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# Insecticidal Behavior of the Synthetic Product and the Natural Extracts of Oil

**Abderrahmane Kassimi[1*], Lahcen El watik[1], Moumni Mohammed[1], Hamid Chaouki[1]**

*[1]*Laboratory natural substances, synthesis and molecular dynamics, Department of Chemistry, Faculty of Science and Technology of Errachidia, University My Ismail, BP 509 Boutalamine, Errachidia, Morocco.*

## Abstract

The strong use of agricultural inputs such as fertilizers and synthetic pesticides can cause toxic residues in the food chain, biological imbalance, environmental contamination, poisoning the beasts and other unknown effects. The use of plant extracts as alternative insecticides is one way to minimize the problems caused by synthetic insecticides. In this way, we treated green alfalfa seedlings attacked by aphids with different doses of the synthetic product Malyphos and of the natural extracts of oil (Oregano, Thyme, Neem, Kanuka, Ravintsara and Tea tree). From the month of May and during the summer or there are a large number of aphids and after a controlled time, the death of the parasite percentages are determined over time and dose of the synthetic product and these extracts natural of oil. The study of the mortality of aphids between the product Malyphos and these oil extracts helped to highlight the role of these natural extracts on limiting these parasites and their possible use as a natural insecticide without effects secondary on human health and the environment.

***Keywords:*** Malyphos; Kanuka; Ravintsara; Tea tree; Neem; Oregano; Thyme.

## 1. Introduction

The growth of the world population has led to an increased demand for food production, leading a green revolution from the 1960s (Corrêa and Salgado, 2011). This led to agriculture being qualified vast monocultures and a great use of synthetic fertilizers and toxic products, the latter being composed mainly herbicides and synthetic insecticides (Menezes, 2005). Insects are the main cause of losses in crops, especially cereals and seeds, as they reduce their nutritional and commercial values. These attacks can occur before, during and after harvest (Almeida et al., 2005).

In North Africa region, among insects, some are true parasites that cause great losses in the quality and quantity of food productivity. In Morocco, some aphid species have been found in large quantities on the fields of various crops such as green alfalfa. These aphids often cause damage by attacking severely the young shoots and buds, this leads to leaf drop and a great loss of livestock feed.

We now know that frequent and systematic use of chemicals that are not always effective provoke the presence of toxic residues in food, biological imbalance, environmental contamination, poisoning humans and animals (Marcomini et al, 2009; Queiroga et al, 2012), the resurgence of pests and insect-resistant strains (Dequech et al, 2008; Almeida et al, 2012).

It is known that the use of plant extract as an alternative insecticide is a way to provide a control without triggering the problems caused by synthetic chemical insecticides (Almeida et al., 1999). These factors justify the studies to identify management practices that reduce the use of synthetic products such as cultural practices based on allelopathy (Balbinot-Junior, 2004).

In this work, we have focused our research on some plants (Oregano, Thyme, Neem, Kanuka, Ravintsara and Tea tree) to see their characters insecticides with synthetic product Malyphos on aphids of green alfalfa. This aims to reduce the damage caused by these parasites maintaining the protection of the environment and in assessing the nature insecticide natural products used in this study.

 

## 2. Materials and methods

### 2.1 Alfalfa

This name is derived from the Greek: Medike which designated the origin of this plant, introduced of the Medes after the expedition of Darius, cited by Theophrastos in his book: Research on the plants (Remi, 2001). Alfalfa has many environmental benefits as the subtraction of inorganic nitrogen in the process of leaching, the treatment of effluents rich in nitrogen and the positive impact on biodiversity. It is also a strategic stake in economic independence and protein for the feeding (Thiebeau et al., 2003).

### 2.2 Description and characterization of the aphids

Name and identification of aphid: The Latin names are Adelgides, Aphidides, Eriosomatides, Phylloxerides and the Common name is Aphids. Aphids belong to the insects, more precisely to the Homoptera order and Aphididae family. They were identified with a magnifying glass of 8x and they are: 0.25 mm – 2.5 mm long, dark and light green head, dark and light green chest, yellow-green and light green abdomen.
Aphids in the alfalfa: The aphids in the alfalfa are the alfalfa aphid (Macrosiphum creelii), blue alfalfa aphid (Acyrthosiphon kondoi), green peach aphid (Myzus persicae), pea aphid (Acyrthosiphon pisum) and spotted alfalfa aphid (Therioaphis maculata) (Knowles, 1998).

