The Effect of three types of Nanoparticles on Lesser Grain Borer, Rhizopertha dominica During Different Storage Periods

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Abstract:

This study was conducted for the purpose of testing three types of nanoparticles: Silver Nanoparticles (AgNPs), Selenium Nanoparticles (SeNPs), and Zinc Oxide Nanoparticles (ZnONPs): using of 200, 400, 600, 800, and 1000 ppm of nanoconcentrations against both larval and and adult stage of lesser grain borer, Rhyzopertha dominica. The results of the study showed that the type and concentration of the nanotype had a significant impact on the larval stage killing which reached 92.00% for the concentration of 1000ppm for nanzinc , while the lowest percentage for larvae killing 44.00%, was recorded for the concentration of 200ppm for nanselenium. The results of the study also showed an effect of nanoelement and their concentrations on the adult stage killing , recording the highest rate 89.66% for the concentration of 1000 for the nano-element of silver, while the lowest percentage decreased at 31.00% recorded for the concentration of 200 for the nano-element of selenium. Thus, the results also indicated that the interaction treatment between the exposure duration and concentration had a significant impact on the adult killing rate of 100% was recorded for the interaction treatment between the exposure time on days 5, 6, 7, 8, 9, and 10 and the concentrations. 400, 600, 800, and 1000 for the nano-element silver, while a 100% killing rate was recorded for the interaction between the exposure duration on days 5, 6, 7, 8, 9, and 10 and the concentrations of 200, 400, 600, 800, and 1000 for the nano zinc element. Also, as a result of the results of the study, the three species included in this study behaved more as a repulsive substance to the major grain borer than as an attractant. The highest repulsion rate of 50% was recorded for the entire insect at a concentration of 1000 parts per million for the element silver, while the lowest repulsion rate of 40% was recorded for the concentration of 200. Parts per million of zinc against the major grain borer Rhyzopertha dominica.

Key words: Nanoparticles, Wheat seeds, Lesser Grain Borer

.1Introduction :

Insects of stored materials are considered one of the biggest challenges facing the process of storing grains and preserving their quality and products, because they have adapted to live and reproduce in a relatively dry environment such as grain stores, as they consume large quantities of them, in addition to contaminating the grains with their secretions and thus affecting the marketing value. For those grains [1], one of the most common warehouse insect pests is the small grain-piercing insect because it has strong mandibles with which it can pierce grains, and this damage may not be able to be caused by many

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warehouse insects, and thus it helps many other species that cannot pierce grains, and in this way They are considered the most harmful to stored grains [2]. Pesticides have been used to combat many pests, against insects, even against wood, not with pesticides against land . [3.[

Stored insects reduce the sufficient amount of protein inside the grain, that is, essential amino acids such as tryptophan and methionine, in addition to non-essential amino acids such as alanine and tyrosine in particular. Among these important creatures is Macria, which reduces the percentage of protein inside wheat grains, which is the expert beetle and the great grain borer [4] , and [5.[

One of the insecticides alternative methods of stored products managing is to use cleaning, cooling, and ventilation to reduce both the stored insects damage and their population density [6.[

There is a strong effort towards the production of new nano-insecticides, and the production of various electrons and various medicines is innovating among the different technology techniques, as many types of different names and pesticides have been produced in the agricultural sector, where spoons, emulsions and pesticides have been produced. Among the best characteristics and advantages of insecticides is their small stores and spread. The lilyum is on the outer wall of the insect's body and is therefore found in traditional insecticides. Also, the various pesticides do not target unseen organisms in the environment, and thus the various pesticides provide one of the advantages of popularity, green and environmentally friendly [7 . [

Various insecticides represent a desired goal against warehouse insects. Rather, they are embodied in the friends of the green environment in the world, especially against warehouse pests. Discover the effectiveness of various insecticides against the southern cowpea weevil. They succeeded in SeNPs and TioENPs, which are very effective against warehouse insects for their eggs and their hatching to a significant extent. Tio2NPs reduce the hatching rate of eggs by 23% and reduce the transformation of larvae into adult insects by 11% [8. [

.2Material and Methodes:

.2.1Nanoparticles used in the study:

The nanomaterials used in our current study were purchased locally from one of the scientific offices in Baghdad Governorate and are as follows

.1Zinc Oxide Nanoparticles (ZnONPs): It is a white powder with a size of 50 nm and a purity of 99.5%, produced by US Research Nanomaterials, Inc.

