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RESEARCH ARTICLE

EFFECT OF INOCULATION WITH BIO-FELTILIZERS, TRICHODERMA HARZIANUM AND GLOMUS MOSSEAE, AND THE ADDITION OF HUMIC ACID IN FLOWERING OF TOMATO PLANT

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ABSTRACT

This study was conducted in the college of education for pure science at Diyala university in Iraq. The experiment included planting tomato seedlings, class (Genan) in the field according to design of R.C.B.D. The experiment included eight treatments resulted from the interaction between the inoculation factor with *Trichoderma harzianum* and Mycorrhiza, *Glomus mosseae* fungus, and the factor of the addition of Humic acid. Each treatment repeated three times. The results showed that the individual application of the inoculation with *T.harzianum* and *G.mosseae* led to a significant increase in the number of flowers, number of holding flowers, content of nutrient in leaves. The results also showed that the individual addition of organic fertilizer with Humic acid led to a significant increase in same features. The results of interaction treatments between inoculation with bio-fertilizers and organic fertilizer also showed a significant increase in all studied features and excelled in all treatments that reached to 70.66, 43.00, 4.45%, 0.540%, 3.85% with increase of 96.27, 115, 34.03, 82.43, 52.17% in the number of flowers, number of holding flowers, the concentration of N, P, K elements respectively compared to the control treatment.

INTRODUCTION

The demand for food increased due to the rapid increase in the population of the globe who have doubled their numbers during the last thirty years, and due to limited land suitable for agriculture to produce enough food to satisfy the current population and the expected increase in their numbers in the future. So we had to be searching for new ways which enable us to increase the productivity of the land, which is made by Utilization methods of breading and genetic improvement of agricultural crops desired to increase their productivity by using fertilizers. The use of chemical fertilizers leads to spread of agricultural pests, which requires used of large quantities of pesticides to combat these pests, and therefore the increase in the use of chemical fertilizers and pesticides cause adverse effects on the environment, and pose a risk to human health, if it relates with food or drinking water (Alarousy, 2003). Which is one of the important problems facing farmers (Lisanky and Coombs, 1994). FAO reported that the demand for nitrogenous fertilizers could be up to 85 million tons per year, note that the price per ton reached to 120 – 150 dollars, also the high content of the soil with certain nutrients leads to imbalance state in the content of these elements within the plant (Elia *et al*., 1998). Therefore became necessary for us to reconsider the policy of fertilization in the world to save the balance of plant nutrition, and finding alternative to the chemical pesticides which caused prejudicein the ecological balance (Amran, 2004; Pal and Gradener, 2006). Elia *et al.* (1998) reported that the use of bio-fertilizers technology is a successful alternative in reducing the use of chemical fertilizers,moreover the application of organic farming systems help to create a state of balance between the nutrients content in the soil and the quantity and quality of yield. So the researchers turned to the use of bio-fertilizers through the use of microorganisms and organic fertilizers. Tomato (*Lycopersicon esculentun*) is one of the important vegetable crops and maintain his health such as Ca, P, Fe, in addition to Carbohydrates, Proteins, Fats, Vitamins such as vitamin A and C (Zidane *et al.,* 1977). So this study aims to investigate the effect of bio-fertilizers and humic acid and the interaction between them on some physiological characteristics of tomato plant.

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MATERIALS AND METHODS

Prepare tomato seedling

A Loamy sand soil was taking and passed through a sieve of 2mm in diameter, then sterilized with Basamid Grana pesticide that contains the active substance Aldazomet (DMTT) G 98%**,** and put a layer of polyethylene and brush the soil above it with thickness of 20 cm, then wetting the soil with water and added the pesticide by 50kg.m-1 of soil**,** then put another layer of polyethylene as a cover for two days. Soil exposed for seven

days in order to soil aeration befor seed planting. The sterilized soil was put in the pots and added bio-fertilizers as 30g of Glomus mosseae and 5g of *Trichoderma harzianum*, then planted the seeds of tomato class Genan in the pots, then added Humic acid as 0.6g. per pot (Alsamurai, 2008).

