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EVALUATION OF THE BIFENTHRIN 10% EC IN BOTH NORMAL AND NANOPARTICLES AGAINST *DACUS FRONTALIS* IN CUCUMBERS FIELD

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Abstract

A field experiment was carried out to determine the numerical density of *Dacus frontalis* melon fruit on cucumber fruits and to evaluate the effectiveness of Bifnethrin 10% EC in its normal and nanoparticles in its control. The results showed that the number of spots on the fruits, which represent the places of egg laying by adult insects between 1-2 spots / fruit and an average of 1.21 spots / fruit. There was a variation in the number of larvae / fruit in the first week of October 4.3 larvae / fruit when the average temperature and relative humidity was 28.61°C, 49.7%, respectively. The highest number of pests reached 18.9 larvae / fruit respectively at the average temperature and humidity of 21.24°C, 87.36% during the fourth week of October. The results also showed that the pesticide in its normal form (That use with the recommended concentration), was superior to the nanopesticide (That use with the half recommended concentration). The average efficiency of them was 51.91, 47.85% respectively after four weeks of treatment. The highest control efficiency was in the seventh day of treatment with the normal form over the nanopesticide, the pesticide efficiency rate were 93.2 and 90.4%, respectively.

Key words: *Dacus frontalis*, Nanopesticides, Bifenthrin.

Introduction

The family of fruit flies (Diptera: Tephritidae) is one of the most important pests globally because of the variety of species (Aluja, 1994; Clarke *et al*, 2005; Follett and Neven, 2006). About 70 of them are economic importance to the many of vegetables and fruits belonging to the genera *Bactrocera*, *Anastrepha*, *Rhagoletis*, *Ceratitis* and *Dacus* which are common in tropical and subtropical regions (White and Elson-Harris, 1994; Gillani *et al*., 2002). Species belonging to the genus *Dacus* specialize in the infestation of some plant families, most notably the pumpkin family. One of the types of flies recorded in Iraq fly cucurbits *Dacus ciliatus* (Loew). First recorded during the autumn season of 1988 in Wasit and Missan (Moans and Abdul rasool, 1989). The Great Melon fly *Dacus frontalis* recorded during the autumn season 2011 in the Maysan (Al-Saffar, 2011). Maklakov *et al*., (2001) found that pyrethroids were more efficient than organophosphate pesticides, effect on adults by contact and stomach, which has led to rapid killing. The use of pesticides have negative environmental and health effects, especially residues on food, low concentrations are often safe but less effective (Al-Dahwi *et al*., 2005, 2012). So the introduction of nanotechnology in the manufacture of pesticides by reducing the size of the pesticide minutes to the nanoscale. It allows the use of the pesticide at lower concentrations with retention its effectiveness against pests and ensure plant health and less environmental and nutritional contamination (Ghormade *et al*., 2011). So, Bifenthrin 10% EC was chosen EC in both normal and nanoparticles against *Dacus frontalis* in cucumbers field.

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Materials and Methods

Calculate the number of spots and the density of larvae in fruits

A plot of 225 m was selected within the experimental station of the Plant Protection Department, College of Agricultural Engineering Sciences, University of Baghdad, Prepared for agriculture by all agricultural operations and according to the recommendations adopted for the cultivation of cucumbers. The land was divided into three replicates and each repeater contains three experimental

Table 1: The number of spots and the density of larvae in fruits.

Relative humidity	Tempe-rature	Larvae number / fruit	Spots number / fruit	The week	The month
49.7	28.61	4.3	1	1	10
44.27	28.72	11.1	1	2	
58.87	23.28	12.8	1.2	3	
87.36	21.24	18.9	1.5	4	
87.72	18.09	17	1.3	1	11
97.87	16.67	16.3	1.3	2	
70.96	22.76	13.4	1.21	The average	
		0.5	0.2	$L.S.D_{0.05}$	

units cucumber seeds were planted on 15/8/2018. The appearance of fruits began on 28/9/2018. Numerical density was studied depending on the larval stage of the pest. By taking samples of 10 plants and three replicates randomly for the period from the last week of September to the last week of November. The number of stains per fruit was calculated, which represents the egg-laying places for adults. Also numerical larval density was calculated in fruits.

