Efficacy And Characterization Of Synthesized Zinc Oxide Nanoparticles Against Tribolium Castaneum And Trogoderma Granarium

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Abstract: Nano sciences and nanotechnology are the study of extremely small things at nm scale. The present studies were carried at Chemistry Laboratory, Punjab Bioenergy Institute, University of Agriculture Faisalabad. Different and mixed age *Tribolium castaneum* and *Trogoderma granarium* was collected from grain market which is located to be Faisalabad. The population for each of the two insect were acclimatized to the laboratory. To raise homogenous population, pupa of the same age were collected during in rearing of insect and in separate plastic jars for adult emergence (2 weeks). After extraction of plant materials, biosynthesis of nano-particles was done accordingly to standard procedure. Toxicity Bioassays were done by three concentrations (5, 10 and 15 %) of the plant extracts (for each of the simple plant oils as well as nano-particles). Data according to mortality was recorded after 24, 48 and 72 hours of the treatment.Highest mortality (15.10%) and lowest (46.12%) was noticed against *Tribolium castaeium*. In case of nanoparticles data, 66.32% mortality was recorded by ZnO oxide particles against the *Tribolium castanium* and 49.51% against *Trogoderma granarium*. Repellency bioassay was done by area preference method. ZnO gave highest repellency 79.17. 77.56% ZnO highest replency was, against the *Trogoderma granarium*.Data of all the bioassays were analyzed by factorial under CRD statistical design.

Key words: nanotechnology, Bioenergy, mortality, *Tribolium castaeium*, ZnO oxide particles, *Trogoderma granarium*

INTRODUCTION

Nano sciences is an emerging and vastly developed form that can encompasses the fundamental's elements which can understand and advanced arising form of exploitation of materials, which have one dimension. It has an ability to control individual atoms and molecules. It is the one of the most effective technology in recent decades [1]. It has an application to control the matter at molecular stage. It also have an ability to design, characterized structural application and also control the shape and size of the molecule at nano scale. Nano particle (Nano powder, Nano cluster, Nano crystal) are the small building block of Nano technology[2]. Recently nanoparticles have become commercial in nature because of their new application such as environmental protection,data storage, biology, cosmetics products, medicines due to their optical, physical and megnatic properties [3].Nano particles can be characterized into following parts such as Quatum dots, organic nanoparticles or metal oxides (Al2O3, In2O3, NiO, Tio2, ZnO, ZrO2, SnO2, CuO, MgO, Cu2O, La2O3, CeO2), carbon nanotubes and fullerenes are also part of this and inorganic or metals (Al, Co, Ni, Fe, Au, Mo, Zn, Ag, Ti,Bi, W) [4]). Store grains and their products are attacked different insects which can cause huge losses. [5]. Storage of cereals is about to 9 % losses occurred in developed countries and 20% in more developing countries [6]it effects on the qualitative

and quantitative loses of grains [7].Postharvest loses range from 10 to 25% throughout the world due to infestation of insect pests and microbial deterioration [8].Wheat is the staple food of Pakistan, also cultivated all over the world expect the Antarctica [9]. Globally, Pakistan is the 3rd largest food crop and eight in world-wide wheat producing country [10]. All stored grain insect pests most disreputable is red flour beetle *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae), is a pervasive pest of store commodities like wheat flour and a crushed cereals, is also the cosmopolitan and most distructive insect pest [11]The quality of grains reduced due to frass and excreta in damage grains, it can create an adverse effect on environment but infested grain an acute effect on human health [12]. *T. granarium* makes unable to germinate the grain because when it attacks there larvae during feeding consume specific nutrients [13].

The *T. castaneum* and *R. dominica* are primarily controlled by fumigant insecticides [14]but use of fumigants has become limited due to development of resistance and environmental hazards because of their reckless and injudicious use against these insect pests[15]. Other chemicals like pyrethroids are being also used for the control of stored grains insect-pests, but consistent use of theses insecticides may lead to serious problems related to biochemical and hematological changes in the human beings [16]. Conventional insecticides also pose hazardous effect on non-target organisms including beneficial insects [17]. Due to less efficiency of traditional method can't control the insect pests to damage the store grained crop therefore now we can use the advance technology such as nano materials. Nano materials can deliver the DNA and the many reactive chemicals into plant tissues for the protection of host plants against insect pest.But now we can use the advance technology such as silver, zinc and titanium oxide nanoparticle. It can be prepared through following method such as Physical Method, Chemical Method and Biological Method.

METHODLOGY

The present works will be carried out at energy physics Laboratory, Punjab Bioenergy institute, University of Agriculture Faisalabad.

