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Test the Efficiency of Magnesium Oxide Nanoparticles in Rhizoctonia Solani Fungus Control in Eggplant

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Abstract: ***This experiment was carried out at mycotoxin laboratory, plant protection Department, College of Agriculture to test pathological ability of Rhizoctonia solani fungus on eggplant and study efficiency of magnesium oxide nanoparticles to control of the pathological fungus R. solani in the culture media PDA at laboratory. The results showed that R. solani pathological fungus isolation gave high rate infection on eggplant seeds compared with the control sample (without fungus addition) where the rate of infection by the fungus (in germination index) in which the germination ratio without fungus presence was 97.33% and it was with fungus treatment 12%. The results showed also effect of MgO nanoparticles in inhibition of the pathological R. solani fungus at 1% , 2% and 3% compared with the control sample, and the inhibition rates were 96.33% ,100% and 100% respectively where the MgO nanoparticles affected greatly and reached to 100% in the pathological R. solani fungus inhibition on eggplant seeds.***

Keywords: Eggplant, Inhibition, MgO nanoparticles, Rhizoctonia solani

1. Introduction

R. solani fungus is considered as the most pathogenic importance soil fungus which may attack many crops such as tomatoes and eggplant and it causes seedlings death disease, roots decay and seeds decay (Al-Selah, 2005). Many methods were being used to control of many fungus diseases such as the use of biotic factors and the widely used organisms in the present time is R. solani fungus and Trichoderma harzianum which is used as alternative of the chemical pesticides (Grey and Kuykendall, 1998; Ozbay and Newman, 2004; Benites et al, 2004; Moraly , 2007; Vermal et al , 2007; Montealegre et al , 2010)

The new trend focus on applying Nano technology in food and agricultural sector (Fakruddin et al ,2013; Prasad et al ,2014) and this technical serves the farmers who don't have elements of success in their countries in which the optimum use of the agricultural elements is sponsor to get high production (Lal, 2007) . The new studies showed that mineral nanoparticles bear distinct chemical and physical properties due to their small size, special shapes and have surface with good reaction agree with the biotic systems and this allow to be linked with biotic compounds (Yin et al , 2006; Puzyr et al , 2004; Puzyr et al , 2007). Some of the nanoparticles such as (SiO_2, MgO and ZnO) are not environmentally suitable to propagated the pathogenic fungus and inhibition and destroying the toxins which were produced by it (Rico et al ,2011). The studies referred to the active effect of MgO nanoparticles in growth inhibition of some of the plant pathogenic fungi such as Fusarium and Aspergillus flavus species (wani et al , 2012; Al-kaise , 2015; Al-Gobore, 2016; Hussen ,2017).

2. Materials and Methods

1) Isolation

A ready and PCR recognized R –solani fungus isolation was got from mycotoxin laboratory, plant protection Department, College of Agriculture, University of Baghdad. It was grown on potato dextrose agar media (PDA) which was prepared by solving 39 gram of the extract in 1000ml water, the medium was sterilized at an Auto clave at 121 **°C** and 1.5 kg/cm^2 pressure for 15 minutes. To the prepared media, 250 mgL^{-1} of tetracycline antibiotic was added to prevent the bacterial growth, then the media was poured in 9 cm diameter petri dishes and they were inoculated by the fungus isolation for the laboratory tests use.

2) Pathogenic ability test

The pathogenic ability of R-solani fungus isolation was tested according to method of (Bolkan and Butler, 1974) by inoculation 9cm diameter petri dishes having 20 ml of water and agar culture media (water/ agar, at 2% ratio , 20gram agar in one liter of distilled water) and it was sterilized in an autoclave at 121 **°C** and 1.5 kg/cm^2 pressure for 15 minutes and contained the tetracycline antibiotic . The prepared petri dishes were left in laboratory to be solid and then they were inoculated by putting 0.5 cm diameter disk of the R. solani fungus which was grown on the potato dextrose agar (PDA) at 5 days age, then, local eggplant seeds (Agoba Al-Iraq species) were added after they were surface sterilized before planting by sodium hypochlorite (1% free chlorine) . The seeds were circular and in parallel put to the edge of the petri dish at average of 25 seed per petri dishes. Three petri dishes were used with 3 petri dishes as a control (with fungus presence) and then they were incubated in an incubator at 25 ± 1 **°C** , for 7 days. The percentage was calculated according to the following equation:

$$\text{Percentage of germination (\%)} = \frac{\text{Number of germinated seeds}}{\text{Number of total seeds}} * 100$$

3) Test efficiency of MgO nanoparticles in R- solani fungus growth inhibition on PDA media laboratory.

