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ORGANIC AND BIO-FERTILIZERS AND THEIR EFFECT IN SOME SOIL AND PLANT VARIABLES AND POTATO YIELD

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Abstract

Organic fertilizers play a key role in improving the physical and chemical soil traits and the activation of beneficial microorganisms in the soil as well as the role of bio-fertilizer in improving plant production. So this experiment was proposed to study the effect of organic and bio-fertilizers on some nutrients in soil and plants and the search for a combination of organic and bio-fertilizer instead of chemical fertilizer, an experiment was conducted in Babylon at 15/9/2016 on the potato plant (*Sulanum tuberosum* L.) Burren cultivar from Dutch Origin. The experiment included two factors, the first of which included seven treatments, which is a organic combination: O1: control treatment of recommended chemical fertilizer, O2: 32 tons.h^{-1} palm leaves compost, O3: 32 tons.h^{-1}, rice Remnants compost, O4: 16 tons.h^{-1} palm leaves compost + 16 tons.h^{-1} rice Remnants compost, O5: 32 tons.h^{-1} palm leaves compost + 2 m.L^{-1} humic acid, O6: 32 tons.h^{-1} rice Remnants compost + 2 m.L^{-1} humic acid, O7: 16 tons.h^{-1} palm leaves compost + 16 tons.h^{-1} rice Remnants compost + 2 m.L^{-1} humic acid. The second factor involved the addition of beneficial fungi to the soil: F0: without adding, F1: adding the Mycorrhiza fungus mixed with Peat moss by 10 g.$plants^{-1}$, F2: Add the Trichoderma mixed with the Peat moss by 0.625 g.$plants^{-1}$. Organic and bio-fertilizer have positively affected on soil content of organic substance, Organic Carbon, Organic Phosphorus, Mineral Phosphorus availability and Plant yield. Organic fertilizers also have significantly affected in the decreasing NO_3, increased soluble potassium and phosphorus percent in plant leaves. Fungi was positively affected in the prepared Mineral nitrogen availability and potassium exchange and the percent of nitrogen in the leaves of the plant due to the interaction between the organic fertilizer and the mineral positively in all the studied indicators. Some of the interactions have significantly excelled on the chemical fertilizer and did not differ from each other and this indicates the active role of organic combinations in the improvement elements in soil and plant in addition to the plant yield.

Key words : *Solanum tuberosum* L., compost, hemic acid, fungi, soil.

Introduction

Solanum tuberosum L. is the most important vegetable plant for its nutritional value and its wide spread. Several studies have been carried out to improve the quality and quantity of these yield. These includes the addition of organic and bio-fertilizers, which improves chemical and physical soil properties. In addition, the world is moving towards clean farming technologies while minimizing pollution. Therefore, the use of natural substances such as organic and bio-fertilizers is an appropriate substitute for chemical fertilizers (El-Akabawy, 2000). The use of organic fertilizer in agriculture increases soil content of organic substance and improves its physical and chemical properties (Hanafy *et al*., 2002). It also promotes microorganisms activity in the soil, thus increases microbial activity and increases the activity of microbial enzymes such as Nitrogenase, Urease, Dehydrogenase (Neweigy *et al*., 1997). Many research (Gaind and Gaur, 1991; Gaur *et al*., 1997; Pareek and Gaur, 1973) showed the important role of organic and mineral acids produced by microorganisms in dissolving phosphorus and converting it to more accessible forms of plant. Hunsler *et al*. (1970) reported that organic manures caused increased phosphorus availability by dissolving some precipitated compounds and some phosphorus-containing primary minerals as well as to increase microorganism activity in the plant. Hassanpanan and Azimi (2012) indicated that the optimum use of organic fertilizer causes increased soil organic substance and improves soil building. Barker and Pilbeam (2007) showed that organic substance is

composed of microbial cells and animal and plant residues and is a source of availability-made ammonium. Morales -Payan and Stall (2003) suggests that the Heomic acid increases the absorption of elements and plant resistance to drought and improves most plant performance. Mahndran and Kumar (1998) found that pollinating potatoes with *Azotobacter* and phosphate analyst bacteria together improved growth, dry substance, carbohydrate content and potato productivity. These organisms also increase the availability of macronutrients N, P, K in the soil. Zoubi *et al*. (2007) showed when the use of organic and bio-fertilizer a significant differences in most of the treatments compared to control and the best treatment of fertilized with organic and bio-fertilizers together.