### 2.3 Malyphos (synthetic insecticide)

Lot: 35100.
Active ingredient: Malathion.
Field of action: flies, aphids, codling moth.
Dose of use: 200 ml / hl.
Product Company: Agri Chemistry (Morocco).
Nature of product: toxic insecticide and acaricide universal.

### 2.4 Substance used as natural insecticide

Reagents used in this work have been provided by Herb'Atlas, supplier of natural products, organic and conventional essential oils.
Kanuka essential oil: Kanuka essential oil is anti-bacterial, anti-fungal and anti-inflammatory. Kanuka (Kunzea ericoides) belongs to the Myrtaceae family and is originally from New Zealand. The major components of the oil are: α-pinene + α-thujene (62.26 %), globulol + viridiflorol (5.40 %) and 1,8-cineole (4.25 %).
Ravintsara essential oil: Ravintsara (Cinnamomum camphora), grown in Madagascar, is a large evergreen tree from the Lauraceae family. It has a broad spec-trum of properties, being anti-viral, anti-bacterial, anti-fungal, immunostimulant, etc. The oil is obtained from the leaves by steam distillation. Its major components are 1,8-cineole (48.2 %), sabinene (7.05 %), α-terpineol (6.25 %), α-pinene (3.4 %) and terpinen-4-ol (3.15 %).
Tea tree essential oil: Tea tree oil, also called melaleuca is taken from the leaves of the Melaleuca alternifolia, which is native to the northeast coast of New South Wales, Australia. The major components of the oil are terpinen-4-ol + β-caryophyllene (42.72 %), γ-terpinene (18.44 %) and α-terpinene (8.61 %).
Oregano essential oil: The Oregano used, Origanum compactum, is widely available in the North of Morocco. The method used for obtaining the essential oil of Oregano is hydro-distillation by steam distillation. Its major constituents are carvacrol (32.14 %), thymol (21.42 %) and y-terpinene (18.80 %).
Thyme essential oil: The species used in this work is Thymus satureoides (Moroccan red Thyme), an endemic plant found in forest clearings, scrub and matorrals of low and medium mountains. The thyme essential oil is obtained by hydro-distillation by steam distillation. The major components of the oil are alpha-terpineol + borneol (39.23 %), camphene (9.25 %), carvacrol (7.93 %) and terpinen-4-ol + beta-caryophyllene (7.06 %).
Neem vegetable oil: The botanical name of Neem, also known as Indian Lilac, is Azadirachta indica. Neem is an evergreen tree native to India, Burma, Java and the Lesser Sunda Islands (Mouffok et al., 2007/2008). Neem oil is obtained by cold pressing and sand filtration. The active molecule is azadirachtin (0.29 %).

 

### 2.5 Experimental conditions and method

Conditions: The tests have been done from the month of May and during the summer in alfalfa green fields. The area of fields ranged from 0.1 to 0.5 hectare. In order to carry out these experiments random plots of 1 m² were taken, mutually separated by 10 m.

Experiments and procedures: The experiments consist of evaluating the mortality of aphids in the presence of dilute solutions of oils using a methodology inspired by the protocol of the World Health Organization (WHO, 1985). In that way, aphids parasitizing fields of 1 m² surface were taken immediately after treatment in 25×40 cm² clear plastic bags for later counting in the laboratory.

According to this, stock solutions of each oil sample were prepared in pure water, and from these solutions the final test dilutions were made at different concentration percentages (v/v) (0.5 % and 1 % oil in pure water). Each plot was sprayed with 100 ml of a solution (oil + water + 1 ml of liquid soap per liter of solution as an emulsifier) by use of a manual sprayer.