Collect and rearing the test culture insect

Different and diverse age *T.castaneum* and *T.granarium* will be collected through grain market which is situated in Faisalabad. The population for all of the tow insect assimilate to the laboratory and 1.5 kg capacity having commodity in plastic jars (firstly decontaminate the store grains for *T.granarium* and store grain flour for *T.castaneum*, it can decontaminate for 30 minutes in 70 ℃ through the oven (Lab Line Instrument Inc. Model No.3512-1) and it shielded through muslin cloths. Both insects' after three days from commodity adults will be sieved out. Target insects can have eggs which can be sieved commodities, will be placed in jars and it can place in an optimal condition (65±5⁄R.H. and 30±2 ℃) and it can be homogeneous and also getting the $F_{1\ population}$ (Hbib-ur-Rehman, 2018). Bottles will be removed after 3 days then shift the bottles into new jars, the floor left behind will contain the eggs, hatching time period is near about 3 to 5 days [18].

To raise homogenous population pupa of the same age will be collected during rearing of insect and in separate plastic jars for adult emergence (2 weeks) [18].Firstly we can collect the leaves of *R. communis, Jatropha curcus* and *Citrus paradise* from different localities in Faisalabad, The identified samples were bought to the Department of Chemistry, Punjab Bioenergy Institute for further work. The sample leaves was thoroughly washed with tap water followed by distilled water to remove the impurities [19].

The wet plant leaves were kept on shade for 25 days and put in air dry.Dried leaves will be converted into powder form through the electrical grinder (Pascal engineering Co. ltd., Gatwick road crawley Sussex, England) and it will be sieved through a mesh (40mm) then we acquire a fine powder form [20]After shading, drying and grinding, 50g of *Ricinus communis* leaves powder material extract were put in the Soxlet apparatus by dipping or mixing 100ml of the methanol, chloroform, petroleum ether and n-hexane for 24 hours at 220 revolution per minute [21]. For the storage of plant powder we were used the opaquae screw caped air tight containers, which would make them moisture free. After this containers were kept at room temperature for further use. The samples were also being stored in refrigerator at 4℃. We can form different concentration such as 8%, 10.0% and 12% from the stock solution of each plant [22]. We were use the filter paper dip method. As an exposure chamber we can use the petri dish. In each petri dish, can placed the 5cm in diameter paper. Ethanol mixed extract *R. communis, Jatropha curcus* and *Citrus paradise were* used. Through the use of syringe required concentration of botanical extracts sprayed on the filter paper which is placed on the petri dish. We can give 20 pupa of *T.granarium* and *T.castaneum* was put in each petri dish on the filter paper sprayed with different concentration of extracts. For the prevention of run out of pupas on the dish, we can cover the petri dish with lid [23]

BIOSYNTHESIS OF NANOPARTICLE

Silver nitrate, titanium oxide, Magnesium oxide and Zinc oxide used in this study, will be obtained from Punjab Bioenergy Institute Laboratory, Agriculture University, Faisalabad.

Preparation of silver Nano-particles

Firstly we can prepare the silver Nano particle like this way, Take the leaves powder from *R.communis*, *Jatropha curcus*, *Citrus paradise* purchased from the local market. Deionized water used in all experiments, I took 10g of *R. communis*, *Jatropha curcus* and *Citrus paradise* extracts by using weight balance, which can be boiled in 100ml distill water in 250ml conical flask. Then this extract were cooled at room temperature, filter through Whatmans No. 1 filter paper. This filtrate was an act of reducing and stabilizing agent for the synthesis of Silver nanoparticles [23]Ammonium solution will be added to AgNO3 (solution followed by addition of plant material extract 1-10ml) as described in [24]

Preparation of Zinc oxide Nano-particles

Firstly we can prepare the silver Nano particle like this way, Take the leaves powder from *R.communis*, *Jatropha curcus*, *Citrus paradise* purchased from the local market. Deionized water used in all experiments, I took 10g of *R. communis*, *Jatropha curcus* and *Citrus paradise* extracts by using weight balance, which can be boiled in 100ml distill water in 250ml conical flask. Then this extract were cooled at room temperature, filter through Whatmans No. 1 filter paper. This filtrate was an act of reducing and stabilizing agent for the synthesis of zinc oxide nanoparticles. Ammonium solution will be added to ZnO (solution followed by addition of plant material extract 1-10ml) as described in [25].

Bioassay of Zinc Oxide

Zinc oxide was synthesized by using green synthesis method. 5 ml solution of plant extracts oil from the stock solution mixed in 50 ml of distilled water, heated at 80℃ for 30 minutes at hot plate. We can add the 10 ml plant extract (oil +Distill water) in 1.5 M solution of zinc nitrate hex hydrate. The salt solution of different concentration (0.5- 2.5M) was used. The pH maintained 7-9 by adding the ammonia solution. The solution mixture was boiled at 60-80℃ or 400rpm stirring till the color would be changed to yellow paste form. Then this paste were transferred into a crucible, which was kept on furnace at 400℃ for 2 hours until the color of the precipitates changed into light yellow to white color. Then this precipitates were grinded and stored for further analysis [26].

Zinc-Oxide Dried nano-composits)

Change in color of solution during formation of zinc oxide nanoparticles by using *Jatropha curcus, Citrus paradise and R. communis* plant extracts.

