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Effect the Treatments of Biofertilizer and Mineral Fertilizer on Content of N P K of Soil Cultivated with Crop Corn (Zea Mays L).

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***Abstract :*Beneficial microorganisms play a key role in the availability of ions minerals in the soil and use Randomized Complete Block Desing (R.C.B.D). The objective of this paper to the study effect of the of biofertilizer and miniral treatments on availability of NPK for crop corn zea mays L.Two types of biofertilizer are Bacterial Bacillus subtilis and Fungal Trichoderma harianum. Three levels of potassium fertilizer are (2.9533, 0.4000 and 2.9533). A field experiment in fall season of 2018 Has been conducted in silty clay loam soil. The experimental Results indicated that Bacillus and Trichoderma inoculation separately or together Have made a significant effect to increase in the availability of N P K in the soil compare to other treatments. The grain yield is where (2.9533, 0.4000 and 2.9533) of bacterial and fungal bio-fertilizer and potassium fertilizers respectively as compared to the control.**

Keywords: Bacillus, Trichoderma, Potassium Fertilizer, N P K , Mays .

***The research is part of MSc for 1st author**

I. INTRODUCTION

In terms of economic importance, corn, (Zea Mays L.) is the third most important cereal crops after wheat and rice. It is one of the most important foods and industrial grain crops in the world,(1). The major maize producing areas are North and South America, Eastern Europe, Russia, China, India, and South Africa, (2) (3). Yellow maize belongs to the family of Poaceae and the tribe of Tripaceae (Maydeae). It is distinguished from the rest of the tribe by the separation of the male organs from the female. Is a multi-use crop. It is used as food for animals and humans (4). Bioreactor treatment, which works to stabilize atmospheric nitrogen, dissolve phosphate and produce growth-stimulating substances such as (IAA) and (GA) additional to decompose plant residues to pre-release and release nutrients and increase the content of humus in the soil. It will be the beginning of a sustainable agricultural system that promotes the growth of plant root populations and high production in whole or in part with time for the use of mineral fertilizers, (5).Bio fertilizer were the most active free nitrogen- fixing bacteria. Research has shown that 100 bacterial strains of nitrogen could be isolated from the rhizosphere (6) .Agricultural exploitation is an important and influential factor in many physical, chemical and biological (7).

Soil microorganisms play an important role in regulating the movement of decaying organic matter and providing important nutrients for plants such as phosphorus, nitrogen, and carbon. It also increases the availability of different minerals the plants and thus leads to economically increase in the yield. Bio-fertilizers are microorganisms that extend the root system and increase seed germination. Biomass differs from organic and chemical fertilizers in that its production technique is simple and the cost of processing is low and its effect on plant growth is much better, (8).

The bacterial strain of (FZB24) B. *subtilis* Has been used as a vital fertilizer for the cotton plant, which resulted in an increase in plant growth As 30% compared to normal fertilizer of nitrogen, phosphorus, and potassium. This is because of the increase in root The size of plant root and the activation of enzymes in the root zone, as well as the increase in the amount of nutrients, (9). Samurai (2006) Has pointed out that the inoculation with Trichoderma spp. plays an important role in increasing the efficiency of nutrient absorption in a similar manner to what occurs when vaccinated with mycorrhizal fungi.

Table (1): Physical and Chemical Proprieties of the Soil.

Trait		Value	Unit
PH degree		7.8	----
Electrical conductivity EC		2.87	ds. m^{-1}
Interchangeable capacitance of positive ions CEC		18.7	Cmol .Kg $soil^{-1}$
Organic matter O.M		2.9	G .Kg $soil^{-1}$
Available elements	Nitrogen	25.06	Mg .Kg $soil^{-1}$
	Phosphorus	13.1	
	Potassium	190.9	
Positive dissolved ions	Calcium	4.5	Cmol. L^{-1}
	Magnesium	2.76	
	Sodium	457	
Negative dissolved ions	Carbonates	Nil	Cmol. L^{-1}
	Bicarbonates	1.75	
	Sulfates	10	
	Chlorides	7.0	
Soil separators	Sand	185	G .Kg $soil^{-1}$
	Loam	495	
	Clay	320	
Soil texture	Silt Clay Loam		----
Bulk density	1.38		$G.Cm-^{3}$