.2Silver Nanoparticles (AgNPs): It is a black powder with a size of 30 nm and a purity of 99.9%, produced by Hongwu International Group Ltd.

-3Selenium Nanoparticles (SeNPs): It is a black powder with a size of 50 nm and a purity of 99.5%, produced by Hongwu International Group Ltd.

.2.2Preparing study solutions:

The base solution of 1000 ppm for each of the nanomaterials used in our study was prepared by dissolving 1 g of the material in 1 liter of distilled water. To obtain a homogeneous solution and to reduce clumping of the sample, use a device (Silent Crusher Homogenizer - Heidolph 10 rpm × 1000) for 10 minutes for each solution. A solution with a concentration of 1000 ppm was obtained

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Then a series of concentrations (0, 200, 400, 600, 800, 1000) ppm were prepared by diluting the base solution for each of the materials used in the study using distilled water. Concentration (0.0) refers to the control treatment in which we used only distilled water.

.2.3Calculating the percentage of death of adults and larvae of the lesser grain borer insect:

The wheat grains treated with nanomaterials were placed in 250 ml plastic bottles at a rate of 30 g/bottle (Figure 9) for three replicates in addition to the control treatment. Five newly hatched pairs of insects (5 males + 5 females) were introduced into each bottle with their nozzles covered. Tightly with a cloth, tied with rubber belts, it was placed in the incubator at a temperature of 32°C + 2 and the relative humidity was set to 70 + 5%. The number of dead insects was counted daily for 10 days and in each replicate, and percentage killing readings were taken according to the equation [9.[

.2.4Testing the effect of attraction and repulsion of nanomaterials on adults of the lesser grain borer insect:

This test was performed using a home-made chemotropism device based on the Folsom Chemotropometer (This device consists of a wooden box 70 cm long, 30 cm next to 30 cm, and with a moving space on two facing weavers on two opposite sides of the recording side. It passes through a glass box 100 cm long and 2.5 cm in diameter. In the middle of this connection there is a hole through which recording is done 1931(

This tube is divided into sections. At its ends, the wheat base, which is designated with different materials, is placed and moves and hides according to the pre-determined concentrations of each nano-substance, but at the end it loses the passing point for comparing the soaked and distilled benefit

After that, 10 insects were recorded, and the repeater appeared once, and three repetitions occurred within the movement, and the number of polyester cells was recorded at a distance of 25 cm from the mesh to the front, after 20 minutes of textile movements, and the attraction factor, the dynamic ratio, and the proportional ratio were calculated, according to the following equations [10.[

Attraction rate % = [redacted](The number of insects that moved @towards the tested material @and traveled a distance of 25 cm @from the center)/(The total number of insects(

Repellence rate % = [redacted](The number of insects that moved opposite @the direction of the material @and traveled a distance of 25 cm@ from the center)/(The total number of insects(

Balance ratio % = attraction ratio - repulsion ratio

If the final result is

) + =meaning that the substance attracts insects(

) - =meaning that the substance repels insects (.[11] ,[10]

.4Results and Discussion:

The results of Table No. (1) showed that the various nanomaterials have an effect on the rate of larvae boring into large grains, especially since nano-zinc may outperform the rest of the various materials in its effect on the effect of killing insect larvae. A was recorded on the rate of stimulation of focal nano-zinc at 1000 ppm. It is 92% larvae, while the lowest percentage allocated to larvae is 44.0% larvae recorded for nano selenium at a concentration of 200 ppm.

