

Insecticide Effect of Plant Extracts on Aphids of Watermelon

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Abstract
The watermelon is an important crop in Morocco, an annual plant, originating in the tropical Africa. The consumed part is the mature fruit whose nutritional value is high; it is rich in vitamin and mineral salts. The fruit is used for medicinal purposes (kidneys and cleaning of the urinary tract). In Morocco, the watermelon is cultivated in large quantities in Souss Massa, in Marrakech, in the Loukkos and in Doukkala. A common problem in the production of watermelon is the infestation at the beginning of the season by aphids. They transmit viruses of the tile to the plants. They are more likely to be a problem in the costs time. The presents study is the effects of essential oils (Thyme and Oregano) and vegetable oil (Neem) on aphids of watermelon. The tests have been performed in the months of June to July 2010/2011 on the aphids in the fields of watermelon. It determines the percentage deaths of aphids in function of the dose 0.5 %, 1% and 5% of these products and the time 1, 3, 5, 7 and 11 hours after treatment. These results highlight an activity insecticide on these insects.
Keywords: Watermelon, Insecticide, Aphid, Neem, Oregano, Thyme

1. Introduction

The culture of the watermelon attracted all the more the producers it generates substantial amount of income. Most importantly, it provides the gains to a period during which the food situation that prevails at the level of a lot of farms require them to incur debts from other more affluent. It remains that the evolution observed in the culture there are a number of problems caused by the parasites and insecticides used.

The most important factors that reduce the productivity of the watermelon are high temperatures, high humidity, exces rain, pests and diseases. The results obtained in our study indicate that the use of different mulch system is a potential factor in aphids control on watermelons (Katja Žanic et *al*., 2009). In this culture, pests such as aphids cause especially of damage to the leaves, causing discoloration. They attack the young shoots and the buds. A severe attack led to the fall of the leaves. In Morocco, a few species of aphids have been found in large quantities on cucurbits (cucumbers, zucchini, melon, watermelon).

Aphids have been one of the principal insect pests of watermelons in Louisiana, primarily because of their role in virus transmission. Melon aphid, green peach aphid, and cowpea aphid feed reproduce on watermelons and other cucurbits. The other aphids listed are also involved in virus transmission, but do not colonize watermelons. The most common aphid is the melon aphid, which is a major pest of cucurbits and cotton and also attacks many other plants, including eggplant, peppers, potatoes, citrus, okra, and a variety of ornamentals and weed species (Henry Harrison et *al*., 2002).

Generally, it found that foliar diseases on the leaves of the cucurbits. No attack on the fruit is noted. It causes stains more or less circular to irregular contour. The center is white in color, straw or light brown. The edges of the spots may be dark purple or black. The lesions may be surrounded by chlorotic halos which eventually will flow and make the sheets entirely yellow. The symptoms usually appear first on older leaves. On the rods, the disease causes stains elongated (Bijlmakers and Verhoek, 1995).

Damage from aphids can be direct or indirect. Direct damage to plants occurs from the feeding activity of aphid nymphs and adults. Aphids pierce the plant tissue and extract sap, which results in a variety of symptoms, including decreased growth rates and reduced vigor; mottling, yellowing, browning, or curling of leaves; and wilting, low yields, and plant death. Indirect damage is also caused by the ability of some aphid species to serve as virus vectors. However, the viruses like watermelon mosaic virus (WMV) transmitted by aphids can cause severe losses. Under favorable conditions, these viruses can cause a high rate of crop failure and severe economic losses (Barbercheck, 2011).

Even if pesticides have contributed to increase crop yields notably fighting against pests, the side effects of the use of pesticides are many: effects on the health of the people, the wildlife and flora; contamination of the water, soil and air (Bouguerra, 1986).The detrimental effect of aphids on the environment, as well as the increasing development of resistant populations led to search for new methods of struggle. Among these, one of the tracks currently envisaged is the formulation of new bios insecticides targeting and disrupting the biochemical functions of the insect. Due to the high specificity of the agents used, these methods of controlling pests do not usually show that very little risk to the environment, non-targeted species and human health (Sophie

Vandermoten, 2008).