Solution	Before Reduction	After Reduction	Color intensity	Time
Jatropha curcus	Dark Yellow			
1.5M zinc nitrate hex hydrate	Transparent	Pale Yellow	+	Immediately
		Yellowish white	++	After 7 hours

		White	+++	After 24 hours
Citrus paradise	Lite Yellow			
1.5M zinc nitrate hex hydrate	Transparent	Dark Yellow	+	Immediately
		Pale Yellow	++	After 7 hours
		Lite Gray white	+++	After 24 hours
R. communis				
1.5M zinc nitrate hex hydrate	Transparent	Orange yellow	+	Immediately
		Pale Yellow	++	After 7 hours
		Lite white	+++	After 24 hours

RESULTS

Current details and studies were planned to give the explanations about the toxicity, growth inhibitory activities and repellent of *Jatropha curcus ,Citrus paradise and R. communis* against *T.castaneum* and *T.granarium* under there laboratory conditions. We can conduct the experiments under specialized designs Completely Randomized Design (CRD) with all different treatments were replicated in thrice along with the control factor. Plants extracts were used at three different types of concentrations i.e., 5, 10 and 15 %, data will be regarding mortality were observed after 24, 48 and 72 hours of treatment application. At same application type/rate of plants extracts we were conducted the repellency experiments and growth inhibition individually. The data were collected regarding larval inhibition, pupa; inhibition and adult inhibition after regular intervals, while the repellency data was recorded after 24 hrs.

MORTALITY DATA AFTER EXPOSURE OF 24 HRS

Table 1 reveals the analysis of variance (ANOVA) of data regarding mean percentage mortality of *T. castaneum* at different concentrations of *Jatropha curcus ,Citrus paradise and R. communis.* Data showed that main effects, plants (F=4.66; df=1: $p<0.05$) and concentration (F=11.10 df=;2 $p<0.05$) were significant regarding mortality values of *T. castaneum* after exposure period of 24 hours.

Table 1. Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for different plant extracts

S.O.V	DF	SS	MSS	F value
Plant	3	293.667	97.222	4.76*
Concentration	2	463.500	233.250	11.12**
Plant*Concentration	6	70.843	11.87	1.576*
Error	24	500.000	20.843	
Total	35	1326.000		

NS = Non-significant (P>0.05);* = Significant (P<0.05); ** = Highly significant (P<0.01)

Table 2. Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	4.68 ± 1.43 c
10	9.37 ± 1.29 b
15	13.40 ± 1.66 a

The mean mortality was 4.68 % at 5% concentration and 13.40% mortality was observed at 15% concentration of the plant extracts. From results we can conclude that concentration has significant effect on percent mean percent mortality of *T. castaneum*.

4.3 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different plant extracts after 24 hrs Table 4.3 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 12.23 and 11.65%,correspondly . While least mortality 5.57% was given by extract of *Citrus paradise.*

4. Comparative mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs.

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	1.77±0.09 d
Citrus paradise x 10	8.04±1.75c
Citrus paradise x 15	11.26±2.64 bc
Jatropha curcus x 5	5.02±1.91 cd
Jatropha curcus x 10	13.76±3.03 bc
Jatropha curcus x 15	18.44±3.12 a
Ricinus communis x 5	10.22±1.96 bc
Ricinus communis x 10	14.73±3.39 ab
Ricinus communis x 15	15.10±3.57 ab

Table 4 showed that maximum mortality 18.34% was observed with 15% concentration of *Jatropha curcus* after exposure of 24 hr followed 15.00 with extract of *Ricinus communis* and g *Citrus paradise* are 11.16% at same concentrations. Mean percentage mortality of 10.12% was recorded at 5% concentration of *Ricinus communis*, followed by *Jatropha curcus* 5.01%. Minimum mean mortaliy 1.67% was given by *Citrus paradise* at 5% concentration, respectively. The mean mortality was found 14.63, 13.67% in case of *Ricinus communis* and *Jatropha curcus* at 10% concentration of plant extract. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

MORTALITY DATA AFTER EXPOSURE OF 48 HRS

Table 45 reveals the analysis of variance (ANOVA) of data regarding mean percentage mortality of *T. castaneum* at different concentrations of *Jatropha curcus, Ricinus communis* and *Citrus paradise.* Data showed that main effects, plants ($F=12.2602$; df=1: $p<0.05$) and concentration ($F=11.4878$ df=;2 $p<0.05$) were significant regarding mortality values of *T. castaneum* after exposure period of 48 hours

Table 5 Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for different plant extracts

S.O.V	DF	SS	MSS	F value
Plant	3	1047.22	349.07	12.2602**
Concentration	2	654.17	327.08	11.4878**
Plant*Concentration	6	90.28	15.05	1.5285*
Error	24	683.33		
Total	35	204.86		

NS = Non-significant (P>0.05);* = Significant (P<0.05); ** = Highly significant (P<0.01)

Table 6 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	13.75 ± 1.95 c
10	19.58 ± 1.89 b
15	24.16 ± 2.56 a

Data table 6 showed that mortality 13.75% mean percentage mortality was observed at 5% concentration and 24.16% mortality was observed at 15% concentration of the plant extracts. From results we can conclude that concentration has significant effect on percent mean percent mortality of *T. castaneum*.