II. Methods and Materials

Field soil Has been prepared by conducting field the regular field management operations including peritoneal. Three main water channels along the field additional to some sub-drivers channels for each experimental unit Have been made. The field was divided into three main blocks. Two meters Has been left between each block and another. Each block are subdivided into (12) experimental unit (3×3)m. A distance of (1 m) was left between each experimental unit and another, bringing the total experimental units to 36 experimental units. Corn seeds of the variety of Bihooth (106) Has been planted on the 24th July 2018. They Has been planted on lines and the distance between the line and was (75) cm and between planting hole and other Have been (25) cm. The experimental unit consists of four lines per each plot and a plant density of 66666 $plants.h^{-1}$. Three seeds Have been planted in each planting hole and after 10 days of planting, the seedlings is rug out to one plant. The number of plants in the experimental unit is (48) plants. Urea fertilizer (46) % N is applied as a source of nitrogen (200) $kg.N.ha^{-1}$. This fertilizer is applied three times, at the stage of six papers, (30) days after the first application and after one month of the second application time, (8). Phosphate rock is applied at the level of (80) $kg.P.h^{-1}$ as a source of the phosphorus element once before planting. Potassium sulfate Fertilizer (K2SO4) (45)% K was applied as a second-time potassium fertilizer application with urea fertilizer and at three levels (0, 112.5 and 225) kg. ha^{-1}.

The Diazinon herbicide Has been applied to control of the corn stem borer (*Sasamia cvetico*) insect. It Has been applied on the meristem of the plant on two times, after (25) days after germination, and the second after 10 days of the first one. Cleanings of harmful plants Have been carried out as needed, as well as the elimination of developing grasses with yellow maize plants. The experimental plots Have been irrigated on a regular basis and according to the plant's need for water.

III. Chemical and Physical Analysis of Soil

Soil samples were taken before planting from a depth of (0-30) cm. A compound sample was taken after mixing the mixture to ensurethe uniformity of the sample. It was dried with a wooden hammer and then sieved with a (2) mm diameter sieve for the purpose of completing some chemical and physical tests.

- **Soil Reaction (pH)**
  Measure in 1: 1 (soil: water) extract using a pH-meter according to (13) method.

- **Electrical Conductivity (EC)**
  It was estimated at 1: 1 (soil: water) extract using an EC-meter according to the method in , (13).

- **Cation exchange capacity CEC**
  Estimated by (13) through soil saturation with Sodium acetate and ammonium acetate.

- **Soil Texture**
  is estimated in the international pipette method as reported in (13).

- **Organic Matter**
  Organic matter estimated according to the method of Walker-Black, (13) by oxidation with potassium dichromate solution with concentrated sulfuric acid, and reverse titration with ferrous sulfate using D-phenylamine.

- **Available Nitrogen**
  The available nitrogen is extracted by potassium chloride (KCl) and nitrogen is determined using the Chaldean device, (13).

- **Available Phosphorus**
  Phosphorus prepared by sodium bicarbonate NaHCO3 was estimated. The color was developed with ascorbic acid and ammonium sulfides and the Spectrophotometer was used in the estimation of phosphorus ready-made, (13).

- **Available Potassium**
  Soil potassium was extracted using (0.5) molar of calcium chloride and was estimated using Flame Photometer as indicated in, (13).

- **Available Sodium**
  Sodium is estimated using sodium chloride solution through the use of the Flame Photometer (14).

- **Calcium (Ca^{+2}) and (Mg^{+2})**
  They are estimated using a structured solution of ammonium hydroxide and ammonium chloride by adding an EBT detector as reported in , (14).

- **Chloride (Cl^-)**
  It is estimated using the potassium chromate guide and the silver nitrate solution, where a white precipitate is formed according to (14).

- **Carbonate CO_3 and HCO_3**

They were estimated that with the addition of sulfuric acid and the orange-phenol-phenyl-phenylethane reagent when the carbonates are present, the solution color changes to violet and then the sulfuric acid is calibrated according to (14).

- **Sulfates SO_4^{-2}**

The barium chloride solution was used with a standard (1) concentration, hydrochloric acid, and ethanol as reported in , (14).

- **Bulk Density**

The bulk density is estimated using a core sample as reported in (14).

IV. Results and Discussion

The results in Table (2) indicate that the application of the bacterial fertilizer (H_1) The highest nitrogen concentration in the plant at the end of the season is increased with the highest nitrogen concentration (2.7467 kg N ha -1)as compared with the H0 treatment. This is due to the role of Bacillus bacteria which indirectly affects the stimulation of biologically stable and endemic microorganisms. Originally in the soil leading to increased nitrogen readiness and absorption by the plant (15) . The addition of T1 has resulted in increased nitrogen concentration at the end of the season with the highest nitrogen concentration of 2.6661 (kg N ha -1) compared to the T0 treatment. This is due to the role of T. harzianum, which forms a dense root mass and can increase the amount of Nitrogen absorbed by the plant as well as the decomposition of organic materials will release the amount of CO2, which leads to the formation of carbonic acid, which plays an important role in raising the intensity of photosynthesis (16).