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The data recorded in the table above also indicated a difference in the effect of days on the rate of killing of insect larvae, as the rate of killing on the tenth day was 88.29% of larvae, while the lowest rate of killing of larvae on the first day was 22.44% of larvae.

It was shown from the results recorded in the above-mentioned table that the interaction between nanomaterials and their concentration has a large and clear effect on the killing rate of micrograin borer larvae. In the case of selenium, the highest larval killing rate of 100% was recorded for the interaction between days 8, 9, and 10 and the concentration is 1000ppm, while the lowest killing rate was 13.33%. It was recorded for an interaction between exposure time of 1 day and concentrations of 200 and 400 ppm. As for the nano-silver element, it was noted that the highest killing rate of 100% was recorded for the intervention between days 5, 6, 7, 8, 9, 10 and all five nano concentrations included in the study

.Thus, the results of Table 1 also indicated that with regard to nano-zinc, it was observed that the highest percentage of killing larvae, which is 100%, was recorded for the overlap between days 6, 7, 8, 9, and 10 and all five concentrations, while the lowest percentage of killing larvae was 16.66%. It was recorded for an interaction between 1 day of exposure and concentrations of 200, 400, and 600 PPm.

These results accepted with Salunkhe et al. (2011) after exposing the second and second instar larvae to different concentrations of silver particles, and they also achieved proportional killing rates and compatibility with the concentrations used by them against these types of mosquitoes.

These results accepted with [12] sfter exposed the southern cowpea weevil for different concentrations of the silver nanoparticles . When they founded aLarge and significant differences in appearance, growth and reproduction of this stored insect.

These results also agreed with [13] after exposing an individual cotton leafworm to silica nanoparticles, they found that the killing rate of this insect increased directly with increasing concentrations of silica nanoparticles.

Our results also accepted with with all of the researchers [14], who explained and showed that the discriminating silver element had a significant effective and significant effect on antioxidants and the activity of insect enzymes, which causes oxidation and then the death of the insect. At the same

time, the discriminating silver particles also reduce the activity of the enzyme Acetylcholinesterase, which breaks down and decomposes neurotransmitters. Such as acetylcholine, and here the endosome acts as an inhibitor of the trypsin enzyme, which causes confusion in the digestive system and thus confuses growth and reproduction..

The results of 1 also accepted with [16] a possibility of nine, their scope for two types of dangerous and essential insects of storage grains, which are the lesser grain borer and Sitophilus oryzae, as they found there is a reason for killing a major failure after exposing the insect individuals of both species directly above to lethal concentrations of nano-aluminium

These results also accepted with [16] after they exposed two types of dangerous and essential insects of storage grains, which are the lesser grain borer, Rhyzopertha dominica and Sitophilus oryzae, to Aluminium nanoparticles so after that they found they found there is ahighly killing in both insect species after using lethal concentrations of

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nano-aluminium againt these primary stored insects.

The results also disappeared after those who found high mortality in proportion to increasing concentrations of silver and zinc against the oleander aphid after exposing the colonies of this insect to concentrations of silver and zinc

The results also accepted with [17] who showed high mortality rates that were directly proportional to thev different concentrations of siver against housefly Bemisia domestica.

The results also accepted with [18] who showed that the rusty flour beetle Tribolium castaneum and the red flour beetle T. confusum can be controlled using Nano-DE nanoparticles, as these materials led to an increase in the death rate of their larvae and a decrease in the percentage of eggs laid compared to the treatment. Control. The study also indicated that these substances can be removed by traditional grinding of wheat grains

.

Table 1. The effect of Selenum, Silver and Zinc nanoparticles on Lesser grain borer , Rhyzopertha dominica larval stage .