Preparation of Bifenthrin Nanoparticles:

Bifenthrin was converted to nanoparticles physically by exposing it to the Homogenizer Ultrasonic for 20 minutes. This device emits 22-24 kHz ultrasonic waves that break down physically exposed particles or particles and convert them from normal volumes to nanoscale volumes (Jayarambabu *et al*., 2016). This device emits 22-24 kHz ultrasonic waves that break down physically exposed particles or particles and convert them from normal volumes to nanoscale volumes (Jayarambabu *et al*., 2016; Al-Shujairi, 2018).

X-ray Diffraction Analysis

An check up was carried out to confirm the transformation of the Bifenthrin to the nanoparticles using a Shimadzu X-Ray Diffractometer. The samples were prepared for testing by deposition of three drops of the pesticide solution on a glass slide and then dried using a 50°C electric oven for 30 minutes.

Scanning Probe Microscope

A further check up was carried out using a Scanning Probe Microscope (SPM). The samples were prepared for testing by placing several models of the pesticide, both normal and nanoparticles, in 10 ml tubes each separately.

The samples were taken to the Nanotechnology Laboratory of the Department of Chemistry, College of Science, Baghdad University.

Evaluation of Bifenthrin in both normal and nanoparticles against *Dacus frontalis* in cucumbers field

Spraying the pesticide on the plants on 9/10/2018 after the occurrence of the infection as the numbers of pest were increasing. Pesticide treatments were distributed to the experimental units in each replicater by the Randomized Complete Block Design (CRBD) as follows:

- Normal Bifenthrin at a concentration of 2 ml/L water (the recommended concentration of the pesticide).
- Nanoparticles Bifenthrin in its was sprayed at a concentration of 1ml/L water (half of the recommended concentration of the pesticide).
- The comparison was sprayed with water only.

Fruits samples are taken to the laboratory and examined and calculated the numbers of larva and corrected the percentage of death according Henderson and Tilton, (1955).

Statistical analysis

The trial experiment was designed according to the complete randomized block design (CRBD). The data were statistically analyzed using the analysis of variance method. The least significant difference LSD was used for at the level of 0.05 probability to compare the means, Genstat v.12.1 software was used in the statistical analysis (Al-Rawi and Khalaf Allah, 2000).

Results and Discussion

Calculate the number of spots and the density of larvae in fruits

Table 2: Percentage of corrected mortality of *Dacus frontalis* larval stage in cucumbers field.

The average	Corrected percentage of death after treatment							Conc. ml/L	The treatment
	28 D.	21 D.	14 D.	7 D.	5 D.	3 D.	1 D.		
51.91	28.2	42.5	77.4	93.2	63.4	31.3	27.4	2	Normal Bifenthrin
47.85	21.3	39.8	72.2	90.4	60.7	28.3	22.3	1	Nano Bifenthrin
48.84	24.75	41.15	74.8	91.8	62.05	29.8	24.85	The average	
LSD = 1.9									

The number of spots on the fruit representing the egg-laying places by adult insects ranged from 1-2 spots / fruit, At a rate 1.21 spot / fruit (Table 1). After hatching eggs and larvae exit, when slicing the fruit in the area of the stain, it was observed that it begins to feed greedily, On the fleshy tissue of the fruit between the outer shell and the pulp containing the seeds. The same table

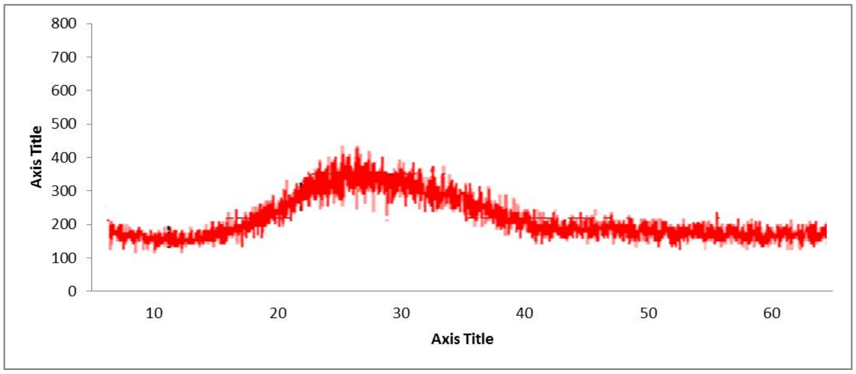

Fig. 1: Shows the X-Ray Diffraction for Normal Bifenthrin.