Three concentrations of 25 nm size MgO nanoparticles and 0.18 g cm^{-1} density were tested. These concentrations were 1%, 2% and 3% . The weights 1, 2 and 3 gram of MgO nanoparticles were used and to one of these weights 100 ml of distilled water was added to get 1%, 2% and 3%

concentrations respectively, then mixing was done to each concentration by homogenizer stirrer for 30 minutes to insure good mixing and these concentrations were subjected to Ultrasonic device at 22-24 kHz frequency for 2 minutes (Gibson, et al ,2009) to insure get good homogenous distribution and dispersion of the mixture. Each individual concentration was put in a 100 ml – volumetric flask that contain 2.4 gm. of PDA media. Sterilization was done on these flasks using an autoclave at 121 °**C** and 1.5 kg cm^{-2} for 20 minutes, then the media was poured in 9 cm diameter petri dishes to get solid. The solid media was inoculated by R. soloni fungus isolation which was grown on PDA media for 7 days age. Incubation at an incubator was done for the petri dishes at 25 ±1 °**C** for 7 days and control treatment was used for comparison.

The inhibition percentage was estimated according to the following equation.

$$\text{The inhibition percentage (\%)} = \frac{\text{Medium diameter of control- medium diameter of treatments}}{\text{Media diameter of control}} * 100$$

3. Result and Discussion

1) Test of pathogenic ability of R.solani fungus on eggplant seeds in laboratory.

The results showed that R. soloni fungus isolation (Table 1) gave significantly very high infection rate compared with control sample.

The R. solani fungus isolation caused significant decline in eggplant seeds germination rate ranged between (0-24%) compared with control sample in which the value of eggplant seeds germination rate was 97% (Fig.1), Hassan (2002) got similar result, it is founded that R- solani fungus isolation taken from eggplant plant gave high infection ratio (98%) compared with the other isolations that were taken from another plants.

Ability of this fungus to cause high infection rate may be attributed to its known and multiple mechanisms such as secretion the host cells disintegration enzymes or secretion the metabolic materials which have toxic effect and work to change the convenient conditions for seeds germination and consequently they lead to germination failure. (Inoue et al , 2002; Al- Refaae, 2004; Mohamed et al .2006)

Table 1: Test of pathological ability of R. solani fungus on eggplant seeds laboratory

Treatments	inhibition rate %			average %
	R3	R2	R1	
control	92	100	100	97.33
fungus treatment	12	24	0	12
LSD at 0.05 level				20.16

Figure 1: Test of pathological ability of R. solani fungus on eggplant seeds laboratory

2) Test efficiency of MgO nanoparticles in R- solani fungus inhibition in laboratory.

The result of table (2) showed activity of MgO(NP) in R-solani fungus inhibition in laboratory at 1% ,2% and 3% concentrations and fungus growth inhibition ratios on PDA media were 96% , 100% and 100% respectively, these results agree with results of many studies which referred to the high actively of nanoparticles minerals and their oxides in inhibition many of the plant pathogenic causes(Clement et al, 1994; Gonzaled- Melendi et al, 2008; Rico et al,2011; Mohendra, et al , 2012) . Kim et al (2012) found that 100 PPM of Silver Oxide nanoparticles caused inhibition of the plants pathogenic fungi causes on PDA media.

