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EFFECT OF ORGANIC REMNANTS COMPOST AND BIOACTIV FERTILIZER ON GROWTH AND YIELD OF POTATO

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Abstract

A field experiment was conducted in farmers' field in Jabla district Babylon province in 15 Sep. 2016. The study was undertaken to determine the best combination between organic material and bioactive fertilizers in the culture of potato using potato cultivar the Burren (HZPC company), Joure, Holland. The experiment was included 6 organic fertilizers:32 tons.ha^{-1} of Palm frond compost, 32 tons.ha^{-1} of rice waste compost, a kon of waste with manure in six treatments > of two factors 16 tons .ha^{-1} of compost palm fronds, 16 tons.ha^{-1} of compost rice wastes compost, palm fronds with humic acid, rice wastes compost with humic acid, rice waste compost with palm fronds compost with humic acid, in addition to chemical fertilizer 600 kg.ha^{-1}-(NPK) and Urea fertilizer 400 kg .ha^{-1}. in addition to the no application treatment. The second factor was 2 treatments of mycorrhizeael fungi with 10 g.plant^{-1}, or the fungus Trichoderma 0.625 g.plant^{-1} in addition to the comparison treatment without adding the combination of palm fronds, rice compost and humic acid had given a significant increase on chlorophyll content compared to other combination treatments as well as the comparison treatment. The no application treatment was lower than the chemical fertilizer addition of palm frond compost produced the highest percent dry matter of the vegetative group palm frond compost produced the highest rate in the marketing product per plant. The bioactive fertilizers produce a significant increase in chlorophyll ratio, the Good for marketing of the plant and weight of the tuber. The overlap between organic and fungi indicated a significant increase in chlorophyll and percent of dry matter of the vegetative group, the marketing share of the plant and the nutrient ratio N and P in the tubers. The combination of the compost of rice and the trichoderma mushrooms gave good results that can be expressed by chemical fertilizer.

Key words : *Solanum tuberosum*, bioactive fertilizers, growth, organic fertilizer.

Introduction

The potato plant is a member of the Solanacea family and is one of the most important vegetables worldwide, ranking fourth after wheat, corn and rice from an economic perspective, yield and cultivation. The potato plant is native to South America and from which was distributed around the world. Fertilizers can be considered one of the most important additions to crops having important effects on potato crop quality and yield (Leytem and Westermann, 2005) environmental pollution effects of chemical fertilizers have led to examination of the use of organic fertilizers (Hanafy *at al*., 2002). Added organic fertilizers can be a source of nutritional elements essential for plants and can improve the physical, chemical and biological characteristics of the soil (Murawska, 1995). A significant increase was observed in readiness of phosphorus in addition to organic fertilizers (Cows and poultry). To the soil and attributed it to increase the readiness of phosphorus is not ready. In the soil or the release of phosphate phosphorus decomposes organic waste or as a result of improved soil properties, which indirectly works to increase phosphorus readiness (Al-Dulaimi and Al-Kubaisi, 1997).

It has become the use of bioactive fertilizers to increase growth, yield and improve quality of plants, they are materials containing beneficial microorganisms applied to the soil supplying the plant with its nutritional needs by converting elements through biological activity's from an unavailable state to an available state that can be absorbed, also supplying the plant with radioactive and growth stimulating material such as hormones and plant growth regulators (Al-Badawi, 2008; Al-Haddad, 2003). The

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study was undertaken to determine the best combination between organic material and bioactive fertilizers in the culture of potato.

Materials and Methods

The experiment was done on a private farm in Jibla a part of Babylon province during the fall planting 15 Sep. 2016 using the potato c.v. Burren (HZPC company, Joure, Holland). Soil samples were obtained from several locations in the field at (0-30 cm) depth to determine chemical and physical attributes (table 1). The soil was plowed twice, leveled and divided into 3 sectors in which treatments were randomly. Seed tubers from the spring planting season of the same year which had been stored at 4°C were planted in trenches. The distance between trenches was 75 cm and the distance between tubers was 25 cm. The soil was irrigated and tubers planted to adepth of 10 cm in the upper third section on one side of the trench opposite from the sun's rays. Each experimental unit included 3 trenches each 2 m long, each trench included 8 tuber seeds, a total of 24 tubers for each experimental unit, leaving 1 m distance between every experimental unit and between sectors to prevent fertilizer displacement. The area of each experimental unit was 4.5 m^2.