Planting tomato seedling

Field´s soil was plowed, then sterilized with Basamid Grana pesticide. The field experiment designed a ccording to randomized complete block design. The experiment included eight treatments which are the effect of bio-fertilizers which includes Mycorrhiza fungi *(Glomus mosseae*), and *Trichoderma harzianum*, and organic fertilizers factor, which includes Humic acid, and their interaction. Each treatment repeated with three replicates. Tomato seedling were transfered after 30 days old, and were planted in the soil of field by eight seedling, four on each side of the experimental unit, with a distance of 40cm between plant and another. Organic fertilizers as Humic acid was added again at 1g per experimental unit with irrigation water. Upon reaching the tomato plant to flowering stage, the following measurements were taken: The number of flowers, number of holding flowers, the concentration of N, P, K elements plant leaves.

RESULTS AND DISCUSSION

The results in Tables 1,2,3,4,5 show that the addition of *Trichoderma harzianum* individually caused a significant increase in growth parameters studied which is nmber of flowers, number of holding flowers, concentration of N, P, K in plant, which a mounted to 56.66, 30.33, 3.64%, 0.413%, 2.98% with increase of 57.38, 51.65, 9.63, 39.52, 17.78% respectively compared to the control treatment.

This due to *T.harzianum* fungi which caused increase in growth parameters such as the percentage of germination and root and vegetative growth of tomato, that may be due to the ability of this fungus to produce growth regulaters such as Ouxin IAA, Gibberellin GA3 which play an important role in the internal organization of the growth activity and a number of configuration phenomena such as dormancy and flowering (Aldoghaji *et al.,* 2006; Abdaljawad *et al.,* 2007). The production of IAA led to encourage the holding of fruits through activation the growth of ovary wall, either Gibberellin stimulates the growth and expansion the cell and encourage the flowering (Gomi and Matsuka, 2003).

The improve of plant growth may be due to the ability of *T.harzianum* to increase the availability of nutrients in the soil that are essential for plant growth (Altomare *et al.,* 1999; Alshibany, 2005). The results in tables 1,2,3,4,5 also show that the addition of *Glomus mosseae* fungi individually caused a significant increase in number of flowers, number of holding flowers, concentration of N,P,K in plant which a mounted to 48.00, 27.33, 3.58%, 0.391%, 2.79% with increase of 33.33,36.65, 7.83, 32.09, 10.27% respectively compared to the control treatment. This due to *G. mosseae* fungi which caused the availability of nutrients in the soil such as nitrogen, phosphorus, potassium in addition to micronutrients which led to increase absorption by the plant which is reflected in the increase in plant growth parameters, also encourages the plant to obsorb water and nutrients, and produce some growth regulaters and increase biological activity in the root zone,and this reflected increase in plant growth such as leaf area, flowering, holding,and fruits (Alani, 1993; Abbas, 2002).

Table 1. Effect of added bio-fertilizers T.harzianum, G.mosseae and organic fertilizer, Humic acid and interaction between them in the number of flowers of tomato plant

Bio-fertilizer / Humic acid	Control	Trichoderma harzianum	Glomus mosseae	T.harzianum + G.mosseae	Mean of Humic acid
Without Humic acid	36.00	56.66	48.00	62.00	50.66
With Humic acid	61.66	67.33	64.33	70.66	65.99
Interaction between bio-fertilizer and HU mic acid LSD P< 0.05 = 9.47					LSD P<0.05 = 4.87
Mean of bio-fertilizer	48.83	61.99	56.16	66.33	
LSD P<0.05 = 6.88					

Table 2. Effect of added bio-fertilizers T.harzianum, G. mosseae and organic fertilizer, Humic acid and interaction between them in the number of holding flowers of tomato plant

Bio-fertilizer / Humic acid	Control	Trichoderma harzianum	Glomus mosseaeee	T.harzianum+ G.mosseae	Mean of Humic acid
Without Humic acid	20.00	30.33	27.33	34.66	28,08
With Humic acid	33.00	41.66	35.66	43.00	38.33
Interaction between bio-fertilizer& HUmic acid LSD P< 0.05 = 6.35					LSD P<0.05 = 3.17
Mean of bio-fertilizer	26.50	35.99	31.49	38.83	
LSD P<0.05 = 4.49					

Table 3. Effect of added bio-fertilizers T.harzianum, G.mosseae and organic fertilizer, Humic acid and interaction between them in the Concentration of N% in leaves of tomato plant