Wani et al (2012) found that using MgO nanoparticles work on inhibition kinds of Fusarium spp fungus which causes the fusarium wilt in plant. It was emphasized by Al-Kaise (2015) that the high efficiency of MgO nanoparticles which gave 100% inhibition ratio at 2 and 3% concentrations and 95.53% in 1% concentration in A. flavus fungus inhibition in the stored seeds of corn and Marziye (2014) emphasized the MgO nanoparticles efficiency on fusarium oxy sporum lycopersici fungus in the broth and solid media and they cause fungus cell decomposition and its growth inhibition.

Al –Gobore (2016) proved the high efficiency of MgO nanoparticles in growth inhibition of A .flavus fungus at 100% rate in 2 and 3% concentration and at 95% in 1% concentration on peanut plant. Hussen (2017) proved the

high efficiency of MgO nanoparticles in inhibition of *F . solani* fungus growth on watermelon plant.

A new studies indicated the ability of metal oxides nanoparticles in inhibition of many of the pathogenic causes of plant, the study was outside living body recorded that using 100ppm of Ag nanoparticles which were carried on graphic oxide (Go) had reactive effect in inhibition of growth of xanthomonas performans bacteria which cause bacterial spotting disease on tomatoes in glass houses (Ocsoy et al , 2013). another outside living body study explained that using the water solutions of the Nano components [silver / chitosan Nano formulation (NFs)] at 100 mg mL^{-1} for range between 10-20 nm size caused high efficiency inhibition of the diseased fungi types such as A. flavus, Alternario alternate and R. solani fungi on PDA media (Wild and Jones, 2009). Al-Rawe (2017) referred to the silver nanoparticles efficiency in A. flavus growth inhibition at rate reached 100% in corn seeds.

The reason of MgO nanoparticles inhibition of the pathetic fungus R. solani is attributed to the highly surface area of the nanoparticle and to the sharp structure of the nanoparticle surface sites and the nanoparticles surface area works as media for solutions absorption and this makes it unsuitable for fungus growth and inhibition its growth . The sharp structure of the nanoparticle surface sites on host cell wall disintegration and puts out all cell contents and that will inhibit fungus growth.

Table 2: Test efficiency of MgO nanoparticles in R.solani fungus inhibition laboratory

Concentrations%	R1	R2	R3	average	inhibition rate %
1	0.3	0.2	0.2	0.2	96.33
2	0.0	0.0	0.0	0.0	100
3	0.0	0.0	0.0	0.0	100
LSD value at 0.05 level	not. Significant				0.66

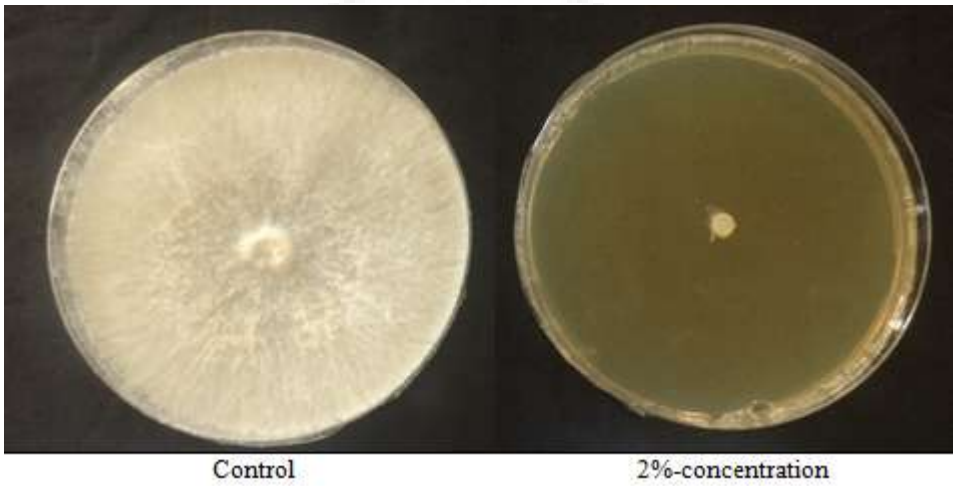

Figure 2: MgO nanoparticles best concentration in R- solani fungus inhibition laboratory

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