The experiment included 2 variables, the first was compost organic remnants and was comprised of: A0, no organic material l; A1, palm frond compost at 32 tha^{-1}; A2, rice remnant compost at 32 tha^{-1}; A3, Palm frond compost at 16 tha^{-1} + rice remnant compost at 16 tha^{-1}; A4, Palm frond compost at 32 tha^{-1} + humic acid at 2 mLL^{-1}; A5, rice remnant compost at 32 tha^{-1} + humic acid at 2 mLL^{-1}; A6, Palm frond compost at 16 tha^{-1} + rice remnant compost at 16 tha^{-1} + humic acid at 2 mLL^{-1} and A7, chemical fertilizer added according to recommended levels 600 $kgha^{-1}$ with NPK and urea at 100 $kgha^{-1}$) (Khalil *at al.*, 1986). The second variable was fungal amendment which included 3 treatments comprised of : B0, no fungi treatment; B1, the mycorrhizal fungus *Glomus mossea*, carried on peat moss, applied at 10 g/hole during planting of seed tubers (Thiab, 2012), and the fungus *Trichoderma harizanum*, carried on peat moss, applied at 0.625 g/hole during planting of seed tubers.

The palm frond and ric compost was produced according to Al-Sharifi (2015). Organic remnants and chemical fertilizers (NPK) were blended with the soil which was irrigated and planted when the soil moisture reached an appropriate level. Urea was added to the soil in 2 portions, the first after complete germination and the second 15 days later, this was the control. Humic acid was applied 5 times in the early mornings; the first application took place after full germination and then there was a 10 day interval between each application. The fungi were acquired from the Ministry of Science and Technology, Department of Agricultural Research Laboratories in Zafarania.

Table 1 : Chemical and physical characteristics of field soil before planting.

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 characteristics of date palm fronds and rice remnants as organic material.

Rice remnants	Palm fronds	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

This experiment was arranged as a factorial in a randomized complete block design with 3 replicates. Vegetative growth parameters were then measured on 4 Jan. 2017. Tubers were harvested and the following were measured at the appropriate times:

Percent of chlorophyll (SPAD), vegetative dry weight percent, marketable yield per plant, average weight of marketable tubers, percent of total soluble solids, percent nitrogen in tubers measured using a micro-Kjeldhal apparatus (Azcon Aguiiar and Barea), percent phosphorous in tubers measured using ammonium vanadate and ammonium molybdate (Ryan *at al.*, 2003) with the spectrometer wavelength of 410, percent potassium in tubers measured (A.O.A.C) using a flame photometer. Means were compared using Least Significant Differences Test (LSD) (AL-Rawi and Aziz Mohamed, 1980).

Results and Discussion

Treatment affected chlorophyll pigments in leaves where most organic material treatments caused an increase in chlorophyll percent, chemical fertilizer produced the highest results (table 3). The use of the fungi an increase in chlorophyll content with Trichoderma producing the highest value which differed from the no fungi treatment. There were no differences between *Trichoderma* and *Glomus* treatments. The combination fungi and organic fertilizers indicated differences in chlorophyll percent. All treatments except the no application had similar values. Chlorophyll increase in organic treatments can be explained due to the decomposed organic matter containing necessary nutritional elements for plant growth also organic matter has an effect on availability of nitrogen and magnesium (Addiscoot, 1974). The increase in nitrogen from organic material increases protein and nucleic acid synthesis an increase in activity of enzymes responsible for chlorophyll synthesis (Al-Bayati, 2017; Al-Sharifi, 2015; Mohamed and Yunis, 1991) palm frond compost increasing chlorophyll content in leaves.

