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The Effectiveness of Nanoparticle Dodonia Leaf Extract on the life stages of the Khapra Beetle *Trogoderma granarium* (Everts.) (Coleoptera : Dermastidae)

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Abstract. The effect of four concentrations (0, 1, 3, 5%) of the nanopesticide was tested on the leaves of the Dodonia plant in five time times (1, 3, 5, 6, 7) days, and the method of direct spraying was used on the different roles of the insect, and it showed. The results showed that there were significant differences between the three concentrations (5,3,1) with the control treatment(0)

Keywords. Dodonia, Nano-plant extracts, Coleoptera.

1. Introduction

The grain beetle, Trogoderma granarium, is one of the most dangerous insect pests that infect stored materials, causing great economic damage, It has been classified among the 100 most dangerous species in the world [1]. [2,3] This insect prefers the embryo of the bean in its feeding, and thus damages the bean and reduces the value of the crop. Excessive use of chemical pesticides led to the emergence of genetic resistance in the insect to these pesticides [4,5]. The frequent use of these pesticides has led to problems in the environment and public health for humans [6-8]. In order to reduce the risk of chemical pesticides, it was necessary to search for alternative materials that have high control effectiveness, are Eco-friendly, and naturally produced or originated from plants [9]. Such plant products are used in many formulations, including powders, oils, or herbal preparations. Such formulations comprise biologically active compounds alternatives to chemical pesticides [10,11]. [12] indicated about 2000 plant species have an insecticidal activity, on which the attention has been paid to investigate their active components for use in controlling insect pests [13,14. Insect resistance may not develope against plant extracts as they may contain highly effective ingredients that can be used to control insect pests. Among those, Dodonia leaf extract that were tetsted to combat various insect pests, including the hairy grain beetle. This plant has many toxic and lethal substances [15]. It was used against the great wax worm, as well [16].

2. Materials and Methods

2.1. Preparation of the Aqueous Extract of the Leaves of the Dodonia Plant

About 200 gm of Dodonia leaf powder was homoginized with 800 ml of distilled water in a 3-liter glass bottle, the bottle was sealed tightly and the mixture was stirred for 3 days continuously. The extract was passed through a layer of wet cloth using a Buchner. Another filtration was performed, using medical cotton. Filtrates were collected in a container placed at the funnel bottom. The extraction the method was performed following Al-Mansour (1966) adapted from [17]. The resultant filtrate was collected and centrifuged for 20 min at 10,000 rpm. The precipitant was collected and placed in a sealed glass container and kept at 4° C [17]. One hundred ml of distilled water was used for control treatment.

2.2. Preparation of Nanopesticides for the Leaves of Dodonia Plant

About 200 ml of the raw filtrate extracted from Dodonia leaves was put it in a 250 ml flask. Added to it 20 g of Zinc acetate, produced by THOMAS BAKER, and put it in the shaker for 24 hours, after which the mixture was centerfuged for 20 min at 10,000 rpm. After this process, we get rid of the filtrate and take the precipitate. The sediment is left in the same plastic tubes and we add 5 ml of distilled deionized water and spun again for 10 min at 10,000 rpm, as this process is considered a washing process to the sediment. After that, the water that was placed is disposed of and the sediment is collected in dishes Petrified, brushed well and with a light layer, and incubated for 3 days at 37 °C for three days to dry. After the precipitate dries well, it is ground to powder and then collected in a plastic box.

2.3. *Laboratory Study of the Effect of Different Treatments on the Phases of the Grain Beetle*

A nanopesticide was used on the leaves of the Dodonia plant, with three concentrations (1, 3, and 5%), in addition to the control treatment, by direct spraying, on all stages of the insect (eggs, larva, pupae, and adults).

Table 1. Effectivity of different concentrations of Dodonaea aqueous extract nanoparticles of egg hatching rate.

Time/day	Hatching ratio Concentration%				Average
	0	**1%**	**3%**	**5%**	
3	0	0	0	0	0,00
5	20	10	5	5	10.00
6	25	15	10	5	13.75
7	35	25	20	7	21.75
8	20	15	10	8	13.25
Average	20.00	13.00	9.00	5.00	--------
LSD=					
Concentration: 3.07* *3.83 : Time * 5.79 : Overlap.					

Nanoparticles synthesized from of the aqueous leaf extract of Dodonia plant could inhibit egg hatch up to 0% at 5% concentration exceeded 5% concentrations, compared to the other treatments (Table 1). Whereas, the hatching rate was 20, for the control treatment. As for hatching timing, the seventh day scored the highest egg hatch rate up to 21.75 compared to the control treatment. Statistical analysis revealed significant differences among the three concentrations based on egg hatching percentage when LSD for concentration was 3.07. The average time was 3.83, with 5.79 overlap.

