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Effects of Topsin M fungicide, nanoparticles with soil biobacteria on growth and their residues on eggplant fruits

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Abstract

The study was conducted in the plastic house at the research station which belongs to the College of Agriculture / University of Kufa during the winter season of 2024. The experimental soil was contaminated with the pathogenic fungus Sclerotinia sclerotiorum which loaded on millet seeds before transplanted at a rate of 5 g / 1 kg, and the bio-resistance bacteria Pseudomonas fluorescens was added at a rate of 5 ml / 1 kg and mixed well with the soil to ensure its spread. Furthermore, the fungicide was added at the dose which recommended by the producing company in its commen and Nano form, at the following treatments : T1(Control treatment) , T2 (Biobacteria), T3 (Nano-pesticide 0.1) , T4 (Nano-pesticide 0.05) ¸ T5 (common pesticide 0.1), T6(common fungicide 0.05), T7(Bacteria + Nano 0.1), T8(Bacteria + Nano 0.05), T9 (Bacteria + common fungicide 0.1) and T10(Bacteria + common pesticide 0.05). Vegetative growth, yield and fungicide residues in fruits were measured. The experiment was carried out using a randomized completely block design (R.C.B.D.) with three replications. Means were compared using the L.S.D test at a probability level of 0.05%. The results revealed that the effect of common and Nano fungicide in reducing the negative effects on vegetative growth and plant yield as following: T7(Bacteria + Nano 0.1) was superior with highest plant height, fresh and dry weight of vegetative growth, roots dry weight, number of fruits and plant yield which reached (19.86 cm, 255.15 g, 103.56 g, 12.63 g, 10.17 fruits plant-1 and 547.05 g plant-1) respectively .

Keywords: Age, Cumulus Cells, morphological, , bovine oocytes, IVM Key words: Topsin M , eggplant ,Nano pesticide, fungicide .

Introduction

Gray and white mold S. sclerotiorum are the most common types of fungal diseases that infect the eggplant. These fungi cause significant economic damages in generally due to its infection for more than 408 genera and 75 families such as Solanaceae, Crucifaceae, Umbellifaceae, Chenopdiaceae families during the harvest season. [1] . In addition to eggplant, S. sclerotiorum also infect a wide range of crops including sunflowers, soybeans, canola, chickpeas, pistachios, as well as lentils and peas [2].According to (Kamran et al., 2017).The infection rate exceeded 85% depending on the planting time and the environmental conditions. In Iraq, there are no accurate statistics on the losses caused by this disease. It must be combated through chemical pesticides used in this field. However, chemical pesticides are considered one of the most important methods of controlling pests[3].Despite their side effects on crops, water pollution, living organism, air and soil due to theaccumulation of toxic substances within the various nutritional components which in turn reflects its negative impact on animals and humans health [4]. According to [5, 6] a positive relationship were found between fungicides and cancer, respiratory diseases as well as hormonal imbalance within the organism depending on the residual toxic accumulation of these pesticides

Nanotechnology has played an important role in reducing the damage of chemical pesticides by adapting materials at the level of atomic and molecular arrangement, with the aim of bringing about a radical change in current food and agricultural systems. What is expected during the next two decades is to exceed the effects of nanotechnology on agricultural systems and products, with lower concentrations as compare with the traditional materials [7]. The modern trend in pest control is to increase the effectiveness of low concentrations of chemical pesticides by reducing fungicide particles from common sizes to Nano sizes, thus increasing their penetration speed into the bodies of the targeted pests and increasing their effectiveness as a result of increasing their surface area. Based on the above and the importance of white mold disease on eggplant plants and the increase in its damage in recent years.

The study aimed to measure the residues of the fungicide in its nano and common forms on growth characteristics and yield of eggplant fruits.