7 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different plant extracts after 48 hrs.

Concentrations (%)	(%) Mean Mortality ± SE
Jatropha curcus	23.32 ± 2.63 a
Ricinus communis	25.54 ± 2.42 a
Citrus paradise	15.01 ± 1.86 b

Table 7 showed percent mean mortality values of different plant extracts at different concentration levels. Extracts of *Ricinus communis* and *Jatropha curcus* gave mortality values 25.54 and 23.32 %, correspondly.While least mortality 15.01% was given by extract of *Citrus paradise*.

8 Comparative mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 48 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	10.02±2.88
Citrus paradise x 10	11.16±1.66
Citrus paradise x 15	16.65±2.64
Jatropha curcus x 5	14.01±2.88
Jatropha curcus x 10	25.06±2.92
Jatropha curcus x 15	29.34±2.89
Ricinus communis x 5	21.66±1.66 bc
Ricinus communis x 10	24.32±3.38 ab
Ricinus communis x 15	31.67±3.40ab

Table 8 revealed that maximum mortality 31.67% was observed with 15% concentration of *Ricinus communis* after exposure of 48 hr followed 29.34 %with extract of *Jatropha curcus, Citrus paradise* gave 16.65 at 15% concentrations. Mean percentage mortality of 21.66 % was recorded at 5% concentration of *Ricinus communis* followed by *Jatropha curcus* 14.01%. Minimum mean mortaliy 10.02 % was given by *Citrus paradise* at 5% concentration, respectively. The mean mortality was found 25.06 and 24.32 % in case of *Jatropha curcus* and *Ricinus communis*, respectively at 10% concentration of plant extract. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

MORTALITY DATA AFTER EXPOSURE OF 72 HRS

Table 4.9 reveals the analysis of variance (ANOVA) of data regarding mean percentage mortality of *T. castaneum* at different concentrations of *Jatropha curcus* , *Ricinus communis* and *Citrus paradise*. Data showed that main effects, plants (F=4.66; df=1: p<0.05) and concentration (F=11.10 df=;2 p<0.05) were significant regarding mortality values of *T. castaneum* after exposure period of 72 hours.

Table 9. Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for different plant extracts

S.O.V	DF	SS	MSS	F value
Plant	3	2054.07	684.69	7.9962*
Concentration	2	3257.89	1628.94	19.0000**
Plant*Concentration	6	545.58	90.93	2.0706*
Error	24	2057.61		
Total	35	7915.15		

NS = Non-significant (P>0.05);* = Significant (P<0.05); ** = Highly significant (P<0.01)

WITH ZnO NANO-PARTICALS against *Tribolium castanium*

MORTALITY DATA AFTER EXPOSURE OF 24 HRS

To evaluate the mortality of *T. castaneum*, homogenous adults were released on treated diet in small plastic jars. Adults were allowed to feed on treated diet and data regarding mortality was recorded. Wheat grains were used as diet and three concentrations of each plant extract were used viz., 5, 10 and 15%. Mortality data was recorded for 24, 48 and 72 h of exposure period. For mortality assessment insects were kept in incubators at 30±2 ºC and 60±5 % RH. Each treatment and control were replicated three times.

Table 4.1 reveals the analysis of variance (ANOVA) of data regarding mean percentage mortality of *T. castaneum* at different concentrations of *Jatropha curcus ,Citrus paradise and R. communis.* Data showed that main effects, plants (F=4.66; df=1: p<0.05) and concentration (F=11.10 df=;2 p<0.05) were significant regarding mortality values of *T. castaneum* after exposure period of 24 hours.

13. Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for ZnO based nano-particals

S.O.V	DF	SS	MSS	F value
Plant	2	2137.520	1068.760	54.1791**
Concentration(Conc.)	2	1438.431	719.215	36.4594**
Plant*Concentration	4	400.542	100.136	5.0762*
Error	18	355.076	19.726	
Total	26	4331.569		

Table 14. Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	9.16 ± 1.99 c
10	18.09 ± 3.35 b
15	27.04 ± 4.99 a

Data in table 2. represents the insecticidal effect of different concentrations of 3 different oil against *Tribolium castaneum*. The experimental data revealed that maximum mortality (27.04 %) at 15% was recorded. The mean mortality was 18.09 % at 10% concentration and 9.16% mortality was observed at 5% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. castaneum*.

15 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	8.34 ± 1.67 c

Concentrations (%)	Mean percentage mortality ± SE
P2	16.12± 2.16 b
P3	29.85 ± 4.79 a

Table 4.3 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 29.85 and 16.12%,correspondly . While least mortality 8.34 % was given by extract of *Citrus paradise.*

16 Comparative mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	3.34±1.67 g
Citrus paradise x 10	8.34±1.67 efg
Citrus paradise x 15	13.34±1.67 def
Jatropha curcus x 5	8.34±1.67 fg
Jatropha curcus x 10	18.34±1.67 cd
Jatropha curcus x 15	21.67±1.67 bc
Ricinus communis x 5	15.82±1.68 de
Ricinus communis x 10	27.69±6.06 b
Ricinus communis x 15	46.12±1.68 a

Table 4. showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. castaneum* was given in percentage by the application of extract of *Ricinus communis, Jatropha curcus, Citrus paradise* oil along with standard error in table 4.