In order to verify the reproducibility of the results each test was repeated four times. A control sample of 100 ml of pure water and emulsifier enables to measure the natural mortality at the same experimental conditions. The count of dead aphids on the last 20 cm of plants taken in a 1 $m^2$ surface area has been accomplished by means of a magnifying glass 8x after 3,7 and 11 hours after treatment. The same procedure was conducted for the other tests

## 3. Results and Discussion

### 3.1 Results

Each mortality percentage (m ± SEM where m is the mortality and SEM is the Standard Error of Measurement) presented in table 1 is the average of sixteen tests which have the unavoidable uncertainty of the measurement.

Table 1: Aphid mortality percentage (%)

| | **Concentration 0.5 % (v /v)** | | | **Concentration 1 % (v /v)** | | |
|---|---|---|---|---|---|---|
| **Time(h) / Oil** | 3 | 7 | 11 | 3 | 7 | 11 |
| **Malyphos** | 39.04±0.8 | 70.31±1.02 | 78.68±1.04 | 52.77±0.7 | 71.49±0.95 | 78.88±1.05 |
| **Kanuka** | 41.66 ±4.17 | 60.33±3.10 | 70.83 ±2.08 | 37.5 ±3.61 | 65.62 ±2.7 | 68.75 ±1.8 |
| **Ravintsara** | 33.33 ±4.17 | 56.30±4.10 | 70.83 ±2.08 | 43.33 ±3.54 | 60.42 ±3.96 | 69.17 ±3.14 |
| **Tea tree** | 35.41 ±4.54 | 57.66±4.12 | 70.83 ±2.08 | 39.16 ±3.41 | 61.87 ±3.1 | 67.08 ±2.66 |
| **Oregano** | 41.5±1.5 | 94.5±1.3 | 95.6±1.7 | 44.38 ±0.62 | 93.7 ±1.2 | 94.7 ±1.8 |
| **Thyme** | 35.4 ±1.3 | 71.1 ±1.2 | 86.8 ±1.03 | 40.64 ±0.93 | 86.29 ±0.92 | 90.79 ±0.98 |
| **Neem** | 26.94±0.9 | 78.6±1.7 | 88.9 ±1.06 | 36.94 ±0.81 | 88.26 ±0.92 | 92.76 ±0.98 |
| **Control** | 5.25 ±1.08 | 09.6 ±0.99 | 12.5 ±1.05 | 6.25 ±1.28 | 11.6 ±0.99 | 13.43 ±1.05 |

Table 1 shows that after hours of experience the control did not exceed 13.43 % mortality in all tests. We see that by the dose 0.5 % mortality is low in 3 hours for the Neem oil and it is strong for the Kanuka. These mortality rates are almost stabilized at the end of each test, which proves that the effect of the products is fast compared with that of other extracts. After three hours, all oil extracts have similar mortality synthetic product

 

Malyphos except Neem oil. For this time of treatment and the dose 1 %, the synthetic product Malyphos becomes more deadly than oil extracts.

After eleven hours of treatment the variation of the mortality rate of aphids in function of the concentration evolved weakly by comparing with the previous case (three hours). We see that by the dose 0.5 % mortality is low in 11 hours for the Kanuka, Ravintsara and Tea tree and it is strong for the Oregano oil. For this time of treatment and the doses 0.5 % and 1 %, the extracts (Kanuka, Ravintsara, Tea tree) are less deadly than the synthetic product Malyphos and other extracts.

In long time for the high dose, the Oregano remains active followed by Neem, Thyme, the synthetic product Malyphos and finally other extracts oil. From these results, the extracts oil (Oregano, Neem, Thyme) even have business order that the synthetic product.

In Table 2, in order to evaluate more precisely the insecticidal activity of these products against aphids, it was calculated $TL_{50}$ and $TL_{90}$, defined as the time respectively lethal causing 50 % and 90 % mortality of aphids treated. Then we calculated the $LC_{50}$ and $LC_{90}$, lethal concentrations causing 50 % and 90 % of the mortality of treated aphids.