The reason behind chlorophyll increase could also be from the bioactive fertilizers that can increase availability of nutrient elements, Phosphor as an example, which has a large role in carbohydrate synthesis and other

Table 3 : Effect of organic remnants compost and bioactive fertilizers and the interaction between them on chlorophyll pigment percent in potato leaves.

Organic compost (A)	Fungi (B)			Means of organic compost
	B2 Trichoderma	B1 Mycorrhizae	B0 No fungi	
A0:-no application	34.44	33.06	30.29	32.60
A1:-palm frond compost	32.41	33.91	33.70	33.34
A2:-rice compost	33.40	33.30	32.98	33.22
A3:- palm frond compost+ rice compost	33.63	35.30	34.25	34.39
A4:-palm frond compost + Humic	35.57	33.69	33.53	34.27
A5:-Rice compost + Humic	35.01	35.26	34.42	34.90
A6:-palm frond compost + rice compost +Humic	36.05	34.98	34.49	35.17
A7:-chemical fertilizer	36.94	36.13	35.97	36.35
Means of Fungi	34.68	34.45	33.70	
L.S.D for A = 0.943	L.S.D (B) = 0.577		L.S.D(A*B) = 1.633	

ns : not signification.

Table 4 : The effect of organic remnants compost and bioactive fertilizers and the interaction between them on vegetative dry weight percent.

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	12.55	17.45	15.56	15.19
A1:-palm frond compost	15.96	16.21	17.29	16.49
A2:-rice compost	15.77	15.56	13.62	14.98
A3:- palm frond compost+ rice compost	17.47	14.12	14.97	15.52
A4:-palm frond compost + Humic	15.03	15.88	15.95	15.62
A5:-Rice compost + Humic	16.40	15.02	15.81	15.75
A6:-palm frond compost + rice compost +Humic	15.85	15.43	16.59	15.96
A7:-chemical fertilizer	15.24	13.65	14.12	14.34
Means of Fungi	15.53	15.42	15.49	
L.S.D (A) = 1.02	L.S.D(B) = N.S		L.S.D (A*B) = 1.77	

ns : not signification.

substances that are yielded from Photosynthesis. Also, Phosphor plays a role in protein and nucleic acid synthesis which are important in building plastids as a result an increase in pigment. Bioactive fertilizers can supply plants with important nutrient elements such as nitrogen, which is part of the Chlorophyll molecule's structure, also bioactive fertilizers can play an important role in Cytokine secretion which can be considered a site that receives elements such as Mg, K, Fe which build up the Chlorophyll molecule (Harman, 1980; Lalitha *at al*., 2004). These results were supported by Tiab (2012), who mentioned that bioactive fertilizer use increased Chlorophyll in leaves of plants. The significant chlorophyll increase in the interactive treatment between the two fertilizers can be explained as an added effect between the two fertilizers.

Treatment affected dry weight percent for vegetative growth where compost organic remnants were used. Palm frond compost recorded the highest dry weight percent, this treatment did not differ greatly from other treatments except for the chemical, rice compost and no application treatments, which gave the lowest results (table 4). As for bioactive fertilizer effect on vegetative dry weight the results show no significant differences between treatments, the comparison treatment recorded the highest value in comparison with Glumos treatment, which recorded the lowest. The interaction between organic and bioactive fertilizers the highest value on vegetative dry weight, recorded interaction between rice remnants + palm frond compost and no added treatment the highest value. This increase in vegetative dry weight could be a result of the important nutritional element content of organic fertilizers, which play a role in the increase of manufactured materials from Photosynthesis such as carbohydrates and proteins which in turn increase leaf size and as a result increase vegetative dry weight, these results agree with the results of (Humaidan *at al*., 2006; Othman, 2007), which state that organic remnants had an effect on increasing vegetative dry weight in potato and also with the results of Al-Byati (2017), Al-Sharifi (2015), who mentioned the increase in vegetative dry weight as a result of palm frond compost use. The increase in vegetative dry weight from organic fertilizers could also be a result of the increase in organic matter enhancing the activity of microorganisms in the soil, which increase the availability of elements in the soil and improve the soils chemical and physical properties and improve the uptake of elements which activates the building of materials in vegetative parts such as carbohydrates and provides energy needed for producing new cells and plant growth and as a result an increase in vegetative wet and dry weight. These results were supported by Sarhan (2008) organic remnant application on potato plants. The significant increase in the interaction treatments could be a mutual effect between both organic and bioactive fertilizers, Bioactive fertilizers can increase nutrient uptake especially nitrogen and phosphor, which increases these elements in leaves which improves the plants capability to carry on biological functions such as protein and nucleic acid synthesis and as a result can increase vegetative wet and dry weight (Thiab, 2012).