Nanoparticles		Percentage of larvae killed (%)										Effect of nanomaterials
		Exposure duration (day)										
		1	2	3	4	5	6	7	8	9	10	
Control		0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 k
Selenium	200	13.3 uvw	16.6 tuv	30.0 pqrst	46.6 klmno	50.0 jklmn	56.6 hijkl	56.6 hijkl	56.6 hijkl	56.6 hijkl	56.6 hijkl	44.00 j
	400	13.3 uvw	20.0 st uv	33.3 o pqrs	46.6 kl mno	50.0 j klmn	50.0 j klmn	60.0 ghijk	66.6 fghi	66.6 t ghi	66.6 t ghi	47.33 j
	600	16.6 t uv	20.0 stuv	33.3 opqrs	53.3 ijklm	60.0 ghijk	66.6 fghi	76.6 cdef	83.3 bcde	83.3 bcde	83.3 bcde	57.66 i
	800	16.6 tuv	23.3 rs tu	43.3 l mnop	53.3 ijklm	66.6 fghi	73.3 d efg	76.6 c def	86.6 a bcd	86.6 a bcd	86.6 a bcd	61.32 h
	1000	16.6 t uv	36.6 n opqr	40.0 mnopq	53.3 ijklm	76.6 cdef	83.3 bcde	86.6 abcd	100.0 a	100.0 a	100.0 a	69.33 g
Silver	200	13.33 uvw	20.0 stuv	26.66 qrstu	30.0 pqrst	53.33 ijklm	76.66 cdef	86.6 abcd	90.0 abc	90.0 abc	90.0 abc	57.66 i
	400	20.0 stuv	40.0 mnopq	66.66 fghi	93.33 ab	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	82.00 de
	600	26.6 qrstu	60.0 ghijk	86.66 abcd	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	87.33 bc
	800	30.0 pqrst	70.0 efgh	86.66 abcd	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	88.66 ab
	1000	40.0 mnoq	70.0 efgh	83.33 bcde	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	89.33 ab
Zinc	200	16.66 tuv	43.3 lmnop	56.66 hijkl	73.33 defg	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	78.00 ef
	400	16.66 tuv	36.6 nopqr	50.0 jklmn	83.33 bcde	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	77.66 f
	600	16.6	46.6	76.66	100.0	100.	100.	100.	100.	100.	100.	84.00

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		6 tuv	klmno	cdef	a	0 a	0 a	0 a	0 a	0 a	0 a	cd
	800	36.6 nopqr	63.33 fghij	96.66 ab	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	89.66 ab
	1000	43.3 lmnop	76.66 cdef	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	100.0 a	92.00 a
Effect of days		22.44 h	40.20 h	56.87 f	70.83 e	77.29 d	81.66 c	83.95 bc	86.45 ab	86.52 ab	88.29 a	

Numbers with similar letters mean that there are no fignificant differences between the means of the coefficients according to the Duncan multiple range test and the level of the test .

The results of Table No. (2) showed that the nanomaterials varied in their effect on the Rhyzopertha dominica adult killing rate . It was clear that nano-zinc outperformed the rest of the nano-materials in its effect on the rate of killing insect adults. The highest killing rate was recorded for nano-zinc at a concentration of 1000 ppm, which is 90.33% of insects, while the lowest percentage of adult killing e is 31.0% of insects, recorded for nano selenium at a concentration of 200 ppm.

The data recorded in the aforementioned table also indicated a variation in the effect of exposuer time s on the adult stage killing rate e, as the rate of killing on the tenth day was 87.44 % adults, while the lowest rate o adult killing 21.24 % in the first day of exposure time..

It was shown from the results recorded in the table mentioned above that the interaction between nanomaterials and their concentration has a large and clear effect on the adult stage killing rate . In the case of the nano-element selenium, it was noted that the highest adult killing rate is 100% is recorded for the interaction treatment between 8, 9, and 10 days at the concentration 1000 ppm, while the lowest adult killing rate 13.33% was recorded for the interaction treatment between the exposure period of 1 day and all five concentrations included in this study.