Horticultural oils can also be applied against aphids and aphid-transmitted viruses. These oils are useful in interfering with the transmission of the viruses. They should be applied early in the growing season (two weeks after planting) as aphids are known to colonize plants shortly after germination. Tank mixes of horticultural oils and insecticides have also been used to enhance the control of non-persistently transmitted viruses (Katis et *al*., 2007). In organic systems, horticultural oils and soaps are effective when applied regularly with a drop nozzle (to get the undersides of leaves) and high pressure, but these must be applied regularly and may be cost prohibitive. Neem and Pyrethrin are other options, but care must be taken when using these broad-spectrum insecticides to prevent harm to beneficial insects (Liburd and Nyoike, 2008).

The insecticidal properties of Neem were also tested with great success in full field in Burkina Faso on the green beans against the fly of the bean and the desert, on the watermelons against the fly of the cucurbits, on the tomato against chrysodeixis of the tomato, aphids and whitefly (André Bélanger and Thaddée Musabyimana. 2005). Several plants provide natural insecticides, but their extent and their specific action often have led us to focus our research on the Neem, Oregano and Thyme. These plants are also used for many uses that we'll discuss. 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 work has for objective to make a study of effect of insecticide products Neem, Oregano, Thyme and their mixture on aphids of watermelon in order to reduce the damage caused by these parasites in protecting the environment and assessing the effect of insecticide natural products used in this study.

2. Materials and methods

2.1 Culture of watermelon

The common name is watermelon. The Latin name is Citrullus Lanatus (Thunberg) Matsumara & Nakai (also called C. vulgaris) and the Family name is Cucurbitaceae (David Rhodes, 2008). The watermelon is a fruit with seeds or the arrangement of the plants is 2 m x 1 m between hills. Its varieties are the Sugar Belle and Royal Jubilee. Its duration of culture is from 70 to 95 days. The potential returns to high productivity of this fruit are of 5 to 12 kg. The watermelon prefers warmer temperatures and a long growing season.

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.

2.2.1 Neem vegetable oil (VO)

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 %).

2.2.2 Thyme essential oil (EO)

The species used in this work is Thymus satureoïdes (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 %).

2.2.3 Oregano essential oil (EO)

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 %).

2.2.4 Mixture

The mixture was obtained from the products and equal in percentage volumes of Thyme, Oregano and Neem in all experiments.

2.3 Description and characterization of the aphids

The Common name is aphids and the Latin name of aphids is Adelgides, Aphidides, Eriosomatides and Phylloxerides. Aphids belong to the insects, more precisely to the Homoptera order and Aphididae family. They are monophagous, sucking biting insects. Aphids are usually soft body, pear-shaped. A single morphological character distinguishes them from other insects is the presence of cornicles. There are the aphids of the cotton (aphid of melon), Aphis gossypii Glover on all cucurbits. It is an aphid-green blackish, about 1 to 2 mm long. The siphunculi and the cauda venenum' as the (the tail) are black in color. There are also the aphids green of the fish, Myzus than (Sulz.) The adult aptere measure 1.5 to 2.6 mm long. It is a matte color olive green or light green, sometimes mixed with yellow. The antennas are as long as the body and the cornicules are green.

The adult wing has the head and thorax black in color. The length of its body is of 2.0 to 2.5 mm. It is a vector of cucumber mosaic and other viruses that can attack the cucurbits. To combat these aphids we used a spray of extracts of Neem, spraying of extracts of tobacco or use of ashes of wood (Bijlmakers and Verhoek, 1995). The aphids were identified with a magnifying glass of 8x and they present the following characteristics: 0.25 mm – 2.5 mm long, dark and light green head, dark and light green chest, yellow-green and light green abdomen.

