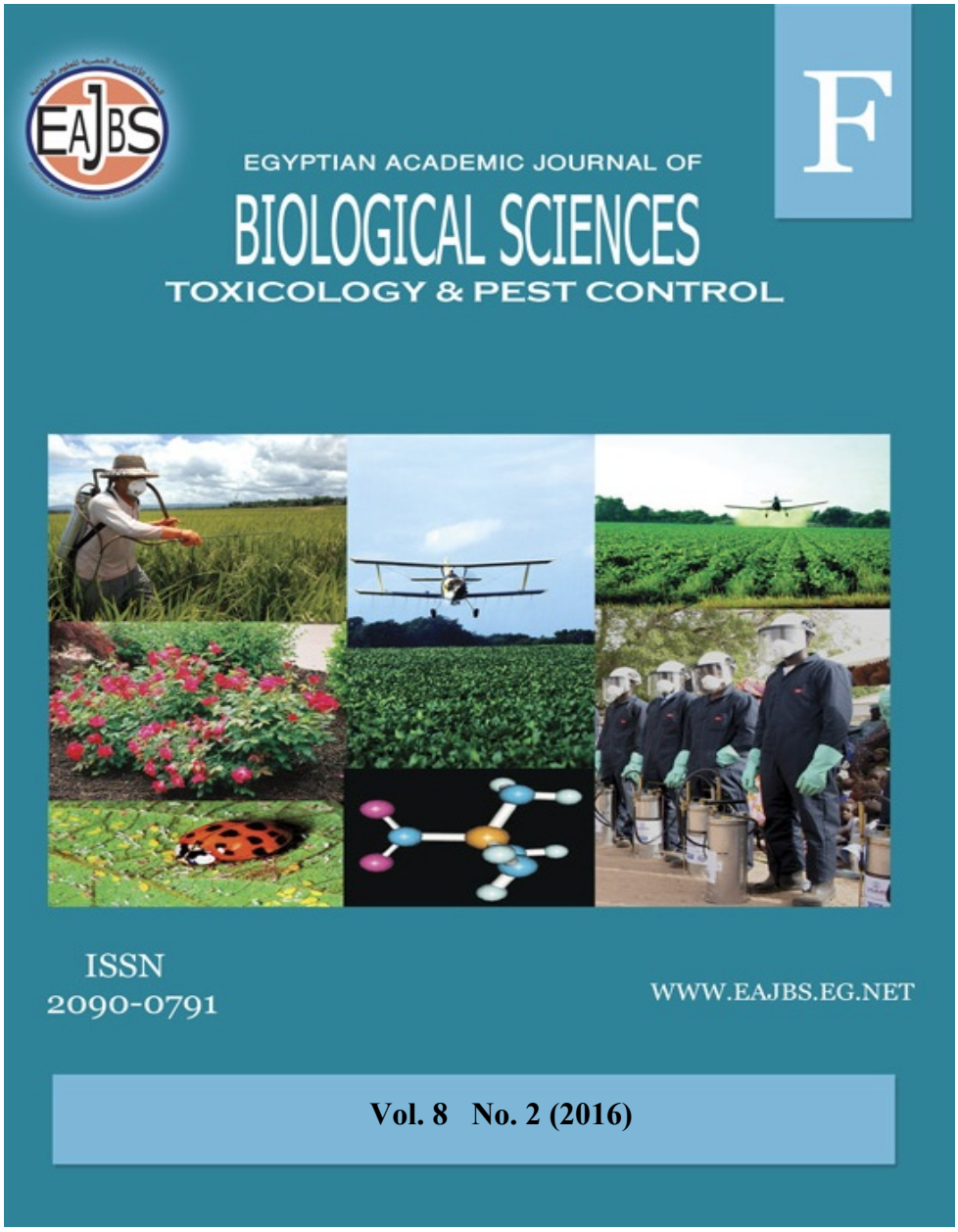

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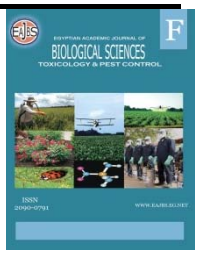

Nano Silica as A promising Nano Pesticide to Control Three Different Aphid Species Under Semi-field Conditions in Egypt

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ABSTRACT

Study the effect of nano silica hydrophilic in comparison with Silica & Lambada as a recommended insecticide against three different economical aphids in Egypt; *Myzus persica*, *Acyrthosiphon pisum* and *Aphis craccivora* (Homoptera: Aphididae) was the aim of this investigation. The study was done throughout the period extended from November, 2015 to February, 2016. The main tested materials was applied as foliar spray on faba beans (*Vicia faba* L.) the greenhouse and after that fed to either winged or wingless aphids. Faba beans leaves were treated with different concentrations of silica, "lambada" 500 ppm, nano-silica hydrophilic; 200, 300, 400 and 500 ppm.

Results proved that mortality rate among tested aphids in any of the treatments were directly correlated with the increase in concentration. Also, wingless or wingless aphids gave 100% mortality for all nano concentrations used seven days post investigation the same result observed with silica alone treatment where Lambada gave rates of mortality in the range (46-66%). Then direct spraying winged and wingless was investigated, Results showed that both winged and wingless had close mortality responses %. Where it recorded 68, 100, 84, 94, 98 and 100 mortality % with winged *Myzus persica*, also mortality % 64, 100, 80, 90, 96, and 98 % with wingless *Myzus persica*. While it was 74, 100, 86, 96, 100 and 100 % with wingless *Acyrthosiphon pisum* and 70, 70, 100, 86, 98, 100 and 98 mortality % with winged *Acyrthosiphon pisum*. The mortality % was 70, 100, 84, 92, 100 and 100 % with winged *Aphis craccivora* and finally mortality % recorded 74, 100, 90, 96, 100 and 100% with wingless *Aphis craccivora* Using silica, lambada, nano-silica hydrophilic 200, 300, 400 and 500 ppm, respectively.

This investigation recommends nano silica hydrophilic at 500 ppm concentration as a promising control method for aphis in Egypt.

INTRODUCTION

Green peach aphid, *Myzus persicae* (Sulzer) (Homoptera: Aphididae) is an extremely polyphagous species which has been reported to feed on more than 500 species of host plants from 40 plant families including several agriculturally important crops under field as well as in greenhouse conditions (Blackman and Eastop, 2007), *Aphis craccivora* Koch is the most important insect pest of cowpea and also causes significant yield losses in other legume crops including alfalfa, beans, chickpea, lentils, lupine and peanuts (Annan *et al*., 2000).

The pea aphid, *Acyrthosiphon pisum* (Harris) is one of the most common insect pests found in pea, lentil, clovers, and alfalfa (Homan *et al*., 1991). In addition to direct losses caused by sucking the vital cell sap from the plant-parts by both nymphs and adults, the aphid is capable of transmitting more than 150 viral diseases in different hosts particularly in Solanaceous vegetables (Cloyd and Sadof, 1998; Basagli, *et al*., 2003 & Leiderer and Dekorsy, 2008).