Thus, with regard to the nano-silver element, it was found that the highest killing rate of 100% was recorded for the interaction between the exposure time of 4, 5, 6, 7, 8, 9, and 10 day and the 600, 800, and 1000 ppm concentrations , while the lowes adult killing percentage, 3.33%, was recorded for the interaction treatment between the exposure period is 1 day and the 200 ppm concentration . What is worth noting is that with regard to the nano-element zinc, it was observed that the highes adult killing percentage 100% was recorded for the overlap between exposure days 7, 8, 9, and 10 and all five nano concentrations included in this study, while the lowest percentage of adult killing, which is 23.33%, was observed. For the overlap between the exposure time of 1 day and the of 200 and 400 ppm. Nanoconcentrations .

These results accepted with [19] after exposing the second and second instar larvae to different concentrations of silver particles, and they also achieved proportional killing rates and compatibility with the concentrations used by them against these types of mosquitoes.

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These results also agreed with [13] after exposing an individual cotton leafworm to silica nanoparticles, they found that the killing rate of this insect increased directly with

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increasing concentrations of silica nanoparticles.

Our results also accepted with with all of the researchers [14], [15] who explained and showed that the discriminating silver element had a significant effective and significant effect on antioxidants and the activity of insect enzymes, which causes oxidation and then the death of the insect. At the same

time, the discriminating silver particles also reduce the activity of the enzyme Acetylcholinesterase, which breaks down and decomposes neurotransmitters. Such as acetylcholine, and here the endosome acts as an inhibitor of the trypsin enzyme, which causes confusion in the digestive system and thus confuses growth and reproduction.

The results of 1 also accepted with [16] a possibility of nine, their scope for two types of dangerous and essential insects of storage grains, which are the lesser grain borer and Sitophilus oryzae, as they found there is a reason for killing a major failure after exposing the insect individuals of both species directly above to lethal concentrations of nano-aluminium

These results also accepted with [16] after they exposed two types of dangerous and essential insects of storage grains, which are the lesser grain borer, Rhyzopertha dominica and Sitophilus oryzae, to Aluminium nanoparticles so after that they found they found there is ahighly killing in both insect species after using lethal concentrations of nano-aluminium againt these primary stored insects.

The results also disappeared after those who found high mortality in proportion to increasing concentrations of silver and zinc against the oleander aphid after exposing the colonies of this insect to concentrations of silver and zinc

The results also accepted with [17] who showed high mortality rates that were directly proportional to thev different concentrations of siver against housefly Bemisia domestica.

The results also accepted with [18] who showed that the rusty flour beetle Tribolium castaneum and the red flour beetle T. confusum can be controlled using Nano-DE nanoparticles, as these materials led to an increase in the death rate of their larvae and a decrease in the percentage of eggs laid compared to the treatment. Control. The study also indicated that these substances can be removed by traditional grinding of wheat grains

.

Table 2. The effect of Selenum, Silver and Zinc nanoparticles on Lesser grain borer, Rhyzopertha dominica adult stage.

		Percentage of adult murder(%)										
Nanoparticles		Exposure duration (day)										Effect of nanomaterials
		1	2	3	4	5	6	7	8	9	10	
Control		0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 w	0.0 k
Selenium	200	6.66 xyz	6.66 xyz	13.33 vwxyz	20.0 tuvwxy	36.6 opqrst	43.3 mnopqr	43.3 mnopqr	46.6 lmnopq	46.6 lmnopq	46.6 lmnopq	31.00 h
	400	13.	23.	30.	40.0	50.0	56.6	66.6	70.0	70.0	70.0	49.00