2.4 Experimental conditions and method

2.4.1 Conditions

The tests have been realized in the months of June to July 2010/2011 in watermelon fields. The geographical area chosen is near the town of Erfoud; named Ziz Oasis Tafilalt in the Southeast Morocco. The area of the watermelon fields ranged from 0.1 to 0.5 hectare. In order to carry out these experiments, it was chosen randomly the plots of 1 m² were taken mutually separated by 10 m for sufficient insulation.

2.4.2 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. In that way, aphids parasitizing fields of 1 m^2 surface were taken immediately after treatment in 25×40 cm^2 clear and white plastic bags for later counting in the laboratory. The mortality percentage is determined by the number of died versus living aphids.

Previous experiments allowed selecting a range of concentrations for the tests. 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 %, 1 % and 5 % oil in pure water). Each watermelon 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 watermelon plants taken in a 1 m^2 surface area has been accomplished by means of a magnifying glass 8x, and this 1, 3, 5, 7 and 11 hours after treatment.

3. Results and Discussion

3.1 Results

The application of different oils and their mixture on aphids causes mortality during the time after treatment as shown in table 1 (page 7). 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 shows that after hours of experience the witness has not exceeded 4 .7% mortality in all tests. We see that at low dose 0.5 % mortality is low. 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 such as Melia volkensii or the effect is observed on two weeks (Diop and Wilps, 1997).

From these results, figures 1, 2 and 3 (pages 8 and 9) depict the mortality observed depending on the time of treatment for each dose (1 % and 5 %) and depending on the concentration after 11 hours of treatment.

Analysis (Bobadilla Álvarez et *al*., 2002) the graphs allows you to see that after an hour of the treatment, for each product employee the mortality rate increases as a function of the concentration but does not exceed 16.96 % to low concentration. These rates are in the order of 10.9% (Neem) to 16.96 % (mixture) for the low concentration and of 27.57% (Neem) to 46.8 % (Thyme) for the higher. In addition, the essential oil of Thyme and the mixture seem the most active in first hour.

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 (an hour) and more particularly in the case of the vegetable oil of the Neem. These rates are in the order of 36.62% (Neem) to 44.64 % (mixture) for the low concentration and of 47.64% (mixture) to 68.54 % (Thyme) for the higher. From these results, the essential oil of Thyme and the mixture seem to be the most active in first hour. Also the Thyme remains active at a high dose but the mixture is not. It is observed that the mortality varies little even at a high dose. It is likely to remain far from the great values of mortalities.

To evaluate more precisely the insecticide activity of these products against aphids, it was calculated the TL_{50} and the TL_{90}, defined as the time causing lethal respectively 50% and 90% of mortality in the population of aphids treated. These values were determined from an experimental curve giving the variations of the percentage of mortality to 1% and 5% depending on the increasing time in the table below. In addition we calculated the CL_{50} and CL_{90} as the lethal concentrations causing 50% and 90% of mortality in the population of aphids treated in table 2 (page 7).

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

After eleven hours of the treatment they reached a mortality of 50% of aphids from the dose 4.75 % of Neem, 2.75% of Thyme, 4% of Oregano and 4.5 % of mixture. It was the mortality of 50% of the time aphids after eleven hours from the concentrations close to 4% of the products whose doses of Thyme and Oregano remain the least high. After eleven hours of the treatment they reached a mortality of 90% of aphids from the 11.25% dose of Neem, 6.75% of Thyme, 9.75% of Oregano and 12.5 % of mixture. It was the mortality of 90% of the time aphids after eleven hours from the concentrations close to 9% of the products whose doses of Thyme and Oregano remain the least high.