Bio-fertilizer / Humic acid	Control	Trichoderm harzianum	Glomus mosseae	T.harzianum+ G.mosseae	Mean of Humic acid
Without Humic acid	3.32	3.64	3.58	3.66	3.55
With Humic acid	3.71	4.15	3.87	4.45	4.04
Interaction between bio-fertilizer& HUmic acid LSD P< 0.05 = 0.09					LSD P<0.05 =0.04
Mean of bio-fertilizer	3.51	3.89	3.72	4.05	
LSD P<0.05 =0.06					

Table 4. Effect of added bio-fertilizers T.harzianum, G.mosseae and organic fertilizer, Humic acid and interaction between them in the concentration of P% of tomato plant

Bio-fertilizer / Humic acid	Control	Trichoderma harzianum	Glomus mosseae	T.harzianum + G.mosseae	Mean of Humic acid
Without Humic acid	0.296	0.413	0,391	0.428	0.382
With Humic acid	0.448	0.521	0.490	0.540	0.499
Interaction between bio-fertilizer& HUmic acid LSD P< 0.05 = 0.035					LSD P<0.05 =0.01
Mean of bio-fertilizer	0.372	0.467	0.440	0.484	
LSD P<0.05 = 0.025					

Table 5. Effect of added bio-fertilizers T.harzianum, G.mosseae and organic fertilizer, Humic acid and interaction between them in the concentration of K% of tomato plant

Bio-fertilizer / Humic acid	Control	Trichoderma harzianum	Glomus mosseae	T.harzianum + G.mosseae	Mean of Humic acid
Without Humic acid	2.53	2.98	2.79	2.98	2.82
With Humic acid	3.02	3.64	3.43	3.85	3.48
Interaction between bio-fertilizer& HUmic acid LSD P< 0.05 = 0.10					LSD P<0.05 =0.05
Mean of bio- fertilizer	2.77	3.31	3.11	3.41	
LSD P<0.05 = 0.07					

As for the treatment of organic fertilization with Humic acid individually, the results in table 1,2,3,4,5 show a significant increase in number of flowers, number of holding flowers, concentration of N, P, K in plant which amounted to 61.66, 33.00, 3.71%, 0.448%, 3.02% with increase of 71.27, 65.00, 11.74, 51.35, 19.36% respectively compared to the control treatment. This due to Humic acid which improves the physical and chemical characteristics of the soil, and increase the availability of nutrients absorbed by the roots (Mackowiak,2001k,2001). As the Humic acid molecule carries oxidizing sites, which facilitates the absorption of nutrients and detained until the plant need it (Turkmen *et al.,* 2004). The individual treatment with Humic acid excelled fertilization treatment with *T.harzianum* and *G.mosseae* fungi and this due to the Humic acid added in a vailable and work directly to improve the properties of soil which is reflected on plant growth. The interaction treatments between Humic acid and each of *T.harzianum* and *G.mosseae* gave results best than the used of the individual treatment, As the interaction treatments between Humic acid and *T.harzianum* given increase in the number of flowers, number of holding flowers, and concentration of N,P,K in plant reached to 19.04, 37.35, 13.38, 26.15,and 22.14% respectively. While the interaction treatments between Humic acid and *G.mosseae* given an increase reached to 34.02, 30.47, 8.10, 25.31, 22.39% respectively. While the interaction treatments between inoculation with bio-fertilizers (*T.harzianum, G.mosseae*) and Humic acid was excelled on all treatments of individual and overlapping, it reached to 70.66, 43.00, 4.45%, 0.540%, 3.85% with increase of 96.27, 115.00, 34.03, 82.43, 52.17% respectively compared to the control treatment. This due to the important role of Humic acid to support the infected roots by Mycorrhiza fungus with nutrients and thus increase the activity of *n* and this reflected positively on plant growth, in addition to the positive interaction between the two fungi and the role of Humic acid which provides the acidic environment needed by these fungi, as well as supply the plant with nutrients through increased their availability (Khudair, 2007), as well as improving the physical and chemical characteristics of the soil and this reflected in the criteria of plant growth including the flowering, holding flowers, and concentration of N, P, K elements within the plant.

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