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		3 vwxyz	3 stuwx	0 qrstuv	nopqrs	klmnop	6 ijklmn	fghijk	efghij	efghij	efghij	g
	600	13.33 vwxyz	23.33 stuwx	23.33 stuwx	43.33 mnopqr	56.66 ijklmn	66.66 fghijk	70.00 efghij	83.33 abcdef	83.33 abcdef	83.33 abcdef	54.66 fg
	800	13.33 vwxyz	26.66 stuvw	36.66 opqrst	46.66 lmnopq	70.00 efghij	80.00 bcdefg	86.66 abcde	90.00 abcd	90.00 abcd	90.00 abcd	63.00 e
	1000	13.33 vwxyz	30.00 qrstuv	43.33 mnoqr	56.66 ijklmn	76.66 cdefgh	83.33 abcdef	86.66 abcde	100.0 a	100.0 a	100.0 a	68.66 d
Silver	200	3.33 yz	10.00 wxyz	26.66 stuvw	46.66 lmnopq	66.66 fghijk	73.33 defghi	80.00 bcdefg	80.00 bcdefg	80.00 bcdefg	80.00 bcdefg	54.66 f
	400	16.66 uvyxz	30.00 qrstuv	60.00 hijklm	73.33 defghi	93.33 abc	96.66 ab	100.00 a	100.00 a	100.00 a	100.00 a	77.00 c
	600	30.00 qrstuv	53.33 jklmno	63.33 ghijkl	76.66 cdefgh	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	82.33 b
	800	33.33 pqrstu	56.66 ijklmn	83.33 abcdef	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	87.33 a
	1000	40.00 nopqrs	70.00 efghij	86.66 abcde	100.00 a	100.00 a	100.00 a	100.00 a	100.0 a	100.00 a	100.00 a	89.66 a
Zinc	200	23.33 stuwx	43.33 mnoqr	53.33 jklmno	63.33 ghijkl	70.00 efghij	93.33 abc	100.00 a	100.0 a	100.00 a	100.00 a	74.66 c
	400	23.33 stuwx	40.00 nopqrs	46.66 lmnoq	63.33 ghijkl	86.66 abcde	100.00 a	100.00 a	100.0 a	100.00 a	100.00 a	76.00 c
	600	33.33 pqrstu	53.33 jklmno	86.66 abcde	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	87.33 a
	800	36.	70.	86.	100.	100.	100.	100.	100.	100.	100.	89.33 a

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		6 opqrst	0 efghij	6 abcde	00 a	00 a	00 a	00 a	00 a	00 a	00 a	
	1000	40.00 nopqrs	73.33 defghi	90.0 abcd	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	100.00 a	90.33 a
Effect of days		21.2 h	38.1 g	51.8 f	64.37 e	75.41 d	80.62 c	83.33 b	85.62 ab	85.62 ab	87.44 a	

Numbers with similar letters mean that there are no fignificant differences between the means of the coefficients according to the Duncan multiple range test and the level of the test .

The results of Table 3 showed that the types of nuclear particles included in this study showed specific differences and differences between the three types of particles in their attractive effect on the grain borer and the complete particles of the major grain borer Rhyzopertha dominica. It was reported that the highest attraction rate was 29.33 records for the element selenium, while the lowest rate of attraction for insects. The minute is 24.66 records for a difference element, as indicated in data table 3. The type of difference also has a large effect on the rate of attraction for the entire insect, as the rate of attraction is 28.885, aiming for a concentration of 200 ppm, while the lowest rate of attraction is 24.44% for a concentration of 800 ppm Thus, the results of Table 3 also show that there is a significant impact of the three various elements mentioned above, as they have a significant impact on the proportion of passengers against the role of the adult insect of the major grain borer, where the highest percentage of repellency, which is 44.66%, was recorded for the silver element and the groups together, while the lowest percentage of repellency against the insect, which is 44.00%, was recorded for the element. As for a large portion of the student percentage, the results of 2 also showed that the highest expulsion rate, which is 47.77%, was recorded for the concentration of 1000 ppm, while the lowest expulsion rate, which is 42.22, was recorded for the concentration of 200 and 400 ppm. But with regard to the effect of the balancing factor, it contributed that the factor of the type of nanostructure has a large and clear effect on the rate of attraction and repulsion, as the results of Table 3 showed that the highest rate of repulsion, which is -16.66%, is recorded for the element silver, while the lowest rate of repulsion, which is -15.33%, is recorded for the nanoelement selenium. However, with regard to the effect of the balancing factor, it was found that the factor of the type of nanoscale difference has a large and clear effect on the ratio of attraction and repulsion, as the results of Table 3 showed that the highest percentage of repulsion, which is -16.66%, is recorded for the nano-element silver, while the lowest percentage of repulsion, which is -15.33%, is recorded for the nano-element selenium. The results of the table above also showed that the concentration factor has an impact and confirms the balancing factor between the extruder and the extruder. The highest characteristic, which is -22.22, indicates a concentration of 1000 ppm, while the lowest percentage, which is -13.33%, is recorded for a concentration of 200 ppm. Hence, it becomes clear that many of the discrepancies all pursue the grain piercer more