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

The mortality of aphids reached 50% for the dose 1% of the product Neem from 12.25 hours and 9.75 hours for the Thyme. Also for the dose 1% of Oregano from 11.75 hours and from 9 hours to the mixture. But for the dose 5% Thyme has less time to reach 50% mortality followed by the Oregano. For the dose 5% we find that the Thyme gives a mortality rate of over 90% from 13 hours and then the Oregano from 18.25 hours. Has a dose of 1% of the product, the mixture reaches 90% of mortality from 19 hours followed by thyme (20.75 hours) and then the Oregano (24 hours) and Neem (24.5 hours).

It can be inferred that the product of Thyme is most deadly of aphids that other products. From 13 hours after treatment allows you to achieve the mortality rate of 90%. At low concentration the mixture remains more lethal as the Thyme but at a high dose becomes the months of deadly products. When we increased the concentration of products the mortality does not vary rapidly as at a low dose. The mortality of aphids of witnesses remains very small when compared with the tests treaties.

3.2 Discussion

It has been observed in all tests a decline in food intake as a function of time. It is likely that the injection of various products of extracts of oils resulted in an extension of the interval between the meals, as well as high concentrations of substances of oils may curb the food activity. Chapman said, the beginning of the taking of food is usually followed by a short period of locomotor activity and immediately after the meal, the insects are without reaction and do not travel much. On the contrary when they are deprived of food, for short periods, it is by the locomotion that they respond to any range of stimuli (Chapman, 1974).

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. The increase in dose makes the oil more deadly against aphids; this can lead to dilution and a modification of the metabolism (Isman, 1999). The salaries of the aphids by the Thyme and Oregano are found the most affected (more than 53% mortality) after eleven hours of processing to high concentration of the product. These two cases in which the concentrations were sufficient to cause the death which has engendered of disturbances in the behavior of the insect. This behavior also calls for a few comments although it is much more complex to identify and under the influence of a large number of factors.

4. Conclusion

The results of our study have allowed to say that the dose 0.5 % of the products applied on aphids does not have much of an impact, this may be due to two reasons: the dose is insufficient and/or these pests are more resistant. For doses greater than 0.5 %, all samples showed an interesting activity on aphids. With time, the extracts of the Thyme and Oregano are the samples the most effective and reaches a mortality rate more than 53 %, for the dose 5 %.

For the blend of oils you can have a complexation between the different compounds which gave a decrease of the insecticide activity by increasing the concentration of oils. This will allow observing the different changes on qualitative and quantitative terms of the oils in order to estimate to what conditions or at what such or such oil could give a satisfactory performance or have an interesting activity. Here, we believe the tests of insecticidal activity of the oils used as a function of time and concentration allows you to see, against all expectations, they retain an activity after a dozen of hours.

The use of insecticides of synthesis is at the origin of many cases of diseases of man and resistance among the insects. In this context, the use of natural molecules of interest (ecological and economic) to the insecticidal properties or repellents, of lesser toxicity in man, is proving to be an alternative approach to the use of insecticides of synthesis. The oils extracted from plants of the insecticidal properties should be more important in the future.

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Table 1. Aphid mortality percentage in terms of time after exposure and oil solution concentration