Nanotechnology is a promising field of research of pesticides and pest control (Bhattacharyya *et al*., 2010; Matsumoto *et al*., 2009; Harper 2010; Gojova *et al,*. 2007 and Pan *et al.,* 2009).

Nanoparticles possess properties associated with their atomic strength (Roy 2009 and Ulrich *et al.,* 2005). Nano-silica, a type of unique nonmaterial, is prepared from silica. It has many applications in medicine and drug development as catalyst and most importantly is that it can be used as nano-pesticide. Barik *et al*. (2008) reviewed the use of nano-silica as nano-pesticide. The mechanism of control of insect pest using nano-silica is based on the fact that insect pests used a variety of cuticular lipids for protecting their water barrier and thereby prevent death from desiccation. But nano-silica gets absorbed into the cuticular lipids by physiosorption and thereby causes death of insects purely by physical means when applied on leaves and stem surface. Surface charged modified hydrophobic nano-silica (3–5 nm) could be successfully used to control a range of agricultural insect pests (Ulrichs *et al.* 2005). For example, assessing the insecticidal activities of Ag and Ag-Zn nanoparticles on the *Aphis nerii* (Rouhani *et al.,* 2011). In the recent years, nano particles have received much attention for controlling pathogens in agriculture (Guan *et al*., 2008; Sang Woo *et al*., 2009 and Eleka *et al*., 2010).

Therefore, the present study was conducted to through light on nano silica hydrophilic and its role in Aphid control compared with recommended chemical insecticide (imidacloprid).

MATERIALS AND METHODS

Maintenance of aphid's cultures:

Seedlings of faba bean plants were used as a host plant for rearing and maintaining stock cultures of the cowpea aphid, *Aphis craccivora* Koch, Pea aphid *Acyrthosiphon pisum* (Harris) and *Myzus persicae* (Sulzer). To start the culture, apterous adult individuals (mothers), collected from the field, were transferred separately on discs of filter paper inside clean Petri- dishes till viviparity (Gavkare & Gupta 20 13; Bosland & Ellington, 1996, and Gorham, 1942). The newly borne progeny were transferred, using a camel's hair brush to healthy plants, grown in plastic pots. Each pot was enclosed in a cylindrical glass cage covered with muslin. Aphid cultures were kept under greenhouse conditions (Fig. 1).

Indirect application (Foliar) application of tested compounds:

Faba bean plants were grown in the greenhouse in (15 cm diameter) plastic pots the 1st of December. Seedling height attained 15 cm and had about 5-7 leaves, were sprayed with the 4 different concentrations (200, 300, 400 & 500 ppm) of the 3 tested compounds (nano-silica, silica Treatments of foliar spray included different concentrations of nano silica in comparison with silica. Negative control plants were sprayed with distilled water, three replicates plus control were carried out and each replicate contained five plants. The plants received a second spray one week after the first one. The positive control was sprayed with the pesticide "Lambada" at the recommended dose.

Bioassay

Leaves from each foliage treatment were offered to 10 winged *M. persicae*, *A. pisum* or *A. craccivora* and other leaves for wingless individuals in ten replicates, five winged or wingless in each replicate. They were observed for mortality rate and survived individuals after treatments were maintained at 25±1°C, 70±10% RH and 12h photo phase until death. Four different concentrations (200, 300, 400 & 500 ppm) of nano silica hydrophilic, (supplied by Nano Tech, Egypt), silica, "Lambada" and distilled water were applied as positive and negative controls, respectively.

Statistical analyses:

Data were submitted to ANOVA, and the means were compared by the means-grouping test of Scott and Knott (1974) at $P < 0.05$.

RESULTS AND DISCUSSION

Mortality response of different aphid species indirect application (Foliar application) of tested compounds:

In this investigation two successive steps were followed to evaluate four different concentrations of nano silica hydrophilic in comparison with silica and "Lambada" pesticide to control three aphid species (*Myzus persicae*, *Acyrthosiphum pisum* and *Aphis craccivora*). The first step; was conducted to evaluate the indirect effect of spraying the tested materials on host plants then introducing them to the aphid species and doing the bioassay. The second step; was carried out to evaluate the direct spraying of tested aphid species themselves. At the first step both winged and wingless aphid forms were investigated for their response toward host plants treated with tested materials. Obtained results showed that; *Myzus persica*e. Winged *Myzus persica*e gave 0.00 ± 0.0, 4.00 ± 1.3, 18.00 ±1.1, 44.00 ± 2.1, 62.00 ± 1.7, 72.00 ± 1.1 and 98.00 ± 0.9 mortality % with Silica treatment; 78 ± 0.2, 64.00 ± 1.3, 50.00 ± 2.1,50.00 ± 1.2, 60.00 ± 1.3, 62.00 ± 0.7 and 66.00 ± 0.8 mortality % with "Lambada" pesticides; 8.00 ± 0.1, 22.00 ± 0.3, 28.00 ± 0.3, 60.00 ± 0.7, 84.00 ± 1.4, 96.00 ± 0.0 and 100.00 ± 0.0 mortality % with 200 ppm nano silica hydrophilic treatment; 14.00 ± 0.7, 30.00 ± 0.7, 38.00 ± 2.1, 60.00 ± 0.3, 78.00 ±1.1, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 300 ppm nano silica hydrophilic, 26.00 ± 1.1, 34.00 ± 1.1, 48.00 ± 0.3, 76.00 ± 0.9, 92.00 ± 2.1, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 400 ppm nano silica hydrophilic and finally mortality percentage gave 50.00 ± 1.1, 56.00 ± 1.1, 88.00 ± 1.1, 100.00 ± 0.0, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm silica hydrophilic determined at one , two, three, four, five, six and seven days of continuous feeding on treated host (Table1).

Wingless *Myzus persicae*: Results showed higher mortality percentages where it gave 8.00 ± 0.7, 20.00 ± 1.3,28.00 ± 1.2, 40.00 ± 0.7, 68.00 ± 0.7, 96.00 ± 0.7 and 94.00 ± 2.1 mortality % with silica treatment, 66.00 ± 0.7, 44.00 ± 1.3, 62.00 ± 0.8, 66.00 ± 0.7, 66.00 ± 0.7, 68.00 ± 0.7 and 66.00 ± 1.3 mortality % with Lambada treatment, 12.00 ± 2.1, 34.00 ±1.3, 48.00 ± 1.3, 64.00 ± 0.8, 64.00 ± 2.1, 74.00 ± 1.3, and 100.00 ± 0.0 mortality % with 200 ppm nanosilica hydrophilic treatment, 22.00 ± 0.8, 38.00 ±0.9, 58.00 ± 2.1, 88.00 ±0.8, 76.00 ± 0.9, 100.00 ± 0.0 and 100.00 ± 0.0 with 300

Direct application of tested compounds:

The same previous treatments were applied on both winged and wingless forms of tested aphid species in ten replicates, five aphids, each. Agar Petri dish plates of 5 cm diameter were poured with 5% agar concentration (Fig. 2). Each plate when reached room temperature was provided with one leaf and five insects were gently transferred on it then two hours later was sprayed directly with the same above mentioned treatments (Alan, 2012).

ppm nano silica hydrophilic treatment, 30.00 ± 0.8, 50.00 ± 1.3, 56.00 ± 2.1, 70.00 ± 0.7, 72.00 ± 1.3, 100.00 ± 0.0 and 100.00 ± 0.0 with 400 nano silica hydrophilic treatment and finally it gave 70.00 ± 1.1, 78.00 ± 2.1, 96.00 ± 0.8, 100.00 ± 0.0, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic one , two, three, four, five, six and seven days of continuous feeding on treated host (Table 2).