Mean comparison of percentage mortality values of *T. castaneum* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (46.12 %) at 15% was recorded. The mean mortality was 27.60% at 10% concentration and 15.82% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (21.67%) at 15% was recorded. The mean mortality was 18.34% at 10% concentration and 8.34% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (13.34%) at 15% was recorded. The mean mortality was 8.34% at 10% concentration and 3.34% mortality was observed at 5% concentration of the plant extracts.The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

5. MORTALITY DATA AFTER EXPOSURE OF 48 HRS

Table 17. Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for ZnO based nano-particals

S.O.V	DF	SS	MSS	F value
Plant	2	2093.50	1046.75	65.5597**
Concentration(Conc.)	2	2732.05	1366.03	85.5566**
Plant*Concentration	4	418.65	104.66	6.5552*
Error	18	287.39	15.97	
Total	26	5531.59		

Table 18. Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 48 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	11.95 ± 1.33 c
10	22.54 ± 1.33 b
15	36.51 ± 1.33 a

Data in table 18. represents the insecticidal effect of different concentrations of 3 different oil against *Tribolium castaneum*. The experimental data revealed that maximum mortality (36.51 %) at 15% was recorded. The mean mortality was 22.54 % at 10% concentration and 11.95 % mortality was observed at 5% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. castaneum*.

19 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different plant extracts after 48 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	12.77 ± 2.51 c
P2	23.89± 3.31 b
P3	34.34 ± 5.51 a

Table 4.19. for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 34.34 and 23.89%,correspondly . While least mortality 12.77 % was given by extract of *Citrus paradise.*

20 Comparative mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 48 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	5.00±0.00 g
Citrus paradise x 10	11.67±1.67 efg
Citrus paradise x 15	21.67±1.67 def
Jatropha curcus x 5	11.67±1.67 fg
Jatropha curcus x 10	26.67±1.67 cd
Jatropha curcus x 15	33.33±1.67 bc
Ricinus communis x 5	19.19±0.00de
Ricinus communis x 10	29.29±2.91 b
Ricinus communis x 15	54.54±5.05 a

Table 20. showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. castaneum* was given in percentage by the application of extract of *Ricinus communis*, *Jatropha curcus*, *Citrus paradise* oil along with standard error in table 20.

Mean comparison of percentage mortality values of *T. castaneum* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (54.54%) at 15% was recorded. The mean mortality was 29.29% at 10% concentration and 19.19% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (33.33%) at 15% was recorded. The mean mortality was 26.67% at 10% concentration and 11.67% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (21.67%) at 15% was recorded. The mean mortality was 11.67% at 10% concentration and 5.00% mortality was observed at 5% concentration of the plant extracts. The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

6. MORTALITY DATA AFTER EXPOSURE OF 72 HRS

Table 21. Analysis of variance (ANOVA) of the data concerning % mortality of *Tribolium castaneum* (Herbst) for ZnO based nanoparticles

S.O.V	DF	SS	MSS	F value
Plant	2	3675.23	1837.62	196.074**
Concentration	2	3386.81	1693.40	180.686**
Plant*Concentration	4	1354.42	338.61	36.129*
Error	18	168.70	9.37	

S.O.V	DF	SS	MSS	F value
Total	26	8585.16		

Table 22. Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 72 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	10.28 ± 1.99 c
10	22.55 ± 3.14 b
15	37.66 ± 7.63 a

Data in table 22. represents the insecticidal effect of different concentrations of 3 different oil against *Tribolium castaneum*. The experimental data revealed that maximum mortality (37.66 %) at 15% was recorded. The mean mortality was 22.55 % at 5% concentration and 10.28 % mortality was observed at 10% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. castaneum*.

23 Comparison of the mean percentage mortality of *Tribolium castaneum* after exposure to different plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	10.56 ± 1.54 c
P2	21.12± 3.51 b
P3	38.83 ± 7.31 a

Table 4.23 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 38.83 and 21.12%,correspondly . While least mortality 10.56 % was given by extract of *Citrus paradise.*

24. Comparative mean percentage mortality of *Tribolium castaneum* after exposure to different concentrations of plant extracts after 24 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	5.00±0.00 g
Citrus paradise x 10	11.67±1.67 efg
Citrus paradise x 15	15.00±0.00 def

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Jatropha curcus x 5	8.33±1.67 fg
Jatropha curcus x 10	23.33±1.67 cd
Jatropha curcus x 15	31.67±1.67 bc
Ricinus communis x 5	17.50±1.68 de
Ricinus communis x 10	32.65±1.68 b
Ricinus communis x 15	66.32±3.36 a

Table 24. showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. castaneum* was given in percentage by the application of extract of *Ricinus communis*, *Jatropha curcus*, *Citrus paradise* oil along with standard error in table 24.