Table 2. Effectivity of different concentrations of nanoparticles synthesized from aqueous leaf extract of Dodonaea plant on mortality rate of larvae.

Time/day	Kill rate Concentration%	Average

	0	1%	3%	5%	
1	0	20	25	30	18.75
2	0	15	20	22	14.25
3	0	10	15	25	12.50
5	0	7	10	8	6.25
7	0	3	5	0	2.00
Average	0.00	11.00	15.00	17.00	-----
LSD=					
Concentration: 2.97* 3.26* Time: 5.24* Overlap:.					

Nanoparticle produced scored 17% highest mortality rate of larvae, at concentration 5% compared to the other concentrations and control treatment (Table 2). Data from time average showed, the first day scored the highest larval mortality rate. Statistical analysis indicated there were significant differences among the 3 concentrations, when the LSD value was 3.28, for the time 3.77.

Table 3. Effectivity of concentrations of nanoparticles produced from aqueous leaf extract of Dodonaea plant on pupa mortality rate.

Time/day	Kill rate Concentration%				Average
	Control	1%	3%	5%	
1	0	15	25	20	15.00
2	0	10	20	25	13.75
3	0	15	10	15	10.00
5	0	6	5	10	5.25
7	0	4	5	5	3.50
Average	0.00	10.00	13.00	15.00	---
LSD=					
4.17* Concentration: ، * Time: 4.62 7.02* Overlap:					

The nanoparticles synthesised from aqueous leaf extract of Dodonia increased mortality percentage of pupae, at 5% concentration scoring 15% maximum mortality average, compared to compared to control treatment (Table 3). Whereas, time average at 1st day scored the highest mortality rate. Similarly, statistical analysis indicated significant differences among the 3 concentrations, scoring 3.28 and 3.77 LSD values for concentration and time, respectively.

Similarly, the synthesized nanoparticles scored 19 highest mortality rate of adults at 5% concentration compared to other treatments (Table 4). While, time average at the 1st day scored the highest adult mortality rate. LSD value scored 4.87, 5.44 and 8.95 of the concentration, time, and the overlap, respectively.

Table 4. Effectiveness of different concentrations of nanoparticles from aqueous leaf extract of

Time/day	Kill rate Concentration%				Average
	Control	1%	3%	5%	
1	0	35	40	50	31.25
2	0	20	30	40	22.50
3	0	13	15	5	8.25
5	0	7	0	0	1.75
7	0	0	0	0	0.00
Average	0.00	15.00	17.00	19.00	-----
LSD=					
4.87* Concentration: * Time: 5.44 8.95* Overlap:					

Dodonaea plant on adult mortality

3. Discussion

The relatedness between the concentration and the mortality rate indicated a direct relationship. When nanoparticle concentration increased, the egg inhibition rate increased. Or it leads to an increase in the hardness of the egg shell and prevents it from hatching, and thus the embryo dies inside it [18]. The reason for the increase in the killing rate of the larvae is that the nanopesticide contains substances that prevent feeding [19]. Or, the larvae die due to poisoning that occurs in the cells that absorb food in the alimentary canal [20,21] .

[22], confirmed that the plant extracts inhibit the natural growth of the caterpillar, which causes its longevity. He also confirmed that the first caterpillar instars are more sensitive than the later instars. The cause of death is due to the effect of toxic substances in the extract on the nervous system, as the phenolic compounds inhibit the enzyme acetylcholine esterase (ACHE), which causes an increase in the secretion of acetylcholine, which transmits nerve impulses, then accumulates at the end of the nerves and leads to paralysis and death [23,24]. The presence of terpenes in plant extracts, which are secondary chemical compounds, is the cause of deformation, killing, and non-emergence in insect phases treated with them.[25-28]. [29] .indicated that the fertility of female insects decreases due to natural extracts whose effect on larval feeding causes the insects to lose weight. The reason for the occurrence of deformities in insects is the similarity in the effect of the secondary chemical compounds with the Juvenile hormone, which decreases at moulting and causes a defect in the moulting process [30]. The superiority of nanopreparations over plant extracts in killing eggs and larvae is due to the high toxicity of nanoparticles [31] Also, the nanoparticles have the ability to penetrate the cuticle and interfere with the moulting process and other vital processes of the insect, penetrating the plasma membrane and entering the cytoplasm and destroying most of the vital molecules, including proteins coagulation enzymes and killing cells due to the low permeability of the plasma membrane and affecting the lifespan of immature insects [32,33]. [34], indicated that the nanoparticles affect the generation resulting from the treated role over time as a result of a disruption in the vital organs and gradual exhaustion of the insect. [15] indicated that aqueous leaf extracts of some plant groups, including Dodonaea viscosa, could affect the larval stage directly and it can be a potential source of natural insecticides.

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