Materials and Methods

A field experiment was conducted in Babylon Province at 15/9/2016 on the potato plant (*Solanum tuberosum* L.). The experiment included two factors, the first of which included seven treatments, which is a group of organic combination: O1: control treatment of recommended chemical fertilizer, O2: 32 tons.h^{-1} palm leaves compost, O3: 32 tons.h^{-1}, rice Remnants compost , O4: 16 tons.h^{-1} palm leaves compost + 16 tons.h^{-1} rice Remnants compost, O5: 32 tons.h^{-1} palm leaves compost + 2 m.L^{-1} humic acid, O6:32 tons.h^{-1} rice Remnants compost + 2 m.L^{-1} humic acid, O7: 16 tons.h^{-1} palm leaves compost + 16 tons.h^{-1} rice Remnants compost + 2 m.L^{-1} humic acid. The second factor involved the addition of beneficial fungi to the soil: F0: without adding, F1: adding the Mycorrhiza fungus mixed with Peat moss by 10 g.plants^{-1}, F2: Add the Trichoderma mixed with the Peat moss by 0.625 g.plants^{-1}. Chemical fertilizer was added as recommended by 600 kg.h^{-1}, compound fertilizer NPK with ratio of 20:20:20 when soil preparation and nitrogen fertilizer (400 kg.h^{-1} (N: 46%), Nitrogen fertilizer was added in two batches after germination completed and the second after 15 days (Khalil *et al*., 1986). Fungi was added when soil preparation (Thiab, 2003). Spray the humic acid five times the first spray after the germination is completed and a 10-day interval between the spray and the other. The experiments were conducted as a factorial experiment and with three replicates according to Randomized Complete Blocks Design (R.C.B.D). The experiment was analyzed according to the least significant difference of LSD at the probability level of 0.05 and 0. 01 (Al-Rawi, 2000).

At the end of the experiment (5/1/ 2017), the following traits were studied in the soil:

The percent of organic substance was estimated by walkly and black method, as mentioned in Page *et al*. (1982). C% organic, organic phosphorus availability, mineral Nitrogen availability according to the Kjeldahl method described in Jackson (1958), Ammonium availability (ppm), NO_3 (ppm), organic phosphorus availability (ppm), exchangeable potassium (ppm), dissolved potassium (ppm) and mineral phosphorus availability (ppm), Determination of Phosphorus Prepared by Sodium Bicarbonate by Method of Olsen and Sommrs (1982), which is contained in Page *et al*. (1982). Potassium is prepared using ammonium acetate and a flame photometer, as stated in Page *et al*. (1982). The following traits were also measured in the plant: Percent of nitrogen by Kjeldahl method (Black, 1965), Percent of phosphorus according to Ryan (2003). Percent of Potassium according to AOAC (1970) and potato plant yield kg.plant^{-1}.

Table 1 : Chemical and physical traits of field soil before cultivating.

Measurements	Unit of measure	Parameter
7.28	—	PH
3.46	dsm^{-1}	Ec
25.52	Ppm	N
36	Ppm	P
88.6	Ppm	K
32	%	Sand
32	%	Clay
36	%	Silt
1.8	%	Organic Material

Table 2 : Chemical and physical traits of date palm leaves and rice fertilizer as organic material

Rice remnants	Palm leaves	Unit of measure	Parameter
6.50	7.04	—	PH
0.93	2.66	dsm^{-1}	EC
18.0	19.0	—	C/N
2.48	2.30	%	N
0.540	0.650	%	P
0.260	2.80	%	K
1.30	2.93	%	Ca
0.38	0.850	%	Mg
0.430	0.622	%	Na
0.259	0.423	%	Fe
0.031	0.055	%	Zn
0.011	0.013	%	Mn

Results and Discussion

Organic fertilizer positively and significantly as shown in tables 3, 4 affected in the percent of organic substance. Percent of organic carbon, nitrate, mineral phosphorus

Table 3 : Effect of organic and bioactive fertilizeres on variables studied in soil.

P maniral available ppm	K solouble ppm	K Exchange ppm	P organic available ppm	N maniral available ppm	No_3 ppm	N% organic available	Ammonium available ppm	C% organic	% organic matter	
*	*	Ns	**	Ns	*	ns	ns	**	**	Organic (O)
**	Ns	**	*	Ns	ns	Ns	ns	*	*	Fungi (F)
**	Ns	**	Ns	*	ns	*	**	Ns	Ns	Interaction (O × F)

NS, *,** Not significant or significant at p<0.o5 or p<0.01, ANOVA.