The addition of potassium fertilizer increases the concentration of nitrogen by increasing the levels of addition of potassium fertilizer at the end of the season, where the highest concentration of nitrogen (2.5658 kg N ha-1) compared to the comparison treatment, and this is due to the role of potassium in the overall biological activities within the plant, including Increasing the effectiveness of the nutrient cycle, which is based on the transfer of nitrates to the leaves from the roots and is transmitted as an accompanying ion of nitrates and thus increase the amounts of nitrogen absorbed, which leads to increasing plant demand for the element nitrogen due to increasing plant growth and thus increase the efficiency of added fertilizers and because of the amount to add an element of potassium as well as the presence of nitrogen in the soil as a result added to the soil through chemical fertilizers and these results are consistent with the (17) .

Bilateral interactions between bacterial and fungicides, potassium fertilizers, bacterial fertilizers, fungicides and potassium fertilizers have a significant effect in increasing nitrogen readiness in the plant at the end of the season. Bilateral and fungal overlap have achieved the highest concentration of ready nitrogen in the plant is (2.9256 kg N ha-1). The plant content of nitrogen to the high potential of Bacillus subtilis bacteria in order to stabilize atmospheric nitrogen as well as the secretion of plant hormones that stimulate the growth produced by these bacteria is known that these materials improve plant growth and increase the density of roots Thereby increasing the absorption of nutrients, including nitrogen element.

As well as bio-fertilizer mushroom T. harzianum, which has a significant role in the readiness of nitrogen through the formation of dense and deep root system of plants treated with mushroom T.harzianum able to increase the amount of nitrogen element absorbed by the plant and these results are consistent with (18).

The results of the table confirm that the triangular interference H1T1K2 resulted in a significant increase in the concentration of ready nitrogen in the plant at the end of the season at 225 kg level. The highest average nitrogen concentration (2.9533 kg N ha -1) at the end of the season is measured with control treatment.

Table (2): Effect of bio-fertilization (bacterial and fungal) and potassium fertilizer on Nitrogen concentration mg.N. Per kg-1soil.

H average	H + T	Potassium fertilization levels			Fungal bio-fertilizer (T)	Bacterial bio-fertilizer (H)
		K2	K1	K0		
2.0733	1.7400	1.7533	1.7333	1.7200	T0	H0
2.7467	2.4067	2.7367	1.7467	2.7500	T1	
	2.5678	2.7800	2.8933	2.0967	T0	H1
	2.9256	2.9533	2.8267	2.9300	T1	
0.02195	0.03104	0.05377			L . S . D	

L . S . D H + K 0.03802	Potassium fertilization levels			Bacterial bio-fertilizer (H)
	K2	K1	K0	
	2.2417	2.2517	1.7267	H0
	2.8900	2.8550	2.4950	H1

Effect average of T	Potassium fertilization levels			Fungal bio-fertilizer (T)
	K2	K1	K0	
2.1539	2.2867	2.2667	1.9083	T0
2.6661	2.8450	2.8400	2.3133	T1
0.02195	0.03802			L . S . D
L . S .D K 0.02688	2.5658	2.5533	2.1108	Effect average of K

The results in Table (3) indicate that the application of the (H_1) bacterial fertilizer resulted It is clear from Table (3) that the addition of bacterial fertilizer H1 increases the concentration of ready phosphorus in the plant at the end of the season, reaching the highest concentration of phosphorus 0.2916 (kg P ha -1)as compared with the comparison treatment H0 and this is due to the role of phosphate solvent bacteria where By dissolving and increasing the readiness of phosphorus through the processes of mineralization of organic phosphorus in the soil as well as working to dissolve the insoluble phosphate compounds in the soil and thus increases the amount of phosphorus absorbed by the plant in addition to the impact of microorganisms added to the soil is the secretion of organic acids and the production of enzyme Ml to increase the readiness of the phosphorus in the soil and absorbed by the plant (19).

The addition of T1 resulted in increased phosphorus concentration at the end of the season with the highest concentration of phosphorus 0.2467 (kg P ha -1) compared with T0 treatment. Such enzymes decompose organic matter, which reduces the degree of soil reactivity. This contributes to increases phosphorus and its readiness and the growth of roots with high density increases the plant's ability to tolerate drought and diseases. Behold phosphorus (20). The addition of potassium fertilizer increased the concentration of phosphorus through the addition of potassium fertilizer at the end of the season. Roots as to higher areas such as fruits, leaves or grains as well as enter in most vital processes within the plant and the addition of potassium fertilizer works to increase the density of the root total, which leads to increase the absorption of nutrients, including phosphorus element by the plant(21).