Treatment affected on marketable yield per plant where organic compost was applied, rice compost treatment and palm frond and rice compost treatment recorded the highest values in contrast with the comparison treatment, which gave the lowest value, these treatments did not differ significantly from rice compost and humic treatment as well as chemical fertilizer treatments, but was significantly different from the comparison treatment (table 5). Bioactive fertilizer effects were shown in same table as significant differences in yield valid for marketing per plant, Trichoderma fungi treatments gave the highest rate in comparison with Glumos treatment, which recorded the lowest rate. The interaction treatments between organic remnants and bioactive fertilizers significant differences in marketable yield per plant, as the interaction treatment between rice and palm frond remnants and Trichoderma treatment gave the highest rate in contrast with the comparison treatment which gave the lowest value.

The increase in marketable yield could be from the role played by organic remnants in supplying nutrients by increasing availability and absorbance of nutrients by roots which increases shoot growth by increasing photosynthesis and carbohydrates synthesized in leaves, which are later transported and stored in tubers which are storage sites throughout the different stages of growth which leads to an increase in tuber number and size and intern an increase in yield. These results correspond with what was mentioned by Al-Bayati (2017), Al-Sharifi (2015), Al-Sultani (2015) that organic remnant application especially palm frond compost increased marketable yield per plant, the increase could also been from bioactive fertilizers, which can increase the relief capacity of the soil and increase growth and yield of the plant (Osip *et al*., 2000). These bioactive fertilizers act like antigens against pathogens that infect potato plants intern improving plant growth and yield (Thiab, 2012). Some isolations of *Trichoderma harzianum* had an effect on plant growth, which returns to its capability of secretion of hormones which are similar to auxins leading to an increase in nutrient absorption and resistance to fungi that infect the plant in turn an increase in plant growth

Table 5 : Effect of organic remnants compost and bioactive fertilizers and the interaction between them on marketable yield per plant kg.plant^{-1}.

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	0.626	0.647	0.683	0.652
A1:-palm frond compost	0.725	0.719	0.741	0.728
A2:-rice compost	0.796	0.795	0.815	0.802
A3:- palm frond compost+ rice compost	0.685	0.803	0.915	0.801
A4:-palm frond compost + Humic	0.736	0.648	0.771	0.718
A5:-Rice compost + Humic	0.870	0.706	0.650	0.742
A6:-palm frond compost + rice compost +Humic	0.733	0.653	0.737	0.708
A7:-chemical fertilizer	0.727	0.758	0.855	0.780
Means of Fungi	0.737	0.716	0.771	
L.S.D for A = 0.070	L.S.D (B) = 0.042		L.S.D (A*B) =0.121	

ns : not signification.

Table 6 : The effect of organic remnants compost and bioactive fertilizers and the interaction between them on marketable tuber weight (g.tuber^{-1}).

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	105.4	88.4	97.2	97.0
A1:-palm frond compost	102.1	112.6	100	104.9
A2:-rice compost	115.5	109.4	117.9	114.3
A3:- palm frond compost+ rice compost	100.9	104.7	137.3	114.3
A4:-palm frond compost + Humic	103.6	97.4	115.6	105.5
A5:-Rice compost + Humic	108.9	102.0	103.5	104.8
A6:-palm frond compost + rice compost +Humic	108.2	101.0	95.0	101.4
A7:-chemical fertilizer	100.2	96.9	125.3	107.5
Means of Fungi	105.6	101.55	111.5	
L.S.D for A = N.S	L.S.D (B) = 7.96		L.S.D. (A*B) = N.S	

ns : not signification.

and yield (Harman, 1980; Hunter and Keith, 2002).