Mean comparison of percentage mortality values of *T. castaneum* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (66.32%) at 15% was recorded. The mean mortality was 32.65% at 10% concentration and 17.50% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (31.67%) at 15% was recorded. The mean mortality was 23.33% at 10% concentration and 8.33% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (15.00%) at 15% was recorded. The mean mortality was 11.67% at 10% concentration and 5.00% mortality was observed at 5% concentration of the plant extracts.The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

WITH ZnO NANO-PARTICALS against *Trogoderma granarium*

MORTALITY DATA AFTER EXPOSURE OF 24 HRS

Table 25. Analysis of variance (ANOVA) of the data concerning % mortality of *Trogoderma granarium* (Herbst) for ZnO based nanoparticles

S.O.V	DF	SS	MSS	F value
Plant	2	994.669	497.334	58.8831**
Concentration	2	881.393	440.697	52.1773**
Plant*Concentration	4	166.266	41.566	4.9214*
Error	18	152.030	8.446	
Total	26	2194.358		

Table 26. Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	6.36 ± 1.31 c
10	12.51 ± 2.54 b
15	20.33 ± 3.16 a

Data in table 26 represents the insecticidal effect of different concentrations of 3 different oil against *Trogoderma granarium*. The experimental data revealed that maximum mortality (20.33 %) at 15% was recorded. The mean mortality was 6.36 % at 5% concentration and 12.51 % mortality was observed at 10% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. granarium.*

27 Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different plant extracts after 24 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	7.23 ± 1.68 c
P2	10.56± 1.54 b
P3	21.43 ± 3.37 a

Table 27 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 21.43 and 10.56%,correspondly . While least mortality 7.23 % was given by extract of *Citrus paradise.*

28. Comparative mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 24 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	3.34±1.67 g
Citrus paradise x 10	5.00±0.00 efg
Citrus paradise x 15	13.34±1.67 def
Jatropha curcus x 5	5.00 ±0.00 fg
Jatropha curcus x 10	11.67±1.67 cd
Jatropha curcus x 15	15.00±0.00 bc
Ricinus communis x 5	10.77±1.68 de

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Ricinus communis x 10	20.87±3.36 b
Ricinus communis x 15	32.65±1.68 a

Table 28. showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. granarium* was given in percentage by the application of extract of *Ricinus communis*, *Jatropha curcus*, *Citrus paradise* oil along with standard error in table 28.

Mean comparison of percentage mortality values of *T. granarium* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (32.65%) at 15% was recorded. The mean mortality was 20.87% at 10% concentration and 10.77% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (15.00%) at 15% was recorded. The mean mortality was 11.67% at 10% concentration and 5.00% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (13.34%) at 15% was recorded. The mean mortality was 5.00% at 10% concentration and 3.34% mortality was observed at 5% concentration of the plant extracts. The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

MORTALITY DATA AFTER EXPOSURE OF 48 HRS

Table 29. Analysis of variance (ANOVA) of the data concerning % mortality of *Trogoderma granarium* (Herbst) for ZnO based nanoparticles

S.O.V	DF	SS	MSS	F value
Plant	2	1535.136	767.568	117.4032**
Concentration	2	1183.249	591.625	90.4918**
Plant*Concentration	4	494.613	123.653	18.9133**
Error	18	117.682	6.538	
Total	26	3330.680		

Table 30. Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 48 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	6.36 ± 1.31 c
10	14.18 ± 2.30 b

Concentrations (%)	Mean percentage mortality ± SE
15	22.58 ± 4.77 a

Data in table 4.30. represents the insecticidal effect of different concentrations of 3 different oil against *Trogoderma granarium*. The experimental data revealed that maximum mortality (22.58 %) at 15% was recorded. The mean mortality was 6.36 % at 5% concentration and 14.18 % mortality was observed at 10% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. granarium*.

31. Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different plant extracts after 48 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	7.23 ± 1.21 c
P2	11.12± 1.82 b
P3	24.80 ± 4.48 a

Table 4.31 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 24.80 and 11.12%,correspondly . While least mortality 7.23 % was given by extract of *Citrus paradise.*

32. Comparative mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 24 hrs

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	3.34±1.67 g
Citrus paradise x 10	8.34±1.67 efg
Citrus paradise x 15	10.00±0.00 def
Jatropha curcus x 5	5.00 ±0.00 fg
Jatropha curcus x 10	11.67±1.67 cd
Jatropha curcus x 15	16.67±1.67 bc
Ricinus communis x 5	10.77±1.68 de
Ricinus communis x 10	22.55±1.68 b
Ricinus communis x 15	41.07±1.68 a

Table 32. showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. granarium* was given in percentage by the application of extract of *Ricinus communis*, *Jatropha curcus*, *Citrus paradise* oil along with standard error in table 32.