Material and methods

A field experiment was conducted in the plastic house at the research station in College of Agriculture / University of Kufa during the winter season of 2024. A mixed soil was used for cultivation, as the plastic pots were treated with the pathogenic fungus Sclerotinia sclerotiorum loaded on millet seeds at a rate of 5 g / 1 kg and mixed well to ensure the spread of the fungal vaccine. The bio-resistance bacteria Pseudomonas fluorescens were added at a rate of 5 ml / 1 kg and mixed well with the soil to ensure its spread. Then, the next day, the seeding process was carried out and the fungicide was added at the recommended dose from the producing company in its common and Nano form at a rate of three time periods (10, 20, 30) minutes and at a distance of 4 cm from the source. The plastic pot treatments were as follows: T1(Control treatment), T2(Biobacteria), T3(Nano pesticide dose 0.1), T4(Nano pesticide 0.05) ¸ T5(common fungicide dose 0.1), T6(

Classic pesticide 0.05), T7(Bacteria + Nano fungicide e 0.1), T8(Bacteria + Nano pesticide 0.05), T9(Bacteria + common fungicide 0.1) and T10(Bacteria + Regular pesticide 0.05).Vegetative growth, yield and fruit residues were measured. A randomized complete block design with GenStat was used to analyze the results and the means were compared at 0.05 probability level.

Results and Discussion

Plant height (cm):

From the results shown in Table 1, it is clear that there were significant differences between the different treatments and soil type on plant height characteristic. However, T10 ,T7, T9 were superior in giving the highest shoots plant height reached (19.893, 19.868 and 19.443 cm) and no significant differences were found among them . Likewise, it was found that contaminated soil affected significantly on shoots plant height with average (19.665 cm) for control soil(P2) comparing with 14.465 cm for P1 (contaminated soil) , also noted that there were significant differences between Contamination with pathogenic fungi treatments. The P2 treatment (19.665 cm) was significantly superior compare than P1 (14.465 cm. For the interactions between the treatments and type of soil, the results in Table 1 showed that (T7P2) treatment was significantly superior to give (23.56 cm) shoots height comparing with (11.13 cm)in (T1P1) treatment.

Table (1): Effect of different treatments , soil types and their interactions on eggplant shoots height (cm)

Treatments	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	16.1	11.13	13.615
T2 (Biobacteria)	17.43	12.9	15.165
T3 (Nano fungicide dose 0.1)	19.667	15.31	17.488
T4 (Nano fungicide (0.05)	18.16	12.86	15.51
T5 (common fungicide e dose (0.1)	19.63	14.76	17.195
T6 (common fungicide (0.05)	17.98	12.4	15.19
T7 (Bacteria + Nano (0.1)	23.56	16.177	19.868
T8 (Bacteria + Nano (0.05)	18.63	15.93	17.28
T9 (Bacteria + common fungicide (0.1)	23.027	15.86	19.443
T10 (Bacteria + common fungicide (0.05)	22.467	17.32	19.893
Mean of Contaminated soil	19.665	14.465	
L.S.D. 0.05	**P=**0.2534	**TP=**0.8014	**T=** 0.5667

Fresh weight of vegetative growth parameter(g):

For the vegetative fresh weight parameter, data in table (2), revealed that T7 and T10 treatments affected significantly with giving highest rate (255.15, 251.16 g) respectively , whereas less average was found at T1 (66.38g).Concerning to the contaminated soil, P2 treatment was significantly superior with (234.69 g) comparing with P1 (124.94 g). The interaction between the different treatments and contaminated soil showed that, P2T7 treatment recorded (339.11 g), while the lowest value (66.38g) was recorded in the P1T1 treatment.

