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Mortality of Watermelon Aphids by Vegetable and Essential Oil with a Chemical Synthetic Product

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Abstract

Plant extracts have historically served as models in the development of human care against agricultural diseases and pests. The production of medicines and the treatment of diseases began with the use of herbs. Following this, the mortality of aphids in the watermelon fields was studied between the synthetic product Malyphos and the essential oil (Oregano) and then vegetable oil (Neem) to compare them in terms of efficacy in mortality and environmental health. Because of this, watermelon seedlings containing many aphids have been taken with various doses of this product and these oils. During the summer when there is a large number of aphids and after a controlled time, we determine the mortality rates of this parasite over time by well-chosen doses of the synthetic product and these oils. This study of mortality between the product Malyphos and these oils (essential and vegetable) made it possible to demonstrate the role of these natural extracts on the limitation of these parasites and their possible use as natural insecticide while preserving the human health and the environment.

Keywords*:* Mortality; Malyphos; Neem; Oregano; Plant extract.

1. Introduction

Authors are advised to provide an introduction for their article. Some of the insects in the Mediterranean region are true parasites responsible for the loss of quality and quantity of food for humans. Aphids from watermelon fields often breed and cause damage to the leaves by attacking young shoots and buds. This damage can be direct by extracting the sap from the phloem, which can lead to a reduction in photoassimilates and crop yields, or indirectly through the transmission of plant viruses (Dedryver and al., 2010)

The spill of 50 % of the viruses transmitted by the insects is transmitted by the aphids (Nault, 1997). In addition, aphids can damage crops with their saccharose-rich feces, called honeydew, which can attract other harmful species (Gratwick, 2007). This pushes farmers increased the use of synthetic pesticides to stop this scourge.

The synthetic pesticides used in our region against these parasites have contributed to increased crop yields, particularly pest control, but there are many side effects on the health of the population, fauna and flora. This pushes the use of horticultural oils that can be applied against the aphids and the transmitted virus. Mixtures of horticultural oils and insecticide reservoirs have also been used to enhance control of the transmitted non-persistent virus (Katis, 2007).

Over the past 20 years, new approaches to insect control have been using botanical insecticides. Many natural products are known to have a range of useful biological properties against insect pests (Isman, 2000). The effectiveness of many botanical oils against stored insect pests has been demonstrated (Shaaya and al., 1991;

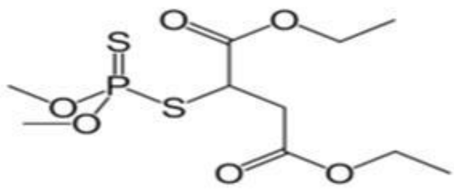
Kim and al., 2003; Lee and al., 2003; Aslan and al., 2005; Cetin and Yanikoglu, 2006; Negahban and al., 2007; Ayvaz and al., 2009; Al Qahtani and al., 2010).
Many spices and herbs and their extracts are known having insecticidal properties and are frequently present in essential oil (Brattsten, 1983; Schmidt and al., 1991; Shaaya and al., 1991). To combat the aphids we used a spray of extracts of Neem, spraying of extracts of tobacco or use of ashes of wood (Bijlmakers and Verhoek, 1995).Most constituents of the essential oil are monoterpenoids considered to be important metabolically. The toxicity of a large number of essential oils and their constituents has been evaluated against a number of insects.
This work aims to make a comparison of the mortality effect between the synthetic product Malyphos and the oil extracts (Oregano and Neem) on watermelon aphids. This is to reduce the damage caused by these pests by keeping environmental protection and assessing the effect of the natural insecticides used in this study.