Table 4 : Effect of organic and bioactive fertilizeres on variables studied in plant.

Yeild (kg.plant^{-1})	K%	P%	N%	
*	NS	**	NS	Organic (O)
*	NS	NS	**	Fungi (F)
**	NS	*	NS	Interaction (O × F)

NS, *, ** Not significant or significant at p<0.05 or p<0.01, ANOVA.

availability, dissolved potassium and mineral phosphorus in soil and percent of phosphorus in plant leaves and plant yield. Bioactive fertilizers significantly affected in the percent of organic substance, organic carbon, organic phosphorus, exchangeable potassium, mineral phosphorus availability in soil, percent of nitrogen in plant leaves, plant yield.

The interaction between the organic and bio-fertilizers positively affected on all studied soil parameters as shown

Table 5 : Effect of organic and biofertilizers interaction on studied variables in soil.

P maniral available ppm	K solouble ppm	K exchange ppm	P organic available ppm	N maniral available ppm	No_3 in soil ppm	N% organic avialable	Ammonium available ppm	C% organic	Organic % matter	Organic × Fungi
4.57	32.8	66.8	3.947	19.46	6.09	0.1250	13.39	1.427	2.460	O1F0
3.24	43.6	70.8	3.500	15.79	5.25	0.1150	10.50	1.317	2.233	O1F1
9.17	40.3	54.5	3.337	17.71	5.74	0.1050	11.97	1.210	2.087	O1F2
4.81	30.7	67.5	4.450	15.09	4.03	0.1400	11.06	1.617	2.780	O2F0
5.25	42.1	97.7	3.537	16.70	3.75	0.1100	12.95	1.280	2.210	O2F1
3.03	50.4	45.5	3.337	16.20	3.64	0.1050	12.50	1.210	2.087	02F2
6.15	54.2	73.4	3.507	20.72	4.48	0.1090	16.24	1.277	2.190	O3F0
4.33	72.9	72.4	2.880	16.42	4.76	0.0900	11.66	1.053	1.807	O3F1
6.91	52.4	62.4	3.340	17.92	4.65	0.1050	13.27	1.207	2.087	O3F2
5.27	40.8	53.8	3.730	17.08	5.50	0.0812	11.59	1.350	2.330	O4F0
4.16	68.2	108.0	4.437	17.71	5.00	0.1400	12.71	1.610	2.770	O4F1
7.15	42.2	58.7	4.587	15.96	3.85	0.1450	12.11	1.667	2.870	O4F2
2.98	58.3	69.8	3.900	15.72	3.89	0.1230	11.83	1.417	2.440	O5F0
5.69	35.8	70.5	2.817	15.19	4.45	0.0900	10.75	1.027	1.760	O5F1
5.43	41.4	75.0	3.497	16.91	6.16	0.1100	11.76	1.267	2.187	O5F2
3.62	38.3	66.9	3.957	15.96	3.75	0.1250	12.22	1.437	2.470	O6F0
3.05	33.0	60.5	3.467	14.53	4.31	0.1050	10.22	1.257	2.390	O6F1
7.38	47.1	68.1	3.670	17.50	4.76	0.1150	12.74	1.337	2.297	O6F2
3.95	30.1	55.0	3.690	14.32	4.31	0.1150	10.01	1.337	2.307	O7F0
3.60	36.5	55.7	3.023	16.56	4.81	0.1000	13.51	1.107	1.903	O7F1
5.18	40.5	59.9	3.397	18.66	6.13	0.1100	12.52	1.230	2.120	O7F2
1.9	25.5	24.7	0.8	3.05	1.8	0.035	2.6	0,29	0.52	Lsd 0.05
2.5	34.2	33.1	1.13	4.08	2.5	0.o47	3.4	0.4	0.61	Lsd 0.01

[a]The interaction was analyzed with least squares means at the 5% and 1% levels and means were separated with LSD.

in table 5. Treatment O4F2 gave the highest value for organic substance, organic carbon, organic nitrogen and organic phosphorus availability in the soil. The interaction O3F0 gave the highest value of ammonium availability and mineral nitrogen availability in the soil, O2F2 interaction gave the lowest rate of nitrate, O4F1 gave the highest value of exchangeable potassium in soil, and O3F1 was the highest value of soluble potassium in soil and interaction O1F2 gave the highest value of mineral phosphorus availability. The variance Analysis indicates that the interaction has a positive and significant effect on all the measured traits in the plant as shown in Table (6). the interaction O1F2 gave the highest percentage of nitrogen, the interaction O6F2 gave the highest of percentage of phosphorus, the interaction O2F2 gave the highest value of percentage of potassium and interaction O4F2 gave the highest value of plant yield.