Table (2): Effect of different treatments, soil types and their interactions and their interactions on eggplant shoots vegetative fresh weight (g)

Contaminated soil	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	153.01	66.38	109.7
T2 (Biobacteria)	184.23	80.16	132.2
T3 (Nano fungicide dose 0.1)	242	155.03	198.52
T4 (Nano fungicide (0.05)	203.18	83.92	143.55
T5 (common fungicide e dose (0.1)	218.5	92.86	155.68
T6 (common fungicide (0.05)	166.51	70.3	118.41
T7 (Bacteria + Nano (0.1)	339.11	171.19	255.15
T8 (Bacteria + Nano (0.05)	222.6	169.5	196.05
T9 (Bacteria + Common fungicide (0.1)	316.89	158.7	237.8
T10 (Bacteria + Common fungicide (0.05)	300.91	201.4	251.16
Mean of Contaminated soil	234.69	124.94	
L.S.D. 0.05	**P=** 1.099	**TP=** 3.474	**T=** 2.457

Dry weight of vegetative growth parameter(g):

The results from Table 3 showed that there were significant differences among the treatments and T7 giving the highest rate (103.56 g) comparing with lowest rate (51.59g) for T1 treatment. Further, it also noted that control (P2) treatment was significantly superior with (92.74 g) dry weight compare than P1 (55.62 g). For the interactions between treatments and contaminated soil, data in table 3 showed that, highest value was recorded in the T7P2 treatment, reached to (135.19 g), while the lowest value (32.33) was recorded in the T1 P1 treatment.

Table (3): Effect of different treatments , S. sclerotiorum fungus and their interactions on eggplant shoots vegetative dry weight (g)

Contaminated soil	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	70.86	32.33	51.59
T2 (Biobacteria)	73.1	45	59.05
T3 (Nano fungicide dose 0.1)	108.6	59	83.8
T4 (Nano fungicide (0.05)	83.6	46.16	64.88
T5 (common fungicide e dose (0.1)	84.53	52.1	68.31
T6 (common fungicide (0.05)	36.4	34.68	35.54
T7 (Bacteria + Nano (0.1)	135.19	71.93	103.56
T8 (Bacteria + Nano (0.05)	99.98	67.8	83.89
T9 (Bacteria + Common fungicide (0.1)	124.58	60.94	92.76
T10 (Bacteria + Common fungicide (0.05)	110.55	86.26	98.4
Mean of Contaminated soil	92.74	55.62	
L.S.D. 0.05	**P=**1.082	**TP=**3.421	**T=** 2.419

Roots fresh and dry weight (g) :

The results in table 4 and 5 clarified that there were significant differences among the treatments under the study in terms of roots fresh and dry weight parameters.However,(T3,T4,T5, T6, T7 and T8) affected significantly on roots fresh weight with average of (23.68, 31.32, 22.09, 27.81, 23.49 and 25.41 g) respectively. while T7 was superior in giving highest average of dry weight (12.632 g).Concerning to contaminated soil, control soil (P2) produced highest fresh and dry weight (27.34 and 9.941 g) as compare to (17.81 and 7.495 g) in contaminated soil (P1) respectively. For the interaction between the treatments and contaminated soil, data in table 4 showed that most of interaction the T7P2(35.7g) treatments affected significantly on eggplant roots fresh and significant differences were found among these treatments for roots fresh weight. On the contrary, the highest rate for dry weight was recorded (13.433 g) at interactions T7P2 (table 5).

Table (4): Effect of different treatments , S. sclerotiorum fungus and their interactions on eggplant roots fresh weight (g)

Contaminated soil	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	20.27	10.07	15.17
T2 (Biobacteria)	23.63	12.3	17.96
T3 (Nano fungicide dose 0.1)	30.82	16.53	23.68
T4 (Nano fungicide (0.05)	26.95	35.7	31.32
T5 (common fungicide e dose (0.1)	26.28	17.9	22.09
T6 (common fungicide (0.05)	22.59	12.37	17.48
T7 (Bacteria + Nano (0.1)	35.7	19.93	27.81
T8 (Bacteria + Nano (0.05)	29.45	17.53	23.49
T9 (Bacteria + Common fungicide (0.1)	32.18	18.63	25.41
T10 (Bacteria + Common fungicide (0.05)	25.58	17.1	21.34
Mean of Contaminated soil	27.34	17.81	
L.S.D. 0.05	**P**=3.699	**TP**=11.696	**T**=8.270