2. Materials and Methods

2.1 Malyphos (synthetic insecticide)

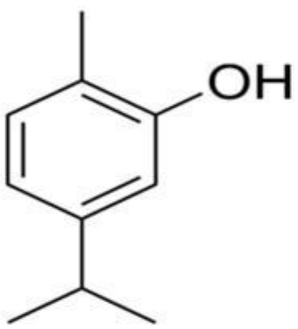
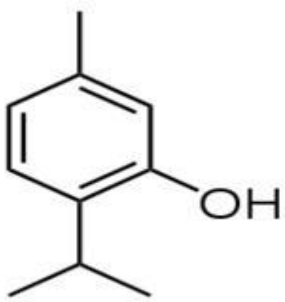
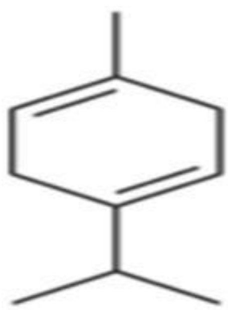
- Lot: 35100.
- Active ingredient: Malathion.
- Field of action: flies, aphids, codling moth.
- Dose of use: 200 ml / hl.
- Product Company: Agri Chemistry (Morocco).
- Nature of product: toxic insecticide and acaricide universal.

- Chemical formula of Malathion: $C_{10}H_{19}O_6PS_2$

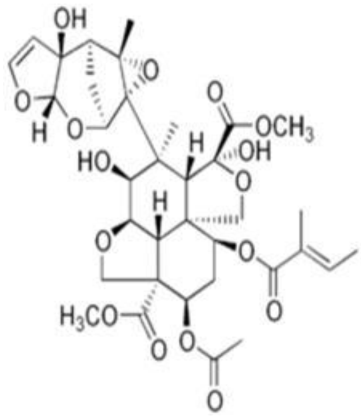
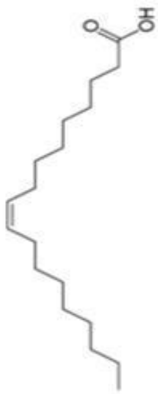


2.2 Substances used as natural insecticides

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

Chemical formula of Carvacrol: **(** $C_{10}H_{14}O$ **)**	Chemical formula of Thymol: ($C_{10}H_{14}O$)	Chemical formula of y-terpinene: ($C_{10}H_{16}$)
		

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 and al., 2007/2008). Neem oil is obtained by cold pressing and sand filtration. The active molecule is Azadirachtin (0.29 %). Its major constituents are Oleic acid (46.8 %) and Linoleic acid (12.8 %).

Chemical formula of Azadirachtin: ($C_{35}H_{44}O_{16}$ **)**	Chemical formula of Oleic acid: ($C_{18}H_{34}O_2$)	Chemical formula of Linoleic acid: ($C_{18}H_{32}O_2$)
		

2.3 Culture of watermelon

The watermelon (common name) is a food more widespread in summer in our region. Its latin name is Citrullus Lanatus (Thunberg) Matsumara & Nakai (also called C. vulgaris) and the family name is Cucurbitaceae (David, 2008). Watermelon is a fruit with seeds or the arrangement of plants is 2 m x 1 m between hills. Its varieties are the Sugar Belle and the Royal Jubilee. Its culture time is 70 to 95 days. Potential yields to the high productivity of this fruit are 5 to 12 kg. Watermelon prefers warmer temperatures and a long growing season.

2.4 Description of aphid

Aphids have only one morphological character that distinguishes them from other insects is the presence of cornicles. The cotton aphids (melon aphid) and the aphid gossypii Glover are found on watermelon fields on all cucurbits. It is a black green aphid, about 1 to 2 mm long. There are also the green fish aphids, Myzus que (Sulz.). Wingless adults are 1.5 to 2.6 mm long. It is a matt green color olive or light green, sometimes mixed with yellow and the antennae are as long as the body and the cornicles are green.
The winged adult has a black head and thorax and then the length of its body is 2.0 to 2.5 mm. It is a cucumber mosaic vector and other viruses that can attack cucurbits. The aphids were identified with an 8x magnifying glass and have the following characteristics: 0.25 mm - 2.5 mm long, dark head and light green, dark green chest and light green, light green and light green.