Through the obtained results, we observe the clear effect of organic fertilizers in most studied indicators. This can be attributed to the role played by organic substance in improving physical and chemical soil traits, improving soil ventilation and microorganisms, processing the plant with necessary nutrients. As well as the conversion of mineral encapsulation in the soil to availability elements for the plant. The addition of compost has increased the soil granularity and good porosity and its apparent density (Brosson *et al*., 2001). Organic fertilization is an improving for physical properties, water system and soil ventilation (Cheen *et al*., 2004). The study agrees with Hassan panah and Azimi (2012) that the optimum use of organic fertilizer is due to increased soil organic substance and good soil construction and increased its permeability to water and air. Hernencia *et al*. (2007) agree that the addition of compost to soil increases nitrogen availability and other nutrients As a result of its slow decay. it agrees with Barker and Pilbeam (2007) that organic substance is a source of ammonium availability. It is in agreement with the Royal (2015) that the use of leaf palm compost has a significant effect on the percentage of organic substance, nitrogen availability, phosphorus availability, and potassium availability in the soil. It also agrees with Morales-Pavan and Tall (2003) that humic acid improves most plant performance and equips it with nutrient elements. The bio-fertilizers positively affected in improving most of the studied indicators. This indicates the role of fungus in the availability of macronutrients NPK in soil (Maherdran and Chadramani, 1998). It agrees with Alzaebi *et al*. (2007) that the use of bio-fertilizer caused an increase in organic substance and nitrogen availability, phosphorus-availability and potassium-availability in the soil and the potato plant yield. Moreover, stimulating potato production may be due to the role of microorganisms fertilized in the secretion of growth regulators such as Auxins, Gibberellins and cytokines, which play an important role in stimulating plant growth and microbial activity, which is reflected in the improvement of the growth and production environment (Hugging and Pan, 1993; Dashti *et al*., 1997; Emskine *et al*., 1993).

Table 6 : Effect of organic and biofertilizers interaction on studied variables in plant.

Yeild (Kg.plant^{-1})	K%	P %	N %	Organic × Fungi
0.7600	0.697	0.217	0.880	O1F0
0.7817	0.727	0.412	1.207	O1F1
0.8623	0.843	0.428	1.843	O1F2
0.7467	0.910	0.437	0.943	O2F0
0.7433	0.740	0.390	0.790	O2F1
0.8540	0.777	0.385	0.910	O2F2
0.8167	0.857	0.457	1.127	O3F0
0.8173	0.950	0.344	0.990	O3F1
0.8340	0.870	0.502	1.307	O3F2
0.7117	0.723	0.069	0.753	O4F0
0.8200	0.750	0.423	1.133	O4F1
0.9323	0.750	0.337	1.537	O4F2
0.7513	0.810	0.457	0.803	O5F0
0.6640	0.803	0.287	1.240	O5F1
0.7890	0.780	0.509	1.273	O5F2
0.8973	0.807	0.555	1.120	O6F0
0.7200	0.803	0.501	0.967	O6F1
0.6817	0.580	0.588	1.330	O6F2
0.7500	0.610	0.230	0.857	O7F0
0.6713	0.770	0.540	0.860	O7F1
0.7540	0.493	0.327	1.707	O7F2
0.12	0.28	0.22	0.55	Lsd 0.05
0.16	0.37	0.29	0.74	Lsd 0.01

[a]The interaction was analyzed with least squares means at the 5% and 1% levels and means wer separated with LSD.

Conclusion

1. The addition of organic and bio-fertilizer has increased the soil content of nitrogen, phosphorus and potassium in their different forms, organic substance and organic carbon.
2. The best treatments are organic and bio-fertilizer treatment together.
3. The addition of organic and bio-fertilizers together increased potato yields and this indicates the possibility of using organic and bio-combination instead of chemical fertilizers.

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