Concentration (v /v)	Mortality percentage (%)					
	Time (h)	VO Neem	EO Thyme	EO Oregano	Mixture	Control
0.5%	1	10.9 ±1.9	15.4 ±2.04	13.75 ±1.3	16.96 ±1.69	1.32 ±0.2
	3	25.12 ±1.75	22.13 ±2.5	26.11 ±1.78	25.21 ±1.51	2.65 ±0.41
	5	29.76 ±2	28.96 ±3.28	33.88 ±4.33	35.48 ±2.78	3.98 ±0.5
	7	33.19 ±2.09	34.02 ±3.69	35.75 ±4.11	40.06 ±3.57	4.64 ±0.61
	11	36.62 ±2.19	39.08 ±4.1	41.62 ±3.89	44.64 ±4.37	5.3 ±0.82
1%	1	14.89 ±1.66	19.87 ±3.29	16.88 ±1.94	18.98 ±1.85	0.61 ±0.09
	3	23.47 ±1.25	37.34 ±2.49	30.1 ±3.12	34.42 ±3.24	1.22 ±0.12
	5	32.3 ±1.46	41 ±1.78	34.66 ±3.34	43.4 ±2.82	1.83 ±0.26
	7	36.01 ±1.5	43.47 ±2.04	37.75 ±2.66	46.06 ±2.85	2.13 ±0.3
	11	39.73 ±1.54	45.94 ±2.3	40.84 ±1.99	48.79 ±2.89	2.44 ±0.35
5%	1	27.57 ±1.46	46.8 ±3.58	39.3 ±1.85	28.28 ±2.55	0.6 ±0.11
	3	36.88 ±1.18	55.3 ±4.13	46.22 ±2.56	34.64 ±3.38	1.2 ±0.22
	5	43.85 ±2.4	63.24 ±5.27	51.34 ±3.2	40.88 ±2.21	1.8 ±0.34
	7	45.98 ±2.68	65.89 ±4.97	52.48 ±3.27	44.27 ±2.69	2.1 ±0.39
	11	48.12 ±2.97	68.54 ±4.67	53.62 ±3.34	47.64 ±3.18	2.4 ±0.45

Table 2. TL_{50} and TL_{90} for 1% and 5% product concentration LC_{50} and LC_{90} for 11 hours after treatment

	TL_{50}		**TL_{90}**		**LC_{50}**	**LC_{90}**
	1%	**5%**	**1%**	**5%**	**After 11 hours**	**After 11 hours**
Neem	12.25h	9h	24.5h	20.25h	4.75%	11.25%
Thyme	9.75h	6.5h	20.75h	13h	2.75%	6.75%
Oregano	11.75h	7h	24h	18.25h	4%	9.75%
Mixture	9h	9.5h	19h	21h	4.5%	12.5%