Mean comparison of percentage mortality values of *T. granarium* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (41.07%) at 15% was recorded. The mean mortality was 22.55% at 10% concentration and 10.77% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (16.67%) at 15% was recorded. The mean mortality was 11.67% at 10% concentration and 5.00% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (10.00%) at 15% was recorded. The mean mortality was 8.34% at 10% concentration and 3.34% mortality was observed at 5% concentration of the plant extracts.The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

MORTALITY DATA AFTER EXPOSURE OF 72 HRS

Table 33. Analysis of variance (ANOVA) of the data concerning % mortality of *Trogoderma granarium* (Herbst) for ZnO based nanoparticles

S.O.V	DF	SS	MSS	F value
Plant	2	1774.278	887.139	95.0392**
Concentration	2	1746.274	873.137	93.5391**
Plant*Concentration	4	774.255	193.564	20.7365**
Error	18	168.020	9.334	
Total	26			

Table 34. Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 72 hrs

Concentrations (%)	Mean percentage mortality ± SE
5	8.59 ± 1.27 c
10	18.01 ± 2.67 b
15	28.16 ± 3.23 a

Data in table 34. represents the insecticidal effect of different concentrations of 3 different oil against *Trogoderma granarium*. The experimental data revealed that maximum mortality (28.16 %) at 15% was recorded. The mean mortality was 8.59 % at 5% concentration and 18.01% mortality was observed at 10% concentration of the plant extracts. From this it is concluded that mortality only increased with increase in concentrations of the 3 different plant oil and also shows that concentration has significant effect on percent mean percent mortality of *T. granarium*.

35 Comparison of the mean percentage mortality of *Trogoderma granarium* after exposure to different plant extracts after 72 hrs

Concentrations (%)	Mean percentage mortality ± SE
P1	9.45 ± 1.54 c
P2	15.06± 2.04 b
P3	27.73 ± 3.58 a

Table 4.35 for percent mean mortality values of different plant extracts at different concentration levels showed that extracts of *R. communis and Jatropha curcus* gave mortality values 27.73 and 15.06%,correspondly . While least mortality 9.45 % was given by extract of *Citrus paradise.*

36. Comparative mean percentage mortality of *Trogoderma granarium* after exposure to different concentrations of plant extracts after 72 hrs.

Plant extracts x Concentrations (%)	(%) Mean Mortality ± SE
Citrus paradise x 5	5.00±0.34 g
Citrus paradise x 10	8.30±1.65 efg
Citrus paradise x 15	15.01±0.85 def
Jatropha curcus x 5	9.47±1.81 fg
Jatropha curcus x 10	16.64±3.31 cd
Jatropha curcus x 15	20.05±2.98 bc
Ricinus communis x 5	12.45±1.68 de
Ricinus communis x 10	25.15±2.91 b
Ricinus communis x 15	49.51±3.16 a

Table 36 showed the interaction between different concentrations (5, 10 and 15%) and different exposure time period. Mean mortality of *T. granarium* was given in percentage by the application of extract of *Ricinus communis, Jatropha curcus, Citrus paradise* oil along with standard error .

Mean comparison of percentage mortality values of *T. granarium* at different concentrations of selected plant extract were highest at maximum concentration. Extract of *Ricinus communis* gave the highest mean mortality revealed that maximum mortality (49.51 %) at 15% was recorded. The mean mortality was 25.15% at 10% concentration and 12.45% mortality was observed at 5% concentration of the plant extracts. Extract of *Jatropha curcus* gave the mean mortality revealed that maximum mortality (20.05%) at 15% was recorded. The mean mortality was 16.64% at 10% concentration and 9.47% mortality was observed at 5% concentration of the plant extracts. Extract of *Citrus paradise* gave the mean mortality revealed that maximum mortality (15.01%) at 15% was recorded. The mean mortality was 8.30% at 10% concentration and 5.00% mortality was observed at 5% concentration of the plant extracts.The given outcome showed that interaction of exposure time and concentration was significant. From results we concluded that there was a gradually increase in mortality values with increase in concentration of plant extracts.

ZINC OXIDE Nano-composites

Electromagnetic radiation such as visible light is commonly treated as a wave phenomenon, characterized by a wavelength or frequencyVisible wavelengths cover a range from approximately 200 to 800 nm. Optical properties of the as-prepared ZnO nanostructure sample was revealed by UV–Vis spectrum at room temperature, as shown in Figure No. 2.This graph was shown that the intense peak would be in 365nm at room temperature in dried nanopowder form.