The results observed show no significant differences in average weight of marketable tubers when decomposed organic remnants where added, palm frond compost treatment and rice compost treatment gave the highest increase in average marketable tuber weight, however the comparison treatment gave the lowest value (table 6). Bioactive fertilizer effect as noticed in same table shows significant differences in marketable tuber size between treatments, Trichoderma fungi treatment gave the highest average in comparison with Glumos treatment which gave the lowest average. Interaction treatments between organic remnants and bioactive fertilizer effect appear to have no significant differences on average tuber weight, as the interaction treatment between rice and palm frond compost and Trichoderma fungi gave the highest average however Glumos alone gave the least average.

The increase in average marketable tuber weight returns to the accumulation of material produced by photosynthesis such as carbohydrates and nutrient elements, the gathering of water and proteins produced by nitrogen synthesis (Thiab, 2012).

The increase in tuber weight may also return to the role played by fungi in increasing plant hormone secretion intern improving plant growth (Azcon Aguilar and Barea, 1996) or the fungi applied increased the surface area of the roots, which increased absorption and availability of nutrients which are then moved to tubers which are

Table 7 : Effect of organic remnants compost and bioactive fertilizers and the interaction between them on total soluble solids (TSS).

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	7.66	8.64	8.42	8.24
A1:-palm frond compost	8.70	8.38	8.54	8.54
A2:-rice compost	8.12	9.0	8.60	8.60
A3:- palm frond compost+ rice compost	8.44	8.48	8.77	8.56
A4:-palm frond compost + Humic	8.69	8.62	8.53	8.61
A5:-Rice compost + Humic	8.82	8.66	8.55	8.67
A6:-palm frond compost + rice compost +Humic	8.98	8.85	9.22	9.01
A7:-chemical fertilizer	9.09	8.92	8.75	8.92
Means of Fungi	8.56	8.70	8.67	
L.S.D for A = 0.329	L.S.D (B) = N.S		L.S.D (A*B) = 0.569	

ns : not signification.

Table 8 : Effects of organic remnanst compost and bioactive fertilizers and the interaction between them on the percentage of nitrogen in tubers.

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	1.11	1.57	1.82	1.50
A1:-palm frond compost	1.48	1.71	1.70	1.63
A2:-rice compost	1.51	1.24	1.77	1.50
A3:- palm frond compost+ rice compost	1.96	1.75	1.89	1.86
A4:-palm frond compost + Humic	2.16	2.060	1.94	2.05
A5:-Rice compost + Humic	1.83	2.09	2.20	2.04
A6:-palm frond compost + rice compost +Humic	1.62	2.29	1.73	1.88
A7:-chemical fertilizer	1.95	2.00	2.10	2.01
Means of Fungi	1.70	1.84	1.89	
L.S.D for A = N.S.	L.S.D (B) = N.S		L.S.D (A*B) = 0.184	

ns : not signification.

considered storage sites for these nutrients intern increasing the weight of tubers. Trichoderma fungus has the capability of increasing Micro and Macro element availability by creating chelate complexes with the element complexes liberating these elements and converting them into forms ready for absorption by the plant such as Potassium, Nitrogen and Iron (Altomare *et al*., 1999). This reflects positively on vegetative plant growth by increasing photosynthesis and nutrient elements moved to the tubers intern increasing tuber weight. These results correspond with what was mentioned by Thiab (2012) that bioactive fertilizers application increased tuber size.

Treatment affected in tuber total soluble solids significant when decomposed organic remnants were applied, rice, palm frond compost and Humic Treatment recorded the highest rate (table 7). This treatment differed significantly from all the other treatments except for the chemical fertilizer treatment. Bioactive fertilizers did not record significant differences between treatments, Glumos treatment gave the highest rate while the comparison treatment gave the lowest rate. As for the interaction between organic remnants and bioactive fertilizers results show significant differences between treatments, the interaction treatment between (rice, palm compost and Humic) treatment and Trichoderma fungus treatment gave the highest rate which did not differ significantly from the other treatments except for the comparison treatment which recorded the least value. The increase

Table 9 : Effect of organic remnants compost and bioactive fertilizers and the interaction between them on percent of phosphorus in tubers.