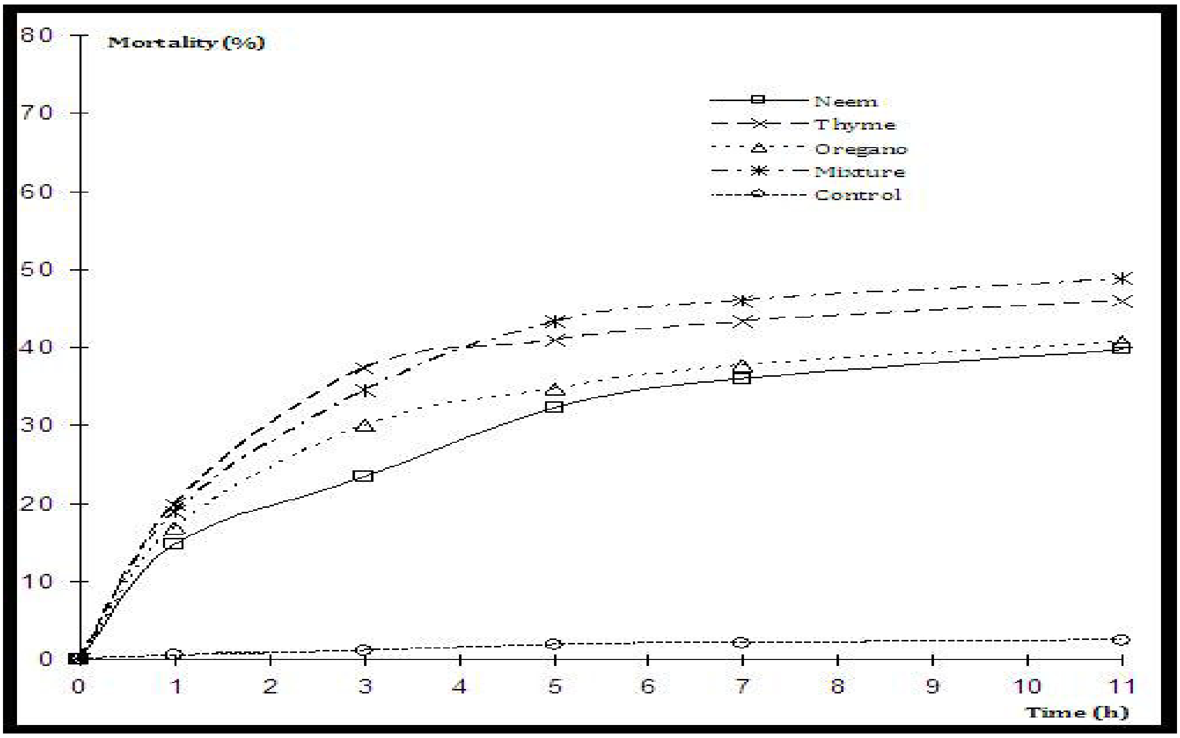

Figure 1. Mortality of aphids in function of time for 1% of product

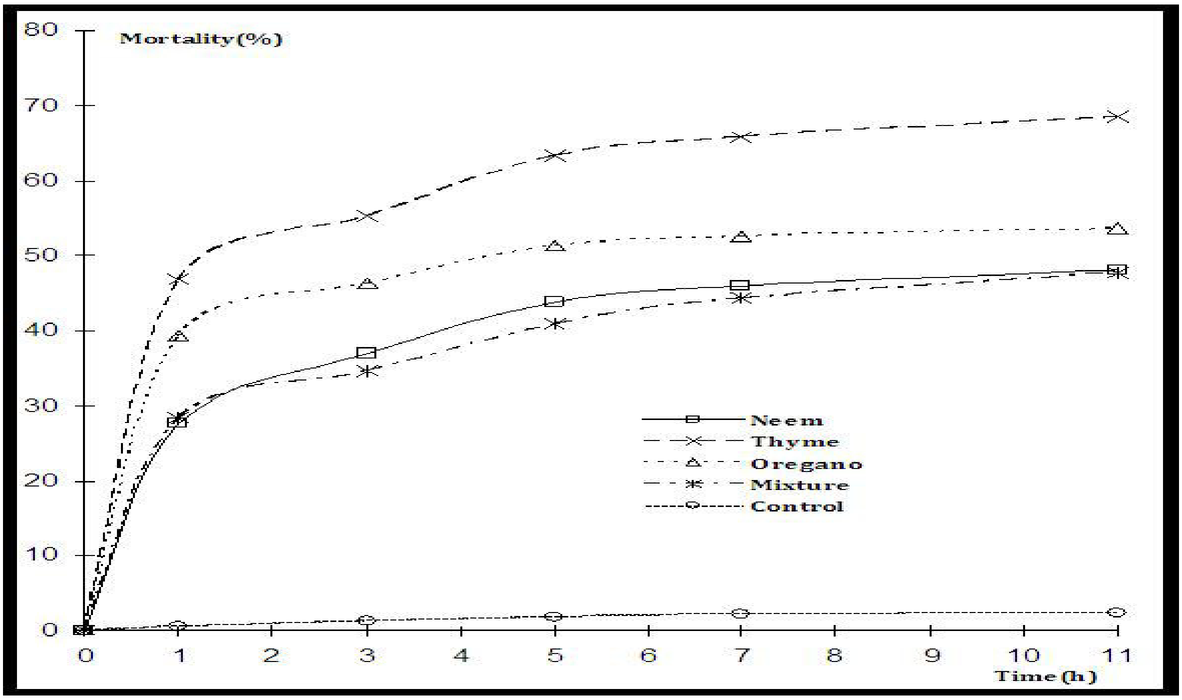