Table 1: Rates and mortality percentages among winged *Myzus persica* tested with faba bean leaves previously treated with different four hydrophilic nano-silica concentrations.

Days of continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 * (0/50)	0.00 ± 0.0 (0/50)	78.00 ± 0.2 (39/50)	8.00 ± 0.1 (4/50)	14.00 ± 0.7 (7/50)	26.00 ± 1.1 (13/50)	50.00 ± 1.1 (25/50)
2nd	0.00 ± 0.0 (0/50)	4.00 ± 1.3 (2/50)	64.00 ± 0.6 (32/50)	22.00 ± 0.3 (11/50)	30.00 ± 0.7 (15/50)	34.00 ± 1.1 (17/50)	56.00 ± 1.1 (28/50)
3rd	0.00 ± 0.0 (0/50)	18.00 ± 1.1 (9/50)	50.00 ± 2.1 (25/50)	28.00 ± 0.3 (14/50)	38.00 ± 2.1 (19/50)	48.00± 0.3 (24/50)	88.00 ± 1.1 (44/50)
4th	0.00 ± 0.0 (0/50)	44.00 ± 2.1 (22/50)	50.00 ± 1.2 (25/50)	60.00 ± 0.7 (30/50)	60.00 ± 0.3 (30/50)	76.00 ± 0.9 (38/50)	100.00 ± 0.0 (50/50)
5th	0.00 ± 0.0 (0/50)	62.00 ± 1.7 (31/50)	60.00 ± 1.3 (30/50)	84.00 ± 1.4 (42/50)	78.00 ± 1.1 (39/50)	92.00 ± 2.1 (46/50)	100.00 ± 0.0 (50/50)
6th	0.00 ± 0.0 (0/50)	72.00 ± 1.1 (36/50)	62.00 ± 0.7 (31/50)	96.00 ± 0.0 (48/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.0 (0/50)	98.00 ± 0.9 (49/50)	66.00 ± 0.8 (33/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets are (Number of dead winged aphid/ total number of tested individuals).

Table 2: Rates and mortality percentages among wingless *Myzus persicae* tested with faba bean leaves previously treated with four different hydrophilic nano-silica concentrations.

Days of Continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	8.00 ± 0.7 (4/50)	66.00 ± 0.7 (33/50)	12.00± 2.1 (6/50)	22.00± 0.8 (11/50)	30.00± 0.8 (15/50)	70.00± 1.1 (35/50)
2nd	2.00 (1/50)	20.00 ± 1.3 (10/50)	44.00± 1.3 (22/50)	34.00± 1.3 (17/50)	38.00± 0.9 (19/50)	50.00± 1.3 (25/50)	78.00± 2.1 (39/50)
3rd	0.00 ± 0.0 (0/50)	28.00 (14/50)	62.00± 0.8 (31/50)	48.00± 1.3 (24/50)	58.00± 2.1 (29/50)	56.00± 2.1 (28/50)	96.00± 0.8 (48/50)
4th	0.00 ± 0.0 (0/50)	40.00 ± 0.7 (20/50)	66.00 ± 0.7 (33/50)	64.00± 0.8 (32/50)	88.00± 0.8 (44/50)	70.00 ± 0.7 (35/50)	100.00 ± 0.0 (50/50)
5th	0.00 ± 0.0 (0/50)	68.00 ± 0.7 (34/50)	66.00 ± 0.7 (33/50)	64.00± 2.1 (34/50)	76.00± 0.9 (38/50)	72.00 ± 1.3 (36/50)	100.00 ± 0.0 (50/50)
6th	0.00 ± 0.0 (0/50)	96.00± 0.7 (48/50)	68.00 ± 0.7 (34/50)	74.00± 1.3 (37/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.0 (0/50)	94.00± 2.1 (47/50)	66.00± 1.3 (33/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.0 ± 0.00 (50/50)	100.00 ± 0.0 (50/50)

* Between brackets (Number of dead wingless aphid/ total number of tested individuals)

Acyrthosiphon pisum: *Acyrthosiphon pisum* winged: The same trend was obtained with *Acyrthosiphon pisum* where winged form showed higher responses in all treatments, where it gave 4.00 ± 0.9, 18.00 ± 0.4, 38.00 ± 0.7, 50.00 ± 0.6, 58.00 ± 0.0, 74.00 ± 1.0 and 96.00 ± 1.2 mortality % with silica treatment; 44.00 ± 1.2, 50.00 ± 0.0, 44.00 ± 1.2, 46.00 ± 0.0, 42.00 ± 1.2, 38.00 ± 1.7 and 64.00 ± 0.0 mortality % with "Lambada" pesticide treatment; 4.00 ± 0.3, 20.00 ± 0.0, 46.00 ± 1.7, 54.00 ± 1.2, 64.00 ± 0.5, 84.00 ± 1.2 and 100.00 ± 0.0 mortality % with 200 ppm nano silica hydrophilic treatment; 12.00 ± 1.7, 34.00 ± 0.4, 60.00 ± 0.6, 80.00 ± 0.8, 82.00 ± 1.7, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 300 ppm nano silica hydrophilic treatment; 26.00 ± 0.9, 36.00 ± 0.2, 76.00 ± 1.0, 96.00 ± 0.4, 100.00 ± 0.3, 100.00 ± 0.7 and 100.00 ± 0.0 mortality % with 400 ppm nano silica hydrophilic treatment. Finally it gave 36.00 ± 2.0, 44.00 ± 0.9, 78.00 ± 0.8, 94.00 ± 1.7, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic treatment determined at one, two, three, four, five, six and seven days of continuous feeding on treated host (Table3).

Table 3: Rates and mortality percentages among winged *Acyrthosiphon pisum* tested with faba bean leaves previously treated with four different hydrophilic nano-silica concentrations.