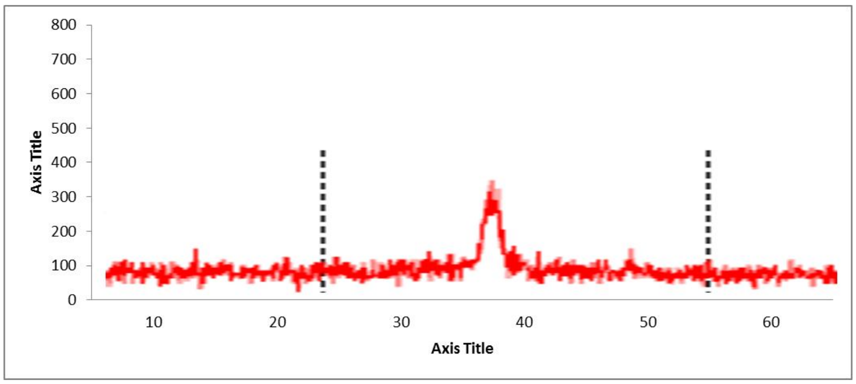

Fig. 2: Shows the X-Ray Diffraction for Nano Bifenthrin.

shows the difference in the number of larvae / fruit and as the number started in the first week of October. It reached 4.3 larva / fruit when the average temperature and relative humidity were 28.61°C and 49.7% respectively. During the second and third weeks of the month, the numbers gradually increased to 11.1 and 12.8 larvae/fruit respectively. At temperatures and relative humidity of 28.72°C, 44.82%, 23.28°C and 58.87% respectively. The highest number of pests reached 18.9 larvae/fruit, respectively, during the fourth week of October at an average temperature and relative humidity of 21.24°C, 87.36% then the numbers began to decrease, during the month of November until the end of the life of the plant and ceased production of fruits in the third week of the same month. The number of larvae in the first and second weeks of November 17, 16.3 larvae / fruit, respectively. When the average temperature and relative humidity were 18.09°C, 87.72%, 16.67°C and 97.87% respectively. In this context, Al-Jourani, (2013) in a study to determine the relative presence of the major melon fruit fly and the pumpkin fruit fly, showed that the average number of larvae in one and two infected fruits was 7.81 and 12.44 larvae/ fruit respectively. Al-Sharif and Bobb, (2009) indicated in a laboratory study that the optimal degree of hatching eggs was between (30-33)°C, while eggs do not hatch at temperatures above 33°C. The best adult temperatures were between 27-30°C for the Great Melon fly.

Preparation of Bifenthrin Nanoparticles

• X-ray Diffraction Analysis: The fig. 1, 2 shows the X-Ray Diffraction for Normal and Nanoparticles of Bifenthrin, Diffraction peaks 450 and 350 respectively, are observed at angles 27 and 37 respectively, also found that these angles are similar to those in the JCPDS card. Which showed that the Polycrystalline compositions are spherical & cubic centered face, the average size of nanoparticles using the Scherrer equation was 185 and 98 nm, respectively (Kelsall *et al*., 2005).

• Scanning Probe Microscope: The fig. 3, 4 shows the 3D image for Normal and Nanoparticles of Bifenthrin deposited on glass substrate with 2×2 mm dimensions, also the figure shows that the average size is found to be around 189.18, 104.83 nm respectively, also the figure

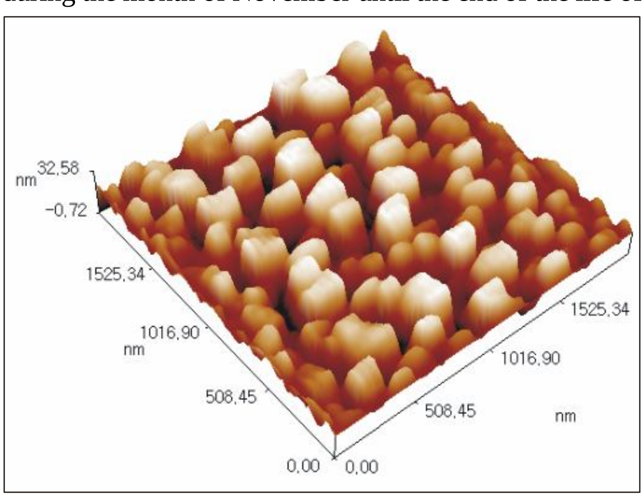

Fig. 3: Shows the 3D image for Normal Bifenthrin.