Table 2: $TL_{50}$, $TL_{90}$, $LC_{50}$ and $LC_{90}$

| | **$TL_{50}$** | | **$TL_{90}$** | | **$LC_{50}$** | **$LC_{90}$** |
|---|---|---|---|---|---|---|
| | **0.5 %** | **1 %** | **0.5 %** | **1 %** | **After 11 hours** | **After 11 hours** |
| **Malyphos** | 4.5 h | 3.5 h | 14.75 h | 13.5 h | 0.1 % | 1.1 % |
| **Kanuka** | 4.75 h | 5.75 h | 16 h | 13.25 h | 0.2 % | 7.6 % |
| **Ravintsara** | 7.5 h | 6.25 h | 16.5 h | 13.5 h | 0.5 % | 7.2 % |
| **Tea tree** | 4.75 h | 6.25 h | 16.25 h | 13.75 h | 0.8 % | 6.6 % |
| **Oregano** | 4.75 h | 4 h | 6.75 h | 8.75 h | 1 % | 4 % |
| **Thyme** | 5.75 h | 4.75 h | 11.5 h | 9.5 h | 1.25 % | 4.25 % |
| **Neem** | 5.5 h | 4.5 h | 11.25 h | 9 h | 1.1 % | 4.1 % |

**- Lethal time causing 50 % and 90 % of mortality ($TL_{50}$ and $TL_{90}$):**

The mortality of aphids reached 50 % for the dose 0.5 % of Malyphos products from 4.5 hours, the extracts (Oregano, Kanuka, Tea tree) from 4.75 hours and then the other extracts. Also for the dose 1 % of Malyphos from 3.5 hours, the Oregano from 4 hours, the Neem from 4.5 hours, the Thyme from 4.75 hours then the other products. For the dose 1 % of Oregano, Thyme and Neem gives a mortality rate of over 90 % in less than ten hours better than the Malyphos and other oil extracts.

**- Lethal concentration causing 50 % and 90 % of mortality ($LC_{50}$ and $LC_{90}$):**

We see that to 50 % of mortality, the extracts (Kanuka, Ravintsara, Tea tree) have a similar activity of the product Malyphos. It reached a mortality rate of 90 % of aphids after eleven hours of treatment close to the dose 4 % for extracts (Oregano, Thyme, Neem) and close to 7 % for other oil extracts.

### 3.2 Discussion

In long time and high dose we found that the Oregano, the Thyme and the Neem are the most deadly of aphids in alfalfa fields followed by the synthetic product Malyphos and other oil extracts. But in short time and less

 

dose of the extracts oil (Kanuka, Ravintsara and Tea tree) are more active than the synthetic product Malyphos. It can be assumed that the mortality is mainly due to the various active compounds containing in these products, the dose used and the processing time of aphids.
For the insecticidal activity, the treatment of aphids with Oregano, Thyme, Neem and synthetic product Malyphos vary almost in the same order. Several oils such as Oregano, Basil, Marjoram, Thyme, Sage, Laurier, Rosemary, Lavender, Anise, Mint, Celery, Cumin, Citrus, Coriander and Fennel were tested and several have caused up to 100 % mortality insects and in different cultures (Shaaya et al., 1991).

## 4. Conclusion

We conclude, for oil extracts (Oregano, Thyme, Neem) were same order of activity as the Malyphos. But in a short time and low doses of oils (Kanuka, Ravintsara, Tea tree) have significant insecticidal activity comparable to that of Malyphos synthetic product. On observing the different changes on the quality and quantity of oil, we can estimate how long such oil can give a satisfactory performance or has an interesting activity. For different doses, the samples showed activity on aphids. With time, extracts of Oregano, Neem and Thyme in green alfalfa being effective samples and reached a mortality rate of over 90 %.
In our region Mediterranean, we have a large number of aromatic plants, a rich climate in brightness and warmth, accompanied by marked seasons, demands from the adaptive plants effort supports a wealth of molecular evolution conferring multiple properties, inter alia the insecticidal effect. It follows that the use of natural plant extracts for insecticidal properties of lesser toxicity in humans and the environment is proving to be an alternative approach to the use of synthetic insecticides.

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