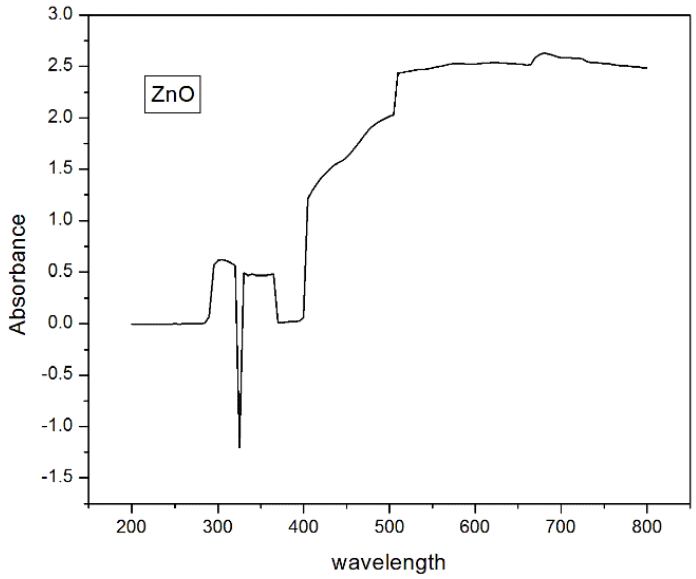

Figure 2: UV-Visible spectral analysis of ZnO

FTIR Spectra analysis of ZnO

Two milligram of Zno nanoparticales were prepared by FTIR spectra were recorded using a Nicolet 520P spectrometer with detector at 4000-400 cm-1 resolution and 20 scans per sample. FTIR Spectra of aqueous Zinc oxide nanoparticles prepared from the e *Ricinus communis* extract was carried out to identify the possible biomolecule responsible for capping and efficient stabilization of the metal nanoparticles synthesized by leaf broth. And their peaks was 3411.30 O-H Stretching, 2469.38 P-H Phosphine, 2174.39 C=C=O Stretching, 1557.44 C=O Vibration , 1409.53 CH2 Bending , 1117.32 O-C Stretching , 1085.04 O-C Stretching, 1020.47 P-OR Esters, 865.44 = CH2 Stretching, 842.14 P-O Stretching , 654.00 C-H Bending, 548.98 Zn-OH Rocking

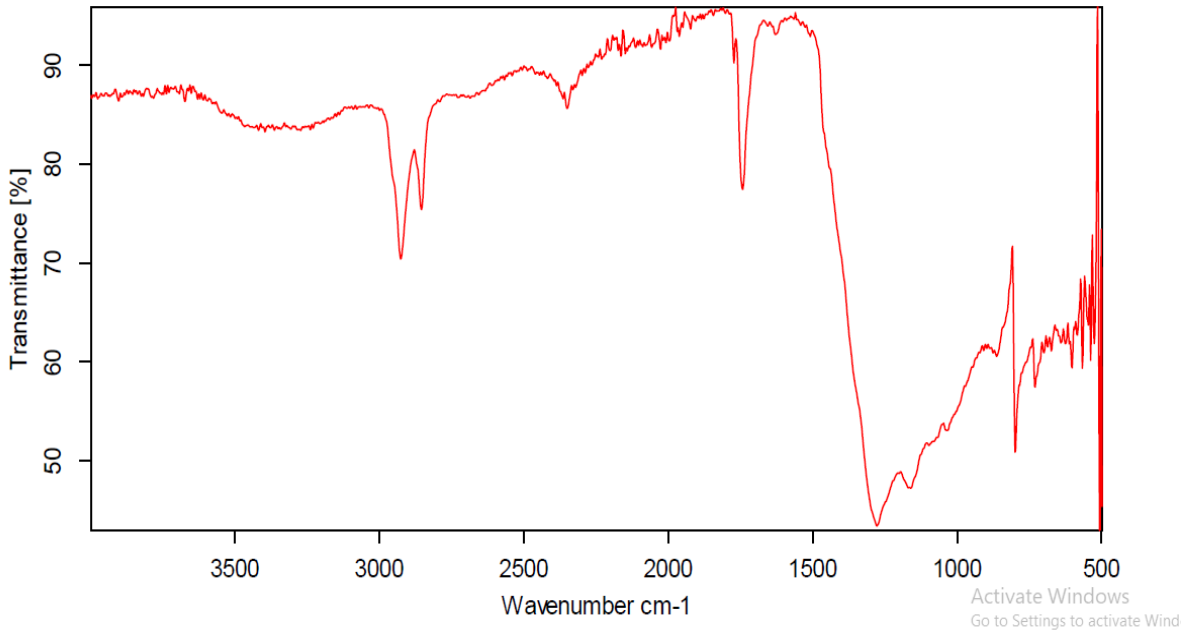

Figure.3

CONCLUSION

The present data gives the evidence that the modern Nanotechnology would also be prepare through the green synthesis method. Different solvents of plants extracts were used to prepare these nanoparticles. *Tribolium castanium* and *Trigoderma granarium* pests were created the huge effect on the soil fertility or growth. Different oil of plant extratcs were used to control this effects in past years, but it will not work properly. Hence now we can use the nano particles to control the huge disorder of fertility in our contory. Our experimnts shows that the nanoparticles works so well and so fast then the oil extracts. Results that given in the article can proved that thing properly.Therefore we can say that the nanoparticles recommended to farm leveal as for its cheap quality, availability, eco-friendly nature and good alternative form against the pest control.

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