2.5 Conditions and experiments

Conditions:
The tests were carried out in the summer of 2016 in the watermelon fields. The chosen geographical area is named Tafilalt in the south-east of Morocco. The area of watermelon fields varied from 0.1 to 0.25 hectares. To carry out these experiments, the plots of 1 m^2 separated by 5 m were chosen randomly.
Experiments:
Aphid mortality is evaluated in the presence of dilute oils using a methodology based on the World Health Organization protocol. The aphids parasitizing the fields of 1 m^2 of surface were taken immediately after

treatment in white plastic bags of 25 x 40 cm ^{2} for subsequent laboratory counting. Stock solutions of each oil sample were prepared in pure water and from these solutions the final dilutions of the test were carried out at different concentration percentages (v / v) (0.5 % and 1 % oil in pure water). Each plot of watermelon was sprayed with 100 ml of a solution (oil + water + 1 ml of liquid soap per liter of solution as an emulsifier) using a manual sprayer.
In order to check the reproducibility of the results, each test was repeated four times. A control sample of 100 ml of pure water and emulsifier makes it possible to measure the natural mortality under the same experimental conditions. The number of dead aphids on watermelon plants taken in an area of 1 m^2 was achieved using an 8x magnifier after 3, 5 and 7 hours of treatment.

3. Results and Discussion

3.1 Results

The application of different products to the aphid's results in their mortality after treatment as indicated in table 1, figure 1 and figure 2. Each percentage of mortality (m ± SEM where m is mortality and SEM is the standard error of measurement) presented in table 1 is the average of sixteen tests.

Table 1: Aphid mortality percentage (%)

	Concentration 0.5 % (v /v)			**Concentration 1 % (v /v)**		
Time (h) / Product	**3**	**5**	**7**	**3**	**5**	**7**
Malyphos	17.98±0.8	33.9±1.02	41.89±1.04	21.01±0.7	35.76±0.95	44.32±1.05
Oregano	26.11 ±1.78	33.88 ±4.33	35.75 ±4.11	30.1 ±3.12	34.66 ±3.34	37.75 ±2.66
Neem	25.12 ±1.75	29.76 ±2	33.19 ±2.09	23.47 ±1.25	32.3 ±1.46	36.01 ±1.5
Control	7.25 ±1.08	09.6 ±0.99	11.5 ±1.05	6.25 ±1.28	10.6 ±0.99	12.43 ±1.05

