 1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup> and 7<sup>th</sup> day counts as a result of applying 1, 3, and 5% concentrations of different essential oils to second instar nymphs of *Aphis fabae*\*

Essential oils	Thyme	Eucalyptus	Garlic
<b>1% Concentration</b>			
1 <sup>st</sup> Day	16.80 ± 6.37 Cab	8.80 ± 2.94 Cb	29.60 ± 5.15 Ba
3 <sup>rd</sup> Day	80.80 ± 4.96 Ba	84.80 ± 3.44 Ba	90.40 ± 3.71 Aa
5 <sup>th</sup> Day	84.00 ± 2.19 ABab	98.40 ± 1.60 Aa	100.00 ± 0.00 Aa
7 <sup>th</sup> Day	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa
<b>3% Concentration</b>			
1 <sup>st</sup> Day	30.40 ± 3.18Ca	22.40±5.84 Ba	40.00±7.27 Ba
3 <sup>rd</sup> Day	87.20 ± 4.27 Ba	91.20±6.25Aa	91.20±1.50 Aa
5 <sup>th</sup> Day	97.60 ± 1.60 ABa	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa
7 <sup>th</sup> Day	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa
<b>5% Concentration</b>			
1 <sup>st</sup> Day	50.40±6.65 Ba	38.40±16.08 Ba	46.40±4.83 Ba
3 <sup>rd</sup> Day	90.40±4.12 Aa	97.60±1.60 Aa	96.00±0.00 Aa
5 <sup>th</sup> Day	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa
7 <sup>th</sup> Day	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa	100.00 ± 0.00 Aa

\*The differences between the means (± Standard Errors) with the same lowercase letter in the same row and the same uppercase letter in the same column, separately for each concentration, are statistically insignificant according to the Tukey test (P<0.05).

In studies on *Aphis fabae*, different concentrations (1.25, 2.50, 5, 10 and 15) of *Eucalyptus globulus* essential oil were examined. As a result of the experiments, 87.5% mortality rate was recorded at 15% concentration. As a result of the counts from 48 hours after at the same concentration, death in all aphids was recorded [16]. In literature reviews, the effects of Eucalyptus essential oil on *A. fabae* have found lethal, repellent, and feeding-inhibiting effects [17,18,19]. In a similar study, it was noted that mortality rates increased depending on the dose increase in 0.88, 1, 2, 4, 6, 8 and 12 µL/L doses of *Teucrium polium* essential oil to one-day-old adult individuals of *A. fabae* [20]. In another study on mortality rates increased due to dose increase, 1%, 2% and 4% doses of essential oils of *Moringa oleifera* L., *Eruca sativa* L., *Raphanus sativus* L., *Allium sativum* L. were applied [21].

#### 4. Conclusion

According to the results, 100.00% mortality rate was recorded in the 7<sup>th</sup> day count of all applied doses of eucalyptus, garlic and thyme essential oils used in the study. It was concluded that it would be beneficial to try these essential oils, which have been applied in pest control methods, in greenhouse and field conditions to reveal the potential of using these essential oils more clearly.

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