Table (5): Effect of different treatments , S. sclerotiorum fungus and their interactions on eggplant roots dry weight (g)

Contaminated soil	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	7.63	4.307	5.968
T2 (Biobacteria)	8.44	5.507	6.973
T3 (Nano fungicide dose 0.1)	11.97	10.103	11.037
T4 (Nano fungicide (0.05)	9.16	6.797	7.978
T5 (common fungicide e dose (0.1)	9.043	6.843	7.943
T6 (common fungicide (0.05)	8.103	5.103	6.603
T7 (Bacteria + Nano (0.1)	13.433	11.83	12.632
T8 (Bacteria + Nano (0.05)	10.67	7.51	9.09
T9 (Bacteria + Common fungicide (0.1)	12.53	11.003	11.767
T10 (Bacteria + Common fungicide (0.05)	8.433	5.943	7.188

Mean of Contaminated soil	9.941	7.495	
L.S.D. 0.05	**P**=0.1960	**TP**=0.6198	**T=** 0.4382

Fruit numbers :

For number of eggplant fruits, the results in Table 6 showed that there were significant differences among the treatments in. However, T7 and T9 achieved ,highest number of fruits (10.17 and 10) respectively and no significant differences was found between both treatments. For soil type, contaminated soil (P1) was affected positively on number of fruits with average (7.40) comparing with (5.0) for control soil (P2). Furthermore, the interaction between the treatments and soil type revealed that T7P1 was superior with highest number of fruits 13.67 while T1P2 treatment recorded least number 4,00 of eggplant fruits .

Table (6): Effect of different treatments, S. sclerotiorum fungus and their interactions on the number of eggplant fruits

Contaminated soil	**Contaminated soil**		**Mean of treatments**
	Control (P2)	**Contaminated (P1)**	
T1 (Control treatment)	3	3.33	3.17
T2 (Biobacteria)	3.67	4.67	4.17
T3 (Nano fungicide dose 0.1)	6	6.67	6.33
T4 (Nano fungicide (0.05)	4.67	9	6.83
T5 (common fungicide e dose (0.1)	4	6	5
T6 (common fungicide (0.05)	4.67	5	4.83
T7 (Bacteria + Nano (0.1)	6.67	13.67	10.17
T8 (Bacteria + Nano (0.05)	5	6.67	5.83
T9 (Bacteria + Common fungicide (0.1)	7.67	12.33	10
T10 (Bacteria + Common fungicide (0.05)	4.67	6.67	5.67
Mean of Contaminated soil	5.00	7.40	
L.S.D. 0.05	**P=** 0.412	**TP=**1.302	**T=** 0.920

The yield of eggplant fruits :

The results inTable (7) showed that there are significant differences among different treatments in related to the yield of eggplant fruits. However, T7 produced highest rate (547.05 g) and significantly superior as compare to the other treatments. It also noted that there were significant differences between Contaminated and non contaminated soil whereas P2 was superior with (390.77 g) compare with (249.64 g) for P1 treatment. For the interaction between different treatments and soil type, T7 P2 recorded highest value reached (683. 7 g), while the lowest value (71.0 g) was recorded in the T1 P1 treatment.