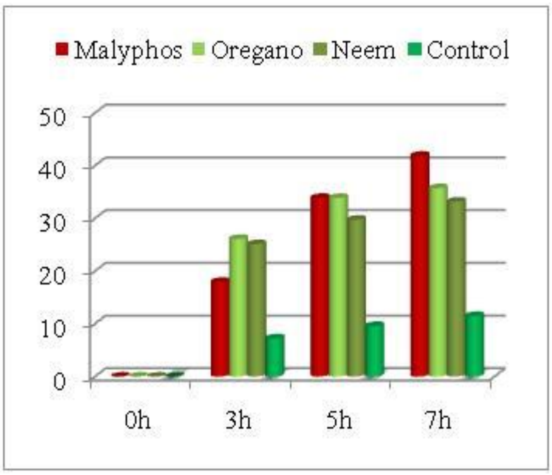


Figure 1: Case of dose 0.5 %

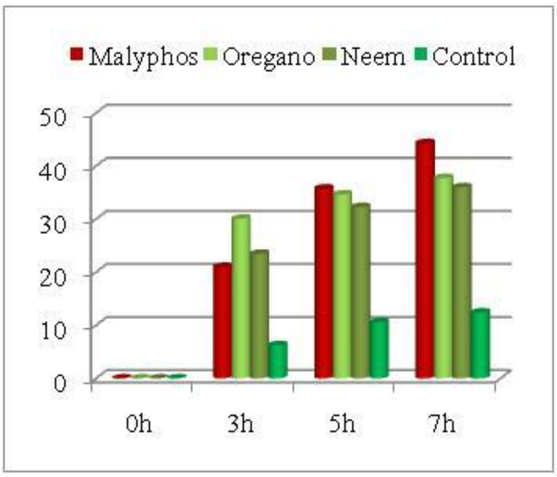


Figure 2: Case of dose 1 %

It is noted that at a dose of 0.5 % the mortality is low at 3 hours for Malyphos (17.98 %) and it is strong for the oil of Oregano (26.11 %). But beyond 3 hours the product Malyphos becomes more deadly than the two oils.

At the 1 % dose, the same applies to malyphos and the two oils. The natural mortality of the control is too low at all times by contribution to the products used and does not exceed 12.43 %.
These mortality percentages normally vary at the end of each test and do not reach high mortality values over short periods, which prove that the effect of the different products is long and similar. Both oils are active in the short term but Malyphos becomes active in the long term. It is observed that mortality varies little in the long term even at a high dose for all products.
To better evaluate in a clear way the insecticidal activity of these products against aphids in watermelon fields, we calculated the lethal times for mortality of 50 % (TL_{50}) and 90 % (TL_{90}), then the lethal doses for the 50 % mortality (LC_{50}) and 90 % (LC_{90}) in table 2.

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 7 hours**	**After 7 hours**
Malyphos	8.2 h	7.6 h	14.6 h	13.8 h	1 %	1.9 %
Oregano	8.8 h	8.2 h	16.4 h	15.6 h	1.2 %	2.25 %
Neem	9.8 h	9 h	18.2 h	16.6 h	1.25 %	2.35 %

3.2 Discussion

In the watermelon fields, aphids die slowly even at a high dose of 1 % and after 7 hours have the high mortality value of 36.01 % for Neem, 37.75 % for Oregano and 44.32 % for Malyphos. These values are close for the different products and are very far from the natural mortality on control of the low or high dose. It can be assumed that the mortality is due to the different active compounds contained in these products, the dose used and the treatment time of the aphids. At high doses, both oils and Malyphos become active against the aphids with a superiority of the last product.
According to these results, at the rate of 0.5 % the time to have a 50 % mortality of the aphids for the vegetable oil (TL_{50} = 9.8 hours) and for the essential oil (TL_{50} = 8.8 hours) are close of the synthetic product (TL_{50} = 8.2 hours). After 7 hours, the doses required to have a 50 % mortality for Neem oil (LC_{50} = 1.25 %) and for Oregano oil (LC_{50} = 1.2 %) are also close to Malyphos (LC_{50} = 1 %).
Looking at the results obtained in table 2, the insecticidal activity of Neem oil and Oregano is closer to the synthetic Malyphos product often used by farmers in our country. These results are proved by Butler and Henneberry (Butler and Hennberry, 1990) who tested a 5 to 10 % solution of cotton seed oil on cabbage aphids. We obtained results indicating that doses of 0.5 % and 1 % of the products applied to aphids have a narrow impact and sufficient insecticidal action. The high dose of 1 % showed that all samples had activity on the aphids. Hour after hour, extracts of Neem and Oregano in the watermelon fields reached a 90 % mortality rate for the high dose 1 % in less time than 16.6 hours near that of Malyphos by 13.8 Hours.

4. Conclusion

The attack by the vegetable oil of Neem and the essential oil of Oregano on the aphids of the watermelon fields is also affected in the same way as the synthetic product Malyphos. This shows that the vegetable and the essential oil in sufficient concentrations can cause death of the insect and replace the product Malyphos. These results show that natural plant extracts are a real richness and can give many insecticidal substances used in the control of parasites. It is concluded that natural insecticides will therefore be of great importance to human, animal and environmental health and will be better than the synthetic product.

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