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	0.26	0.27	0.30	0.27
A1:-palm frond compost	0.29	0.23	0.35	0.29
A2:-rice compost	0.31	0.32	0.27	0.30
A3:- palm frond compost+ rice compost	0.27	0.30	0.31	0.30
A4:-palm frond compost + Humic	0.37	0.28	0.25	0.30
A5:-Rice compost + Humic	0.31	0.34	0.28	0.31
A6:-palm frond compost + rice compost +Humic	0.27	0.32	0.35	0.31
A7:-chemical fertilizer	0.31	0.26	0.24	0.27
Means of Fungi	0.302	0.292	0.290	
L.S.D for A = N.S	L.S.D (B) = N.S		L.S.D (A*B) = 0.081	

ns : not signification

Table 10 : Effect of organic remnants compost and bioactive fertilizers and the interaction between them on the percent of potassium in tubers.

Organic compost (A)	Fungi (B)			Means of organic compost
	B0 No fungi	B1 Mycorrhizae	B2 Trichoderma	
A0:- no application	1.78	1.88	2.08	1.91
A1:-palm frond compost	2.12	2.07	2.08	2.09
A2:-rice compost	1.98	2.20	2.04	2.07
A3:- palm frond compost+ rice compost	2.21	2.46	1.98	2.22
A4:-palm frond compost + Humic	2.28	1.92	2.02	2.07
A5:-Rice compost + Humic	2.18	2.12	2.31	2.20
A6:-palm frond compost + rice compost +Humic	2.08	2.19	2.28	2.18
A7:-chemical fertilizer	2.03	2.13	2.18	2.11
Means of Fungi	2.08	2.12	2.12	
L.S.D for A = N.S.	L.S.D for B= N.S		L.S.D for (A*B) = N.S	

ns : not signification.

in total soluble solids could be a result of the role played by organic matter in providing many nutritional elements and increasing absorption of these elements intern increasing photosynthesis and dry weight in turn increasing TSS in tubers. These results agree with what was mentioned by Abu-Hussein *at al*. (2003), Al-Sharifi (2015), Al-Sultani (2015), who referred to the increase in dry weight and TSS in Potato tubers treated with organic fertilizers. Microorganisms found in bioactive fertilizers increase decomposition of organic material, which increases availability and absorption of nutrient elements which leads to an increase in vegetative growth and an increase in leaf area leading to an increase in nutrients which increases dry weight and an increase in TSS, these results agree with the results obtained by Thiab (2012), who applied bioactive fertilizers. The increase in interaction treatments can be attributed to the accumulation effect between the two fertilizers organic and bioactive fertilizers.

Results show no significant differences in nitrogen percent of tubers between decomposed organic fertilizer treatments, palm frond compost and humic treatment gave the highest percent (table 8). As for bioactive fertilizers, results from the table shows no significant differences in tuber nitrogen percentages. Trichoderma treatment gave the highest percent while the comparison treatment gave the lowest percent. The interaction effects between decomposed organic remnants and bioactive fertilizers on tuber nitrogen percent appear in table 8 to have significant differences. The interaction treatment between (rice compost, palm frond compost, humic) and Glumos recorded the highest percent of nitrogen in tubers, this nitrogen increase in tubers returns to the accumulation effect between organic and bioactive fertilizers. Organic fertilizer improves soil fertility characteristics that have a connection with availability of nutrient elements as a result of microorganism activity which increases plants nutrient uptake increasing nutrient content in leaves, which are then transported to tubers, or the increase in nitrogen percentage after organic fertilization could be a result of increasing the availability of elements as well as increasing the absorption efficiency of elements by the root system which increases plant nutrient content and finally is transferred to tubers to be stored (Al-Zawbaee, 2000). These results are followed up by what was mentioned by Al-Sharifi (2015), Al-Sultani