Days of continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	4.00 ± 0.9 (2/50)	44.00 ± 1.2 (22/50)	4.00 ± 0.3 (2/50)	12.00 ± 1.7 (6/50)	26.00 ± 0.9 (13/50)	36.00 ± 2.0 (18/50)
2nd	2.00 ± 1.0 (1/50)	18.00 ± 0.4 (9/50)	50.00 ± 0.0 (25/50)	20.00 ± 0.0 (10/50)	34.00 ± 0.4 (17/50)	36.00 ± 0.2 (18/50)	44.00 ± 0.9 (22/50)
3rd	0.00 ± 0.0 (0/50)	38.00 ± 0.7 (19/50)	44.00 ± 1.2 (22/50)	46.00 ± 1.7 (23/50)	60.00 ± 0.6 (30/50)	76.00 ± 1.0 (38/50)	78.00 ± 0.8 (39/50)
4th	0.00 ± 0.0 (0/50)	50.00 ± 0.6 (25/50)	46.00 ± 0.0 (23/50)	54.00 ± 1.2 (27/50)	80.00 ± 0.8 (40/50)	96.00 ± 0.4 (47/50)	94.00 ± 1.7 (47/50)
5th	0.00 ± 0.1 (0/50)	58.00 ± 0.0 (29/50)	42.00 ± 1.2 (21/50)	64.00 ± 0.5 (32/50)	82.00 ± 1.7 (41/50)	100.00 ± 0.3 (50/50)	100.00 ± 0.0 (50/50)
6th	0.00 ± 0.0 (0/50)	74.00 ±1.0 (37/50)	38.00 ± 1.7 (19/50)	84.00 ± 1.2 (42/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.7 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.1 (0/50)	96.00 ± 1.2 (47/50)	64.00 ± 0.0 (32/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead winged aphid/ total number of tested individuals)

***Acyrthosiphon pisum* Wingless form:** Results of response gave 20.00 ± 2.3, 32.00 ± 1.4, 50.00 ± 1.1, 68.00 ± 1.7, 76.00 ± 1.4, 86.00 ± 1.5 and 100.00 ± 0.0 mortality % with silica treatment; 62.00 ± 1.7, 58.00 ± 2.1, 54.00 ± 1.8, 44.00 ± 1.9, 42.00 ± 0.7, 42.00 ± 1.3 and 46.00 ± 1.3 mortality % with "Lambada" pesticide treatment; 20.00 ± 1.1 , 44.00 ± 1.2, 54.00 ± 1.8, 78.00 ± 1.00, 86.00 ± 1.1, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 200 nano silica hydrophilic treatment, 24.00 ± 0.8, 58.00 ± 0.9, 74.00 ± 2.3, 92.00 ± 1.4, 96.00 ± 1.3, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 300 ppm nano silica hydrophilic. Mortality % increased to 48.00 ± 0.7, 66.00 ± 1.3, 86.00 ± 1.3, 98.00 ± 1.3, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 400 ppm nano silica hydrophilic treatment, finally mortality % gave 54.00 ± 1.3, 74.00 ± 2.1, 72.00 ± 1.3, 100.00 ± 0.0, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % were obtained with 500 ppm nano silica hydrophilic treatment determined at one , two, three, four, five, six and seven days of continuous feeding on treated host (Table 4).

Table 4: Rates and mortality percentages among wingless Acyrthosiphon *pisum* tested with faba bean leaves previously treated with four different hydrophilic nano-silica concentrations.

Days of continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	2.00 ± 1.4 (1/50)	20.00 ± 2.3 (10/50)	62.00 ± 1.7 (31/50)	20.00 ± 1.1 (10/50)	24.00 ± 0.8 (12/50)	48.00 ± 0.7 (24/50)	54.00 ± 1.3 (27/50)
2nd	0.00 ± 0.0 (0/50)	32.00 ± 1.4 (16/50)	58.00 ± 2.1 (29/50)	44.00 ± 1.2 (22/50)	58.00 ± 0.9 (29/50)	66.00 ± 1.3 (33/50)	74.00 ± 2.1 (37/50)
3rd	0.00 ± 0.0 (0/50)	50.00 ± 1.1 (25/50)	54.00 ± 1.8 (27/50)	54.00 ± 1.7 (27/50)	74.00 ± 2.3 (37/50)	86.00 ± 1.3 (43/50)	72.00 ± 1.3 (36/50)
4th	0.00 ± 0.0 (0/50)	68.00 ± 1.7 (34/50)	44.00 ± 1.9 (22/50)	78.00 ± 1.00 (39/50)	92.00 ± 1.4 (46/50)	98.0 ± 1.30 (49/50)	100.00 ± 0.0 (50/50)
5th	0.00 ± 0.0 (0/50)	76.00 ± 1.4 (38/50)	42.00 ± 0.7 (21/50)	86.00 ± 1.1 (43/50)	96.00 ± 1.3 (48/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
6th	0.00 (0/50)	86.00 ± 1.5 (43/50)	42.00 ± 1.3 (22/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.0 (0/50)	100.00 ± 0.0 (50/50)	46.00 ± 1.3 (23/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead wingless aphid/ total number of tested individuals)

Aphis craccivora

Winged forms of *Aphis craccivora* gave 4.00 ± 0.7 , 8.00 ± 0.5, 28.00 ± 1.0, 50.00 ± 0.8, 76.00 ± 0.4, 72.00 ± 0.8 and 98.00 ± 0.9 mortality % with silica treatment; 44.00 ± 0.3, 48.00 ± 0.4, 52.00 ± 0.9, 78.00 ± 1.0, 66.00 ± 1.0 , 66.00 ± 1.0 and 62.00 ± 0.8 mortality % with "Lambada" pesticide treatment; 22.00 ± 0.7 , 28.00 ± 0.6, 52.00 ± 0.3, 78.00 ± 0.9, 84.00 ± 1.0,100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 200 ppm nano silica hydrophilic treatment; 32.00 ± 0.6, 46.00 ± 0.8, 76.00 ± 0.2, 88.00 ± 1.2, 96.00 ± 0.4 , 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 300 ppm nano silica hydrophilic treatment; 52.00 ± 0.2, 64.00 ± 0.1, 86.00 ± 0.1, 96.00 ± 0.4, 100.00 ± 0.0 , 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 400 ppm nano silica hydrophilic treatment and finally it gave 70.00 ± 0.6, 80.00 ± 0.7, 100.00 ± 0.0 , 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic treatment determined at one , two, three, four, five, six and seven days of continuous feeding on treated host (Table 5).

Wingless *Aphis craccivora*; assured previous theory of higher response that wingless aphids showed in all treatments compared to winged forms. Wingless aphids gave 12.00 ± 0.3, 20.00 ± 0.7, 46.00 ± 0.5, 70.00 ± 0.8, 72.00 ± 1.0, 76.00 ± 0.9 and 100.00 ± 0.0 mortality % with silica treatment; 52.00 ± 0.9, 58.00 ± 2.0, 56.00 ± 0.7, 62.00 ± 0.7, 44.00 ± 0.7, 48.00 ± 0.3 and 54.00 ± 2.1 with "Lambda" pesticides with 200 ppm nano silica hydrophilic treatment; it gave 28.00 ± 0.1, 40.00 ±0.4, 62.00 ±0.8, 78.00 ±1.0 , 90.00 ±1.0, 100.00 ±1.0 and 100.00 ±0.0 mortality % and 56.00 ± 0.1 , 64.00 ± 0.7, 96.00 ± 0.4 98.00 ± 0.2, 100.00 ±0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 300 ppm nano silica hydrophilic treatment, 64.00 ± 0.2, 84.00 ± 2.0, 96.00 ± 1.2, 98.00 ± 0.4, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 400 ppm nano silica hydrophilic treatment and finally it gave 90.00 ± 0.7 , 100.00 ± 0.0 , 100.00 ± 0.0, 100.00 ± 0.0, 100.00 ± 0.0, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic treatment determined at one , two, three, four, five, six and seven days of continuous feeding on treated host (Table 6).

Table 5: Rates and mortality percentages among winged *Aphis craccivora* tested with faba bean leaves previously treated with four different hydrophilic nano-silica concentrations.

Days of continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	4.00 ± 0.7 (2/50)	44.00 ± 0.3 (22/50)	22.00 ± 0.7 (11/50)	32.00 ± 0.6 (16/50)	52.00 ± 0.2 (26/50)	70.00 ± 0.6 (35/50)
2nd	0.00 ± 0.0 (0/50)	8.00 ± 0.5 (4/50)	48.00 ± 0.4 (24/50)	28.00 ± 0.6 (14/50)	46.00 ± 0.8 (23/50)	64.00 ± 0.1 (32/50)	86.00 ± 0.7 (43/50)
3rd	0.00 ± 0.0 (0/50)	28.00 ± 1.0 (14/50)	52.00 ± 0.9 (26/50)	52.00 ± 0.3 (26/50)	76.00 ± 2.0 (38/50)	86.00 ± 0.1 (43/50)	100.00 ± 0.0 (50/50)
4th	0.00 ± 0.0 (0/50)	50.00 ± 0.8 (25/50)	78.00 ± 1.0 (39/50)	78.00 ± 0.9 (39/50)	88.00 ± 1.2 (44/50)	96.00 ± 0.4 (48/50)	100.00 ± 0.0 (50/50)
5th	0.00 ± 0.0 (0/50)	76.00 ± 0.4 (38/50)	66.00 ± 1.0 (33/50)	84.00 ± 1.0 (42/50)	96.00 ± 1.0 (48/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
6th	0.00 ± 0.0 (0/50)	72.00 ± 0.8 (36/50)	66.00 ± 1.0 (33/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.0 (0/50)	98.00 ± 0.9 (49/50)	62.00 ± 0.8 (31/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead winged aphid/ total number of tested individuals)

Table 6: Rates and mortality percentages among wingless *Aphis craccivora* tested with faba bean leaves previously treated with four different hydrophilic nano-silica concentrations.

Days of continuous feeding on treated host	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	12.00 ± 0.3 (6/50)	52.00 ± 0.9 (27/50)	28.00 ± 0.1 (14/50)	56.00 ± 0.1 (28/50)	64.00 ± 0.2 (32/50)	90.00 ± 0.7 (45/50)
2nd	0.00 ± 0.0 (0/50)	20.00 ± 0.7 (10/50)	58.00 ± 2.0 (29/50)	40.00 ± 0.4 (20/50)	64.00 ± 0.7 (32/50)	84.00 ± 2.0 (42/50)	100.00 ± 0.0 (50/50)
3rd	0.00 ± 0.0 (0/50)	46.00 ± 0.5 (23/50)	56.00 ± 0.7 (28/50)	62.00 ± 0.8 (32/50)	96.00 ± 0.4 (48/50)	96.00 ± 1.2 (48/50)	100.00 ± 0.0 (50/50)
4th	0.00 ± 0.0 (0/50)	70.00 ± 0.8 (35/50)	62.00 ± 0.7 (31/50)	78.00 ± 1.0 (39/50)	98.00 ± 0.2 (49/50)	98.00 ± 0.4 (49/50)	100.00 ± 0.0 (50/50)
5th	0.00 ± 0.0 (0/50))	72.00 ± 1.0 (36/50)	44.00 ± 0.7 (22/50)	90.00 ± 1.0 (45/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
6th	0.00 ± 0.0 (0/50))	76.00 ± 0.9 (38/50)	48.00 ± 0.3 (24/50)	100.00 ± 1.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)
7th	0.00 ± 0.0 (0/50)	100.00 ± 0.0 (50/50)	54.00 ± 2.1 (27/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead wingless aphid/ total number of tested individuals)

By the end of the first step, it could be concluded from the above mentioned results that, wingless aphids more sensitive than winged ones Fig. (3), this result agrees in general with several authors concerned with aphid control (Rouhani *et al.*, 2011) as far as almost all aphid species that infest their host plant are wingless it gives us notice that previous treatment might be a permissive method to control aphids in general. Systemic pesticides have high mortality percentage as it is very will referenced (Assemi *et al*., 2014)., but it is fixed as it shown in previous tables (1,2,3,4,5 and 6 and (Fig. 3) while it increases in case of either silica and nano silica treatments. Finally it could be concluded that silica had moderately control effect against tested aphid species this result goes in line with (Rouhani *et al.*, 2012 & Nitai *et al*., 2010 & Lee, *et al*., 2005) who found that silica accumulates intracellular in plants and prevent sucking.

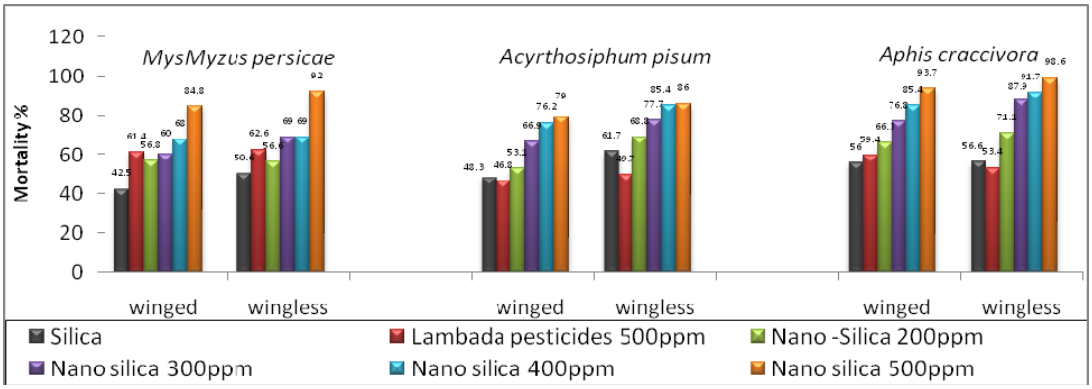

Fig. 3: Mortality percentages among three aphid species either winged or wingless tested with faba bean leaves previously treated with different four hydrophilic nano-silica concentrations since seeding.

Direct spraying of tested aphid species

The second step was designed to evaluate the direct spraying to winged and wingless aphid forms. The natural behavior of aphids that it accumulates on the top of plants on it's newly emerged leaves made this step logic and very near to what happens in nature that we apply the treatments to host plants covered and infested with both winged and wingless forms. All treatments resulted in 100 % mortality at the fourth day post

application that is why we stopped taking the data in the third day.

***Myzus persicae* wingless** forms gave 30.00 ± 0.0, 46.00 ± 1.1, 68.00 ± 1.2 mortality % with silica; 100.00 ± 0.7, 100.00 ± 0.5 and 100.00 ± 1.1 % with "Lambada" pesticide treatment; 42.00 ± 0.8, 56.00 ±0.9, 84.00 ± 0.9 mortality % with 200 ppm nano silica hydrophilic treatment, 62.00 ± 0.2, 74.00 ± 0.8, 94.00 ± 1.1 mortality % with 300 ppm nano silica hydrophilic treatment; 74.00 ± 0.2, 84.00 ± 0.5 and 98.00 ± 0.4 mortality % with 400 ppm nano silica hydrophilic treatment and finally 88.00 ± 0.9, 96.00 ± 0.4 and 100.00 ± 0.7 mortality % with 500 ppm nano silica hydrophilic treatment determined at one , two and three days post application (Table 7).

Table 7: Rates and mortality percentages among *Myzus persica* wingless tested with nano-silica after daily up to the 7th day post emergence using direct spraying.

Days post application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	2.00 ± 0.0 (1/50)	30.00 ± 0.0 (15/50)	100.00 ± 0.7 (50/50)	42.00 ± 0.8 (21/50)	62.00 ± 0.2 (31/50)	74.00 ± 0.2 (37/50)	88.00 ± 0.9 (44/50)
2nd	4.00 ± 0.0 (2/50)	46.00 ± 1.1 (23/50)	100.00 ± 0.5 (50/50)	56.00 ± 0.9 (28/50)	74.00 ± 0.8 (37/50)	84.00 ± 0.5 (42/50)	96.00 ± 0.4 (48/50)
3rd	2.00 ± 0.0 (1/50)	68.00 ± 1.2 (34/50)	100.00 ± 1.1 (50/50)	84.00 ± 0.9 (42/50)	94.00 ± 1.1 (47/50)	98.00 ± 0.4 (49/50)	100.00 ± 0.7 (50/50)

*Between brackets (Number of dead wingless aphid/ total number of tested individuals)

On the other hand, *Myzus persicae* winged gave rates of mortality similar to all other treatments where it gave 24.00 ± 0.7 , 34.00 ± 0.8, 64.00 ± 0.7 with silica treatment; 96.00 ± 1.1, 100.00 ± 1.2 and 100.00 ± 0.8 mortality % with "Lambada" pesticide treatment, 46.00 ± 2.1, 60.00 ± 1.3 and 80.00 ± 0.9 mortality % with 200 ppm nano silica hydrophilic treatment, 52.00 ± 0.7, 72.00 ± 0.7 and 90.00 ± 1.1 mortality % with 300 ppm nano silica hydrophilic treatment; 58.00 ± 0.7, 74.00 ± 0.5 and 96.00 ± 0.7 mortality % with 400 ppm nano silica hydrophilic treatment and finally 80.00 ± 1.0, 88.00 ± 1.1 and 98.00 ± 98.00 mortality % with 500 ppm nano silica hydrophilic treatment determined at one, two and three days post application (Table 8) & Fig. (4).

Table 8: Rates and mortality percentages among *Myzus persica* winged tested with nano-silica after daily up to the 7th day post emergence using direct spraying.

Days post Application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	24.00 ± 0.7 (12/50)	96.00 ± 1.1 (48/50)	46.00± 2.1 (23/50)	52.00± 0.7 (26/50)	58.00± 0.7 (29/50)	80.00± 1.0 (40/50)
2nd	2.00± 0.0 (1/50)	34.00 ± 0.8 (17/50)	100.00± 1.2 (50/50)	60.00± 1.3 (30/50)	72.00± 0.7 (36/50)	74.00± 0.5 (37/50)	88.00± 1.1 (44/50)
3rd	4.00 ± 0.0 (2/50)	64.00 ± 0.7 (32/50)	100.00± 0.8 (50/50)	80.00± 0.9 (40/50)	90.00± 1.1 (45/50)	96.00± 0.7 (48/50)	98.00± 1.1 (49/50)

*Between brackets (Number of dead winged aphid/ total number of tested individuals)

***Acyrthosiphon pisum* wingless** response recorded 42.00 ± 1.1, 56.00 ± 1.1 and 74.00 ± 1.2 mortality % with silica treatment; 100.00 ± 1.2, 100.00 ± 1.1 and 100.00 ± 1.3 mortality % with "Lambada" pesticide treatment; 62.00 ± 1.2 , 70.00 ± 0.9 and 86.00 ± 0.8 mortality % with 200 ppm nano silica hydrophilic treatment; 76.00 ± 0.7, 82.00 ± 0.6 and 96.00 ± 1.1 mortality % with 300 ppm nano silica hydrophilic treatment; 94.00 ± 0.7 , 98.00 ± 0.8 and 100.00 ± 1.1 mortality % with 400 ppm nano silica hydrophilic treatment and

finally; 100.00 ± 0.7, 100.00 ± 0.8 and 100.00 ± 0.7 mortality % with 500 ppm nano silica hydrophilic treatment determined at one, two and three days post application (Table 9).

Table 9: Rates and mortality percentages among *Acyrthosiphon pisum* wingless tested with nano-silica after daily follow up to the 7th day post emergence using direct spraying.

Days post application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	4.00 ± 0.8 (2/50)	42.00 ± 1.1 (21/50)	100.00 ± 1.2 (50/50)	62.00 ± 1.2 (31/50)	76.00 ± 0.7 (38/50)	94.00 ± 0.7 (47/50)	100.00 ± 0.7 (50/50)
2nd	0.00 ± 0.7 (0/50)	56.00 ± 1.1 (28/50)	100.00 ± 1.1 (50/50)	70.00 ± 0.9 (35/50)	82.00 ± 0.6 (41/50)	98.00 ± 0.8 (49/50)	100.00 ± 0.8 (50/50)
3rd	0.00 ± 0.5 (0/50)	74.00 ± 1.2 (37/50)	100.00 ± 1.3 (50/50)	86.00 ± 0.8 (43/50)	96.00 ± 1.1 (48/50)	100.00 ± 1.1 (50/50)	100.00 ± 0.7 (50/50)

*Between brackets (Number of dead wingless aphid/ total number of tested individuals)

***Acyrthosiphon pisum* winged response** showed higher mortality %, where silica alone gave 46.00 ± 0.9, 58.00 ± 0.4and 70.00± 0.7 mortality %, 96.00± 1.2, 100.00 ± 0.0 and 100.00 ± 1.2 with "Lambada" pesticide treatment; 56.00 ± 0.3, 66.00 ± 0.0and 86.00 ± 1.7 mortality % with 200 ppm nano silica hydrophilic treatment; 72.00 ± 1.7, 86.00 ± 0.4 and 98.00 ± 0.6 mortality % with 300 ppm nano silica hydrophilic treatment, 86.00 ± 0.9, 94.00 ± 0.2 and 100.00 ± 1.0 mortality % with 400 ppm nano silica hydrophilic treatment and finally it gave 100.00 ± 2.0, 96.00 0.9 and 98.00± 0.8 mortality % with 500 ppm nano silica hydrophilic treatment determined at one ,two and three days post application (Table 10).

Table 10: Rates and mortality percentages among *Acyrthosiphon pisum* winged tested with nano-silica after daily follow up to the 7th day post emergence using direct spraying.

Days post Application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	46.00 ± 0.9 (23/50)	96.00 ± 1.2 (48/50)	56.00 ± 0.3 (28/50)	72.00 ± 1.7 (36/50)	86.00 ± 0.9 (43/50)	100.00 ± 2.0 (50/50)
2nd	4.00 ± 1.0 (2/50)	58.00 ± 0.4 (29/50)	100.00 ± 0.0 (50/50)	66.00 ± 0.0 (33/50)	86.00 ± 0.4 (43/50)	94.00 ± 0.2 (47/50)	96.00 ± 0.9 (48/50)
3rd	0.00 ± 0.5 (0/50)	70.00 ± 0.7 (35/50)	100.00 ± 1.2 (50/50)	86.00 ± 1.7 (43/50)	98.00 ± 0.6 (49/50)	100.00 ± 1.0 (50/50)	98.00 ± 0.8 (49/50)

*Between brackets (Number of dead winged aphid/ total number of tested individuals)

***Aphis craccivora* wingless** gave 36.00 ± 0.5, 60.00 ± 0.9 and 70 ± 0.7 mortality % with silica treatment; 100.00 ± 0.6, 100.00 ± 1.1 and 100.00 ± 1.2 mortality % with "Lambada" pesticide treatment; 60.00 ± 0.1, 74.00 ± 0.2, and 84.00± 0.9 mortality % with 200 ppm nano silica hydrophilic treatment; 68.00 ± 1.1, 82.00 ± 1.2 and 2.00 ± 1.3 mortality % with 300 ppm nano silica hydrophilic treatment; 74.00 ± 1.4, 92.00 ± 0.6 and 100.00 ± 0.9 mortality % with 400 ppm nano silica hydrophilic treatment and finally 88.00 ± 0.8, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic treatment determined at one ,two and three days post application (Table 11).

However, winged forms gave mortality % in the same range where it gave 26.00 ± 0.6, 46.00 ± 0.9 and 74.00 ± 1.0 mortality % with silica treatment; 94.00 ± 0.6, 100.00 ± 0.8 and 100.00 ± 1.1 mortality % with "Lambada" pesticide treatment, 66.00 ± 0.9, 58.00 ± 0.4 and 90.00 ± 0.7 mortality % with 200 ppm nano silica hydrophilic treatment, 60.00 ± 0.8, 74.00 ± 0.9 and 96.00 ± 1.1

mortality % with 300 ppm nano silica hydrophilic treatment, 74.00 ± 0.4, 88.00 ± 0.9 and 100.00 ± 0.9 mortality % with 400 ppm nano silica hydrophilic treatment finally and it gave 84.00 ± 0.5, 100.00 ± 0.0 and 100.00 ± 0.0 mortality % with 500 ppm nano silica hydrophilic treatment at one ,two and three days post application (Table 12 and Fig 4). It is worth mentioning that, nano materials have been exploited as pesticides *i.e.* polymeric nano particles, iron oxide nano particles, gold nano particles, and silver ions. (Al-Samarrai, 2012) and their potential for use in insect control (Bhattacharyya *et al.*, 2010) such as *Helicoverpa armigera* (Vinutha *et al.*, 2013), mosquito larvicidal activity (Jayaseelan *et al.*, 2011) and cotton leaf worm *Spodoptera littoralis* (El-bendary and El-Helaly 2013 and El- Helaly *et al.*, 2016) and Mustard aphid; *Lipaphis pseudobrassicae* (Nitai *et al.*, 2010) *Aphis nerii* (Rouhani *et al.*, 2012) green peach aphid, *Myzus persicae* (Kang *et al.*, 2012). California red scale (*Aonidiella aurantii*) and Oriental fruit flies; *Bactrocera dorsalis* (Kuo-Hsun *et al.*, 2015).

Table 11: Rates and mortality percentages among *Aphis craccivora* wingless tested with nano-silica after daily follow up to the 7th day post emergence using direct spraying.

Days post application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	4.00 ± 0.0 (2/50)	36.00 ± 0.5 (18/50)	100.00 ± 0.6 (50/50)	60.00 ± 0.1 (30/50)	68.00 ± 1.1 (34/50)	74.00 ± 1.4 (37/50)	88.00 ± 0.8 (44/50)
2nd	2.00 ± 0.0 (1/50)	60.00 ± 0.9 (30/50)	100.00 ± 1.1 (50/50)	74.00 ± 0.2 (37/50)	82.00 ± 1.2 (41/50)	92.00 ± 0.6 (46/50)	100.00 ± 0.0 (50/50)
3rd	0.00 ± 0.0 (0/50)	70.00 ± 0.7 (35/50)	100.00 ± 1.2 (50/50)	84.00 ± 0.9 (42/50)	92.00 ± 1.3 (46/50)	100.00 ± 0.9 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead wingless aphid/ total number of tested individuals).

Table 12: Rates and mortality of percentages among *Aphis craccivora* winged tested with nano-silica after daily follow up to the 7th day post emergence using direct spraying.

Days post application	Control DW	Silica	Lambada pesticide 500 ppm	Silica hydrophilic nano particles/ppm			
				200	300	400	500
1st	0.00 ± 0.0 (0/50)	26.00 ± 0.6 (13/50)	94.00 ± 0.6 (47/50)	66.00 ± 0.9 (33/50)	60.00 ± 0.8 (30/50)	74.00 ± 0.4 (37/50)	84.00 ± 0.5 (42/50)
2nd	4.00 ± 0.2 (2/50)	46.00 ± 0.9 (23/50)	100.00 ± 0.8 (50/50)	58.00 ± 0.4 (29/50)	74.00 ± 0.9 (37/50)	88.00 ± 0.9 (44/50)	100.00 ± 0.0 (50/50)
3rd	4.00 ± 0.3 (2/50)	74.00 ± 1.0 (37/50)	100.00 ± 1.1 (50/50)	90.00 ± 0.7 (45/50)	96.00 ± 1.1 (48/50)	100.00 ± 0.9 (50/50)	100.00 ± 0.0 (50/50)

*Between brackets (Number of dead winged aphid/ total number of tested individuals).

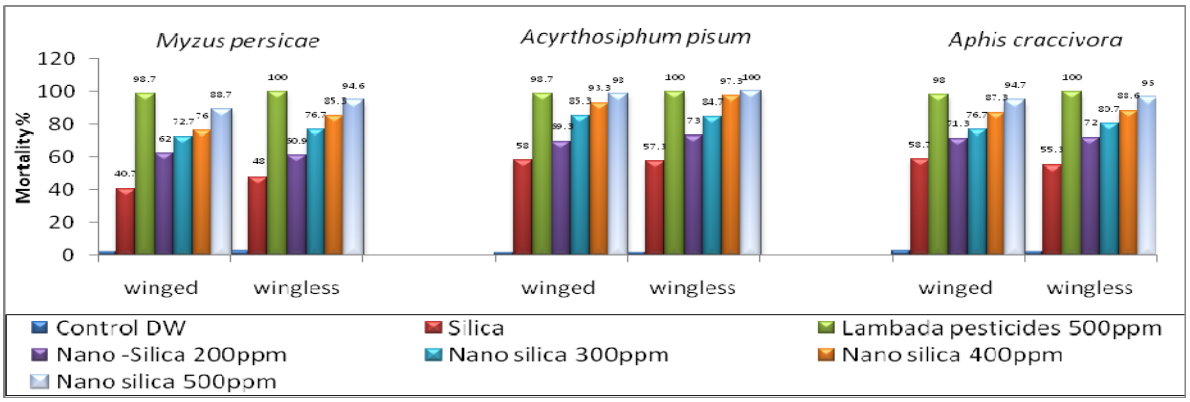

Fig. 4: The mean of mortality percentages among three aphid species either winged or wingless tested with nano silica after daily up to the 7th day post emergence using direct spraying.

Results showed that these nanoparticles could be an effective pest control approach for species *Myzus persicae*, *Acyrthosiphon pisum* and *Aphis craccivora* the mortality % increased significantly with increase concentrations. Although aphids mortality as a result of using nanoparticles was slightly near to imidacloprid (which is consistent with other researcher's reports such as Guan *et al*., 2008; Samih *et al*., 2011; Rouhani *et al*., 2011).

Our findings in this research are the first record for these aphid species. They show the possibility of controlling different aphid's species through applying 500 ppm of hydrophilic nano silicate. Further investigation should focus on bio-safety and the pathways of nano silica hydrophilic inside insects that causes the death.

CONCLUSION

Nanotechnology has the potential to revolutionize the existing technologies used in various sectors including agriculture. Nanotechnology may have solutions against many agriculture problems like insect pest management using traditional methods, adverse effects of chemical pesticides, development of improved crop varieties, etc. Nano materials can be used for efficient management of insect pests and formulations of potential insecticides and pesticides. Therefore, it can also be concluded that nanotechnology can provide green and eco-friendly alternatives for insect pest management without harming the nature.

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Fig. 1: Aphid cultures

Fig. 2: Petri dish plates with diameter 5 cm poured with 5% agar concentration and provided with Faba bean leaves for direct investigation

ARABIC SUMMERY

"النانو سليكا" كمبيد نانوى واعد لمكافحة ثلاثة أنواع من حشرات المن تحت الظروف شبه الحقلية في مصر

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استهدف هذا البحث دراسة تأثير النانو سيليكا المحبة للماء بالمقارنة بالسليكا العادية مبيد اللامبادا (كمبيد موصى به) ضد ثلاثة أنواع من حشرات المن كآفات اقتصادية في مصر وهى (مّن الخوخ الأخضر،مّن البسلة و مّن اللوبيا). أجريت الدراسة خلال الفترة من نوفمبر ٢٠١٥ الى فبراير ٢٠١٦ .تم معاملة نباتات الفول البلدي تركيزات ٢٠٠ ، ٣٠٠ ، ٤٠٠ و ٥٠٠ جزء فى المليون. من النانوسيليكا، مقارنة بالسيليكا العادية Silica و مبيد اللامبادا "Lambada" ٥٠٠ جزء فى المليون.

تم تغذيه حشرات المن (المجنحة Winged- غير المجنحة Wingless) على أوراق نباتات الفول/معاملة كل على حدي باستخدام ١٠ إفراد من حشرات المن /خمس مكررات /تركيز لكل شكل و نوع من حشرات المن. تم حساب نسب الموت /معاملة والتحليل الإحصائي للنتائج :

أهم النتائج المتحصل عليها : أن هناك علاقة طردية بين معدل الموت مع الزيادة في التركيز. كما أوضحت النتائج ان حشرات المن سواء المجنحة أو غير المجنحة أعطت نسب موت وصلت إلى ١٠٠% مع التركيزات المختلفة للنانو سيليكا في اليوم السابع بعد المعاملة. كذلك تحصل على نفس النتائج عند المعاملة بالسيليكا فقط. بينما المعاملة بمبيد اللمبادا أعطت نسب موت تراوحت مابين ٤٦-٦٦ % سواء مع الأفراد المجنحة او غير المجنحة للأنواع الثلاث من حشرات المن.

أظهرت النتائج أن المعاملة المباشرة لحشرات المن المجنح وغير المجنح بالتركيزات المختلفة المستخدمة أدت إلى حدوث نسب موت ٦٨، ١٠٠، ٨٤، ٩٤، ٩٨ و ١٠٠ % بالنسبة لمعاملة حشرات من الخوخ الأخضر المجنحة.بينما معاملة الحشرات غير المجنحة أعطت نسب موت: ٦٤، ١٠٠، ٨٠، ٩٠، ٩٦ و ٩٨% على التوالي.

أظهرت النتائج إن معاملة أفراد من البسلة غير المنجحة كانت ٧٤، ١٠٠، ٨٦، ٩٦، ١٠٠و ١٠٠% على التوالي. بينما كانت نسب الموت نتيجة معاملة الأفراد المجنحة ٧٠، ٧٠، ١٠٠، ٨٦، ١٠٠و ٩٨ % على التوالي. وأخيراً كانت نسب الموت المسجلة لحشرات من البقوليات المجنحة نتيجة المعاملات المختلفة ٧٠، ١٠٠، ٨٤، ٩٢، ١٠٠ و ١٠٠ % على التوالي. بينما معاملة الأفراد غير المجنحة أسفرت عن نسب موت ٧٤، ١٠٠، ٩٠، ٩٦، ١٠٠ و ١٠٠% على التوالى نتيجة المعاملة بالسيليكا ، اللمبادا، النانوسيليكا محبة للماء بتركيزات ٢٠٠ ، ٣٠٠ ، ٤٠٠ و ٥٠٠ جزء فى المليون.

توصى الدراسة الحالية باستخدام النانوسيليكا المحبة للماء بتركيز ٥٠٠ جزء فى المليون كطريقة واعدة لمكافحة حشرات المن في مصر.