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than outperforming the workforce according to the factors and outcomes of the result.

Table 3. The effect of nanoparticles on the rates of attraction, repulsion, and balance of Lesser grain borer ,Rhyzopertha dominica .

Effect rate of nanomaterials/days		Attraction ratio	Repulsion ratio	Balancing ratio
Selenium		29.33[a]	44.66[a]	-15.33[a]
Silver		26.66[ab]	44.66[a]	-18.66[a]
Zinc		24.66[b]	44.00[a]	-18.33[a]
Effect rate of nanomaterial concentrations				
200 ppm		28.88[a]	42.22[a]	-13.33[a]
400 ppm		26.66[a]	42.22[a]	-15.55[ab]
600 ppm		27.77[a]	44.44[a]	-16.66[abc]
800 ppm		24.44[a]	45.55[a]	-21.11[bc]
1000 ppm		26.66[a]	47.77[a]	-22.22[c]
Celenium	200 ppm	30.00[a]	43.33[a]	-13.33[a]
	400 ppm	30.00[a]	43.33[a]	-13.33[a]
	600 ppm	30.00[a]	46.66[a]	-16.66[ab]
	800 ppm	26.66[a]	43.33[a]	-16.66[ab]
	1000 ppm	30.00[a]	46.66[a]	-16.66[ab]
Silver	200 ppm	30.00[a]	43.33[a]	-13.33[a]
	400 ppm	26.66[a]	40.00[a]	-13.33[a]
	600 ppm	26.66[a]	43.33[a]	-16.66[ab]
	800 ppm	23.33[a]	46.66[a]	-23.33[ab]
	1000 ppm	26.66[a]	50.00[a]	-26.66[b]
Zinc	200 ppm	26.66[a]	40.00[a]	-13.33[a]
	400 ppm	23.33[a]	43.33[a]	-20.00[ab]
	600 ppm	26.66[a]	43.33[a]	-16.66[ab]
	800 ppm	23.33[a]	46.66[a]	-23.33[ab]
	1000 ppm	23.33[a]	46.66[a]	-23.33[ab]

Numbers with similar letters mean that there are no significant differences between the means of the coefficients according to the Duncan multiple range test and the level of the test.

Conclusions:

We conclude from the results of this study that the types of nanoparticles have a significant, effective and significant effect on the killing rate in the larval stage and in the adult stage of the lesser grain borer, Rhyzopertha dominica. Only the nano-zinc element outperforms the silver and selenium elements in the killing rate in larvae, and thus this element outperforms in killing adults as well. We conclude that the killing period also has a significant and clear effect on the killing rate in the larval and adult stages of the insect, where the highest killing rate was recorded during the exposure period of 10 days. We also conclude that the stored insect killing rate began to increase with increasing concentrations and exposure times

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of the Selenium Silver and Zinc nanoparticles three. We also conclude that the behavior of repulsion is superior to the behavior of attraction against this insect adults by these nanoelements

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