Table (7): Effect of different treatments , S. sclerotiorum fungus and their interactions on eggplant yield

Contaminated soil	Contaminated soil		Mean of treatments
	Control (P2)	Contaminated (P1)	
T1 (Control treatment)	175.8	71	123.4
T2 (Biobacteria)	300.5	185.9	243.2
T3 (Nano fungicide dose 0.1)	493.6	311.4	402.5
T4 (Nano fungicide (0.05)	350.3	188.5	269.4
T5 (common fungicide e dose (0.1)	375.4	290.5	332.95
T6 (common fungicide (0.05)	275.2	142.61	208.9
T7 (Bacteria + Nano (0.1)	683.7	410.4	547.05
T8 (Bacteria + Nano (0.05)	406.6	307.9	357.25
T9 (Bacteria + Common fungicide (0.1)	540	400.12	470.06
T10 (Bacteria + Common fungicide (0.05)	306.6	188.05	247.32
Mean of Contaminated soil	390.77	249.64	
L.S.D. 0.05	P =3.048	TP =6.816	T=9.64

Fungicide residues:

Results in table 8 showed that there were significant effects between the fungicide doses and time of infection characteristic. However, Nano fungicide at the dose 0.1 produced highest rate (372.77 mg Kg-1), which significantly superior to the rest of treatments. Table 8 also revealed that there were significant differences between different times and 1 hour gave (436.05 mg Kg-1) which significantly superior to the rest. For the interaction, data showed that treated with nano fungicide at 0.1 concentrations for 1 hour was significantly superior with (710.8 mg Kg-1) while no residues were found for common fungicide at 0.1 or 0.05 when interaction 5 day or 0.05 with 3 day .

Table (8): fungicide residues found in eggplant fruits infected with the pathogenic fungus *S. sclerotiorum*.

Fungicide	Dose	Infection time			Mean of fungicide
		5 day	3 day	One hour	
Common fungicide	0.1	0.0	88.9	524.9	204.6
	0.05	0.0	0.0	123.6	40.87
Nano fungicide	0.1	85.9	321.6	710.8	372.77
	0.05	0.0	122.6	385.9	169.50
Mean of time		21.48	133.28	436.05	
L.S.D. $_{0.05}$	Time=1.974		fungicide=2.279		Interaction =3.947

Discussion :

From the results above, it is clear that, the decrease in vegetative growth resulting from treatment with common and Nano pesticides alone may be due to the possibility that many chemical pesticides kill the organism by interfering with the process of cellular respiration and energy production in the mitochondria or by changing the bio-encapsulation of some compounds which is necessary for the organism's life, such as nucleic acids (RNA, DNA) as well as proteins, and as a result, they affect on the glycolysis process which occurs in the cytoplasm and the Krebs cycle and oxidative phosphorylation in the mitochondria [8 ,9]. The fungi that were severely affected by pesticides may be due to the inhibition process, in addition to the fact that some pesticides inhibit cutinase and Phosphatase enzyme, or affect plant growth by inhibiting (DNA) synthesis, cell division or by inhibiting important enzymes in the mitochondria [10].

As a result of what was mentioned above in this research, it is believed that the treatment is superior due to the effect of the biobacteria in reducing the effect of the pathogenic fungus that causes white mold disease on eggplant (source), and thus allowed the plant to grow in a more normal way, which increased the plant hormones responsible for growth, including auxins, which in turn increased the plant height fresh and dry weight of vegetative growth and root system. [11 , 12 , 13] , that's led to increase the number and yield fruits ,this agree with Raheem and Issa [14].

Fungi have an enzymatic ability that breaks down many pesticides and increases their solubility and benefits from pesticide molecules as a source of energy that they depend on in their lives, as their numbers increase until the pesticide is completely broken down [15]. Or perhaps the survival of these low concentrations of the pesticide in the soil is due to the fact that the organic matter in the soil contributed to the dissipation of this pesticide. These results are also with [16] who found that the fungi A. terreus and Fusarium sp. have the ability to biodegrade hydrocarbons, as the percentage of aliphatic compounds reached 100%. The same applies was found to A. chroococcum bacteria, which have the ability to break down fungicide residues.

Conclusion:

Through research, it has been proven that it is necessary to add biobacteria to reduce the residual effect of the pesticide, thus reducing the damage to the plant and thus increasing the yield and reducing the residues .

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