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Comparison of Insecticidal Activity of Three Essential Oil with A Synthetic Product

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ABSTRACT

To see the comparison of insecticidal activity of the essential oils (Kanuka, Ravintsara and Tea tree) on the aphid green alfalfa and the synthetic product, we conducted tests on these oils and the synthetic product Malyphos most used by farmers in our region. For this purpose, fields of green alfalfa parasitized by aphids were treated with different doses of this product and of these oils as a function of time. During the summer when there is a large number of aphids and after a controlled time we were determined the percentage mortality for this parasite versus time and dose of the product synthesis and of these oils. Comparison of the insecticidal activity between the product Malyphos and these essential oils has revealed the role of these natural extracts on the limitation of chemical insecticides and their possible use as naturalness without side effects on human health and the environment.

Keywords: Activity, Alfalfa, Aphid, Insecticide, Kanuka, Malyphos, Ravintsara, Tea tree

I. INTRODUCTION

Some insects are true parasites responsible for losses in the quality and quantity of crops. The aphid alfalfa is often present; it winters in the neck and then colonized the stems, leaves, inflorescences and pods. In the culture of green alfalfa such pests as aphids cause particular damage to the leaves, they attack the young shoots and buds.

Of the larva to adult, all stages of aphid feed on the underside of the leaves. They can affect the plant in different ways: reduction of photosynthesis, injection of phytotoxic substances while they are fed, accumulation of faeces and paintings on the plants that can affect the appearance of plants. All of these effects have consequences for the decrease of the usable quantity of plants and therefore causes great economic losses (Johnson and Lyons, 1991).

To limit such damage the farmers use synthetic insect whose side effects are numerous on the health of the population, fauna and flora. According to the World pesticides cause poisoning of man and his environment Tank mixes of horticultural oils and insecticides have also been used to enhance the control of non-persistently transmitted viruses (Katis, 2007).

Several plants provide natural insecticides, but their extent and their specific action often have led us to focus our research on the Kanuka, Ravintsara and Tea tree. These plants are also used for many uses. The growing interest in the use of pesticides based on extracts from these plants in the world is motivated by their effects comparable to those of chemical pesticides (Mouffok et al., 2007/2008).

This study aims to make a comparison of the insecticidal activity of natural oils Kanuka, Ravintsara, Tea tree with the synthetic product Malyphos on aphids green alfalfa to reduce the damage caused by these pests without affect the human health and environment.

II. METHODS AND MATERIAL

A. Substances used as natural insecticides

Reagents used in this work have been provided by Herb'Atlas, supplier of natural products, organic and conventional essential oils.

1) 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 %), 1,8-cineole (4.25 %) and para-cymene (3.89 %).

2) *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, etc. Its major components are 1,8-cineole (48.2 %), sabinene (7.05 %), α-terpineol (6.25 %), α-pinene (3.4 %), terpinen-4-ol (3.15 %) and β-pinene (2.4 %).

3) *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 %).

B. 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.

C. Alfalfa

The scientific name: Medicago is neighbor of the Latin designation. 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).

D. Aphids in the alfalfa

Generally aphids belong to insects, specifically the Homoptera order and Aphididae family. They are polyphagous, sucking biting insects. 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).

E. Experimental conditions and method

1) Conditions

The tests have been done during the summer in alfalfa green fields. The geographical area chosen is near the town of Erfoud (Morocco). The area of fields ranged from 0.1 to 0.5 hectare. 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).

1) Method

As a final protocol, 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. The 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. 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 2 m^2 surface area has been accomplished by means of a magnifying glass 8x, and this 3, 5 and 11 hours after treatment. The same procedure was conducted for the other plots and concentrations (0.5 % and 1 %).

III. RESULTS AND DISCUSSION

A. 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. The table 1 shows that after hours of experience the control did not exceed 14.27 % mortality in all tests. We see that by the dose 0.5 % the mortality is low in 3 h for the Ravintsara and Tea tree but it is strong for the Kanuka and Malyphos. For the dose 1 %, hour after hour the mortality with Kanuka remains close to the Malyphos.

We notice for the dose 0.5 % mortality is almost the same for the synthetic product Malyphos that for the oil Kanika. We see that by the dose 1 % mortality is strong from the 11 hours for the Malyphos. From these results, the Tea tree to be the less active in first hour. Also the Kanuka is still active but the Malyphos become active in the long term. It is observed that the mortality varies little even at a high dose and long duration. To evaluate more precisely the insecticide activity of these products against aphids, it was calculated the TL_{50}, the TL_{90}, LC_{50} and the LC_{90} defined in table 2.