Bilateral interactions between bacterial and fungicides, potassium fertilizers, bacterial fertilizers, fungicides and potassium fertilizers have a significant effect in increasing phosphorus readiness in plants at the end of the season. -1) This is due to the role of the fungus Tricoderma as it works to increase the root density and the production of antifungal agents that protect it from plant pathogenic infections as well as the secretion of plant hormones stimulating growth in addition to the high capacity possessed by the fungus Trike Derma will process nutrients such as phosphorus, iron, zinc and potassium (22). The results of the table confirm that the triangular interference H1T1K2 is in a significant increase in the concentration of ready phosphorus in the plant at the end of the season at the level of 225 kg. The highest mean phosphorus concentration (0.4000 kg P ha -1) at the end of the season is measured with control treatment.

Table (3): Effect of bio-fertilization (bacterial and fungal) and potassium fertilizer on Phosphorus concentration mg . Per kg-1soil.

H average	H + T	Potassium fertilization levels			Fungal bio-fertilizer (T)	Bacterial bio-fertilizer (H)
		K2	K1	K0		
0.2183	0.1950	0.2167	0.1800	0.1700	T0	H0
0.2916	0.2150	0.2733	0.2500	0.2200	T1	
	0.2613	0.2700	0.2467	0.2360	T0	H1
	0.2783	0.4000	0.3100	0.2867	T1	
0.00829	0.01435	0.02030			L . S . D	

L . S . D H + K 0.01172	Potassium fertilization levels			Bacterial bio-fertilizer (H)
	K2	K1	K0	
	0.2450	0.2478	0.1889	H0

	0.3350	0.3322	0.2509	H1
Effect average of T	Potassium fertilization levels			Fungal bio-fertilizer (T)
	K2	K1	K0	
0.2282	0.2433	0.2133	0.2030	T0
0.2467	0.3367	0.2800	0.2533	T1
0.01015	0.01435			L . S . D
L . S .D K 0.00829	0.2900	0.2900	0.2199	Effect average of K

The results in Table (4) indicate that the application of the bacterial fertilizer (H_1) The highest concentration of ready potassium in the plant at the end of the season reached the highest concentration of potassium (1.8583 kg K ha -1) As compared with the treatment treatment H0 and this is due to the possibility of bacterial vaccine added in the production of some important enzymes that contribute to the process of hydrolysis of the compound Amino-cyclo propan - 1-carboxylate - ACC deminase, which has an important role in the manufacture of ethylene, which positively affects the size and mass of the roots of the plant, which leads to has increase the absorption of nutrients, including potassium(23) (24).

The addition of T1 fertilizer has increased the concentration of ready potassium at the end of the season with the highest concentration (1.7972) kg ha-1as compared with T0 treatment. Some of the nutrients of the plant and the penetration of T. harzianum into the skin of the root of the treated plants (25) (26) . The addition of potassium fertilizer increases the concentration of potassium through the addition of potassium fertilizer at the end of the season. In the soil solution, which increases the potassium absorbed by the root total and increase its concentration in the leaves in proportion to the need of the plant to This is consistent with what he has stated (27).

Bilateral interactions between bacterial and fungicides, potassium fertilizers, bacterial fertilizers, fungicides and potassium fertilizers hav a significant effect in increasing potassium readiness in plants at the end of the season. This is due to the role of the fungal and bacterial vaccine on the production of some growth regulators, the most important of which is the oxygen IAA, which works to encourage the absorption of plants to phosphates, nitrates and potassium. The results of the table confirm that the triangular interference H1T1K2 results in a significant increase in the concentration of ready potassium in the plant at the end of the season at the level of 225 kg. The highest average concentration of potassium (1.9200 kg K ha -1) at the end of the season is measured with control treatment.

Table (4): Effect of bio-fertilization (bacterial and fungal) and potassium fertilizer on Potassium concentration mg.K.kg-1soil.

H average	H + T	Potassium fertilization levels			Fungal bio-fertilizer (T)	Bacterial bio-fertilizer (H)
		K2	K1	K0		
1.6839	1.6600	1.6700	1.6600	1.6500	T0	H0

1.8583	1.7078	1.7233	1.7100	1.6900	T1	
	1.8300	1.8300	1.8400	1.8200	T0	H1
	1.8867	1.9200	1.8800	1.8600	T1	
0.00914	0.01583	0.02238			L . S . D	

L . S . D H + K 0.01292	Potassium fertilization levels			Bacterial bio-fertilizer (H)
	K2	K1	K0	
	1.6967	1.6850	1.6700	H0
	1.8750	1.8600	1.8400	H1

Effect average of T	Potassium fertilization levels			Fungal bio-fertilizer (T)
	K2	K1	K0	
1.7450	1.7500	1.7500	1.7350	T0
1.7972	1.8217	1.7950	1.7750	T1
0.01119	0.01583			L . S . D
L . S .D K 0.00914	1.7858	1.7725	1.7550	Effect average of K

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