Figure 2. Mortality of aphids in function of time for 5% of product

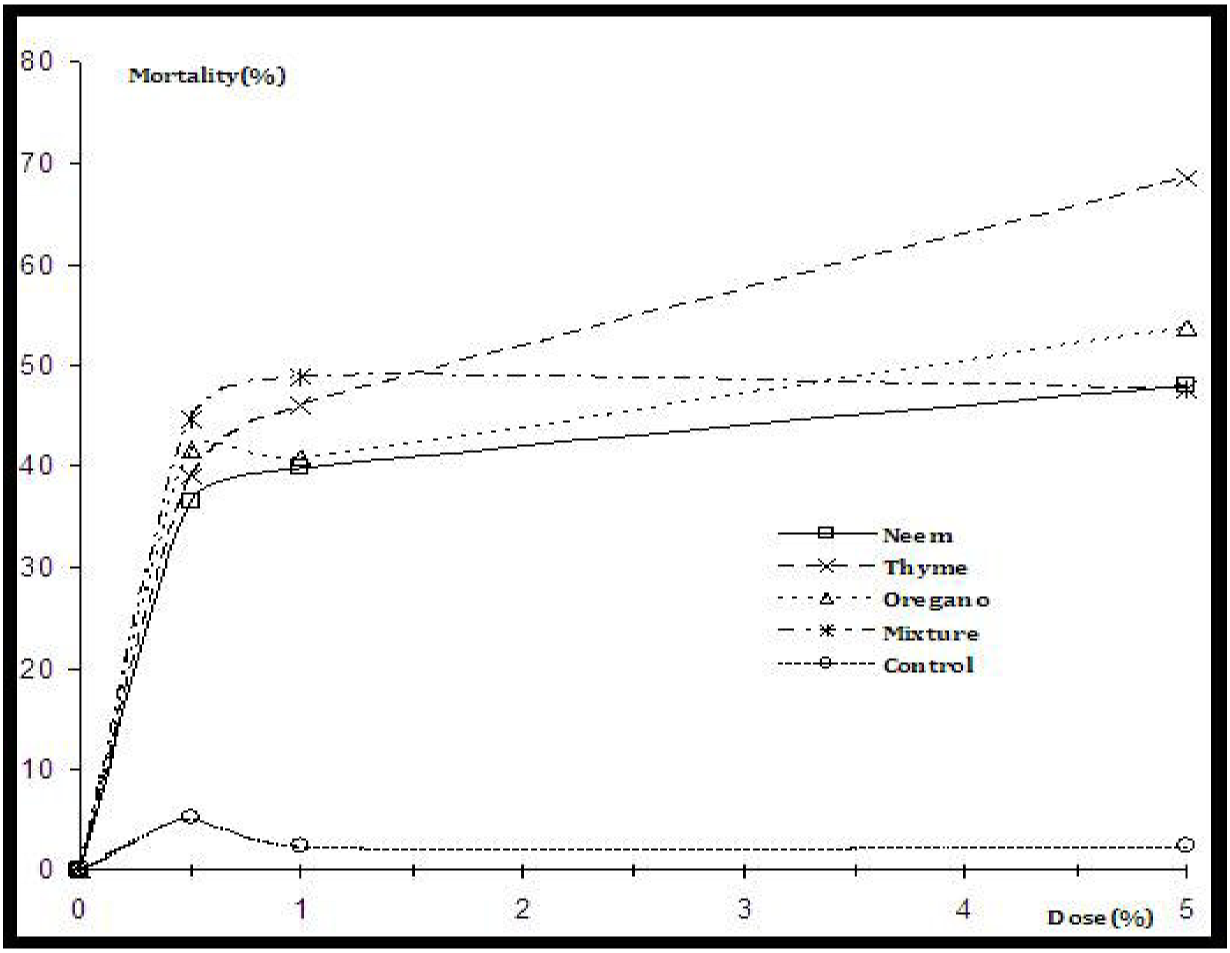

Figure 3. Mortality of aphids depending on the dose of the product after 11 hours