1) Lethal concentration causing 50 % and 90 % of mortality (LC_{50} and LC_{90})

We reached a 50 % mortality of aphids to low dose 0.2 % of Kanuka, then to 0.5 % of Ravintsara and then to 0.8 % of Tea tree but it was 90 % of mortality that at a dose close to 6 %. It was the mortality of 50 % of the aphid after eleven hours of treatment from the concentrations close to 0.1 % of Malyphos products. We reached a 90 % mortality of aphids after eleven hours of the treatment from the low dose from 1.1 % of the Malyphos followed by the Kanuka with dose 5.6 %.

2) *Lethal time causing 50 % and 90% of mortality (TL_{50} and TL_{90})*

The mortality of aphids reached 50 % for the dose 1 % of Malyphos from 3.5 hours and then the Kanuka from 4.25 hours. Also for the dose 0.5 % of malyphos from 4.5 hours then the Kanuka from 4.75 hours. For the dose 1 % we have that the Kanuka gives a mortality rate of over 90 % from 13.25 hours then the Malyphos from 13.5 hours. At a dose of 0.5 % was this mortality for the Malyphos from 14.75 hours and then the Kanuka from 16 hours.

TABLE 1. APHID MORTALITY PERCENTAGE (%)

Dose (v /v)	**Mortality percentage (%)**					
	Time (h)	**Malyphos**	**Kanuka**	**Ravintsara**	**Tea tree**	**Control**
0.5 %	3	39.04 ±2.85	41.66 ±4.17	33.33 ±4.17	35.41 ±4.54	4.56 ±2.39
	5	65.95 ±3.07	58.33 ±4.17	41.66 ±4.17	54.17 ±3.61	7.34 ±2.06
	11	78.68 ±3.14	70.83 ±2.08	70.83 ±2.08	70.83 ±2.08	13.29 ±0.94
1 %	3	52.77 ±3.41	37.5 ±3.61	43.33 ±3.54	39.16 ±3.41	7.83 ±1.04
	5	66.1 ±2.36	62.5 ±3.61	51.67 ±4.78	56.67 ±3.54	11.89 ±0.45
	11	78.88 ±3.79	68.75 ±1.8	69.17 ±3.14	67.08 ±2.66	14.27 ±1.11

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	4.25 h	16 h	13.25 h	0.2 %	5.6 %
Ravintsara	7.5 h	5 h	16.5 h	13.5 h	0.5 %	7.2 %
Tea tree	4.75 h	4.5 h	16.25 h	13.75 h	0.8 %	6.6 %

B. **Discussion**

It can be inferred that the product of Malyphos is the most deadly of aphids in alfalfa fields followed by the essential oil Kanuka . More than 16.5 hours after treatment to achieve mortality rate of 90 % for all products for dose 0.5 %. This shows that all products even at low concentrations are already active after a sixting of hours.

Hour after hour show a very low activity of aphids treated with the dose 1 % which implies that the concentrated action of the oil on the ground can increase the rate of mortality. From these results, essential oil Kanuka and Malyphos product seem to be the most active for long time. But the other essential oils remain active months. It is found that the mortality varies little even at a high dose and long term. 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.

In relation to the witness, it is the treatment of aphids by the Malyphos product and the oil Kanuka in alfalfa which are located the most affected. Butler and Henneberry (Butler and Hennberry, 1990) have tested a solution of 5 to 10 % of the oil from the seeds of cotton on the aphids of the cabbage, the couple, the thrips and the to legionnaire in the beet. The oil from the seeds of cotton has reduced up to 91 % the number of larval legionaries on the bette to carde.

IV. CONCLUSION

These results will allow observing the different changes in the quality and quantity of essential oils to estimate what conditions or at what time and in what culture a particular essential oil can give a satisfactory performance or have an interesting activity. The results of our study may say that the dose of 1 % of Kanuka and Malyphos products applied to aphids have much impact. For a dose of 1 % in the two previous cases, all samples showed activity interesting on aphids.

In Mediterranean area, we are greeted by a large number of aromatic plants. Its rich climate in brightness and warmth, accompanied by marked seasons, demands from the effort adaptive plants support a wealth of molecular evolution conferring with multiple properties, including the insecticide effect (Pénoël, 1994).
For this reason, the natural extracts of plants are a true wealth and can be the cause of a large number of substances insecticides exploitable in the control of pests (Isman, 2001). In this context, the use of natural molecules of interest (ecological and economic) to the insecticidal properties of lesser toxicity in man, is proving to be an alternative approach to the use of insecticides of synthesis.

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