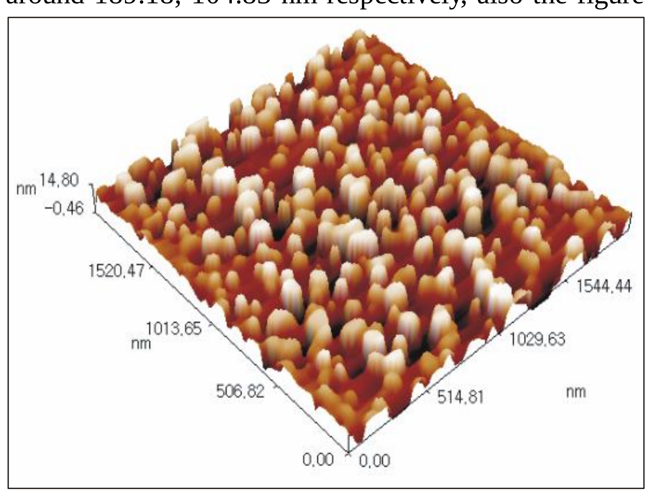

Fig. 4: Shows the 3D image for Nano Bifenthrin.

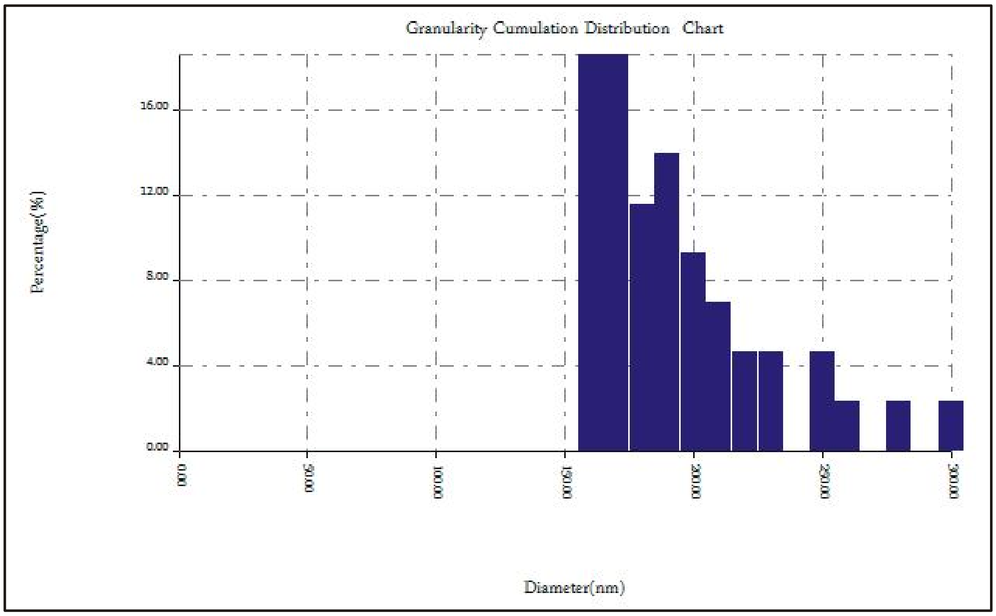

Fig. 5: Granularity Cumulation Distribution Chart for Normal Bifenthrin.

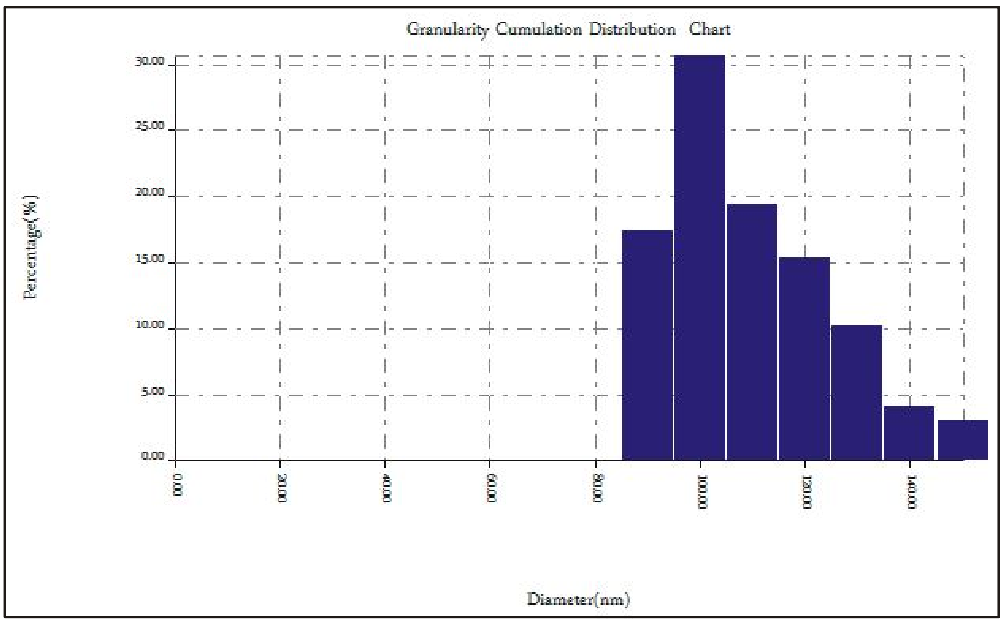

Fig. 6: Granularity Cumulation Distribution Chart for Nano Bifenthrin.

refers that the shape of these particles is spherical distribution as matrix on the vertical axis and directed to horizontal and cover all the surface, this means that the thin film is homogenous and uniform.

The fig. 5, 6 shows the Granularity Cumulation Distribution Chart for Normal and Nanoparticles of Bifenthrin. It appears that 50% of nanopesticide particles are less than 100 nanometers, 90% of them are less than 120 nm, while 50% of normal pesticide nanoparticles are less than 180 nm, 90% of which are less than 230 nm.

It turns out that the nanoparticle particle size is less than half the normal pesticide particle size. This explains why, despite the use of the pesticide in the nanoparticles at half the recommended concentration used in the pesticide in the normal formæ However, it gave comparable control efficiency and effectiveness to the normal pesticide, as will be shown later.

• Evaluation of Bifenthrin in both normal and nanoparticles against *Dacus frontalis* in cucumbers field: The superiority of the normal Bifenthrin pesticide over the nanoparticles in the effect on the larval stage of the insect in the field during different time periods. The relative efficacy of the pesticide was 51.91% after four weeks of treatment, while the nanopesticide reached 47.85% (Table 2). As for the effect of the time duration on the efficiency of the pesticide, the effect started one day after the treatment to reach the percentage of death 27.4 and 22.3% of the pesticide in its normal and nanoparticles respectively. It gradually increased after three and five days of treatment to reach 31.3, 63.4% for normal pesticide and 28.3, 60.7% for nanopesticide, respectively. The highest control efficiency was achieved on the seventh day of treatment with the pesticide's normal superiority over the nanopesticide, with an average pesticide efficiency of 93.2 and 90.4%, respectively. The efficiency of the pesticide then gradually decreased to reach 77.4 and 72.2% in the second week of control for both normal and nanoparticles respectively. And continued to decline in the third and fourth week after treatment to 42.5, 28.2%, respectively for the pesticide in the normal form and 39.8, 21.3% respectively for the pesticide nanoparticles. The results of the study show that the nanoparticles proved highly effective against the pest and an approach to the effectiveness of the normal pesticide, although the concentration used for the first is half the recommended concentration and used for the normal pesticide. This indicates that the physical transformation of the pesticide to the nanoparticles led to the reduction of the size of the pesticide molecules without affecting their chemical properties, which increased the surface area of the molecules and this led to increased accessibility and thus increased pesticide effectiveness against the pest. Maklakov *et al*., (2001) found in a laboratory study that the Bifenthrin pesticide works for the rapid killing of cucurbit fly *Dacus ciliatus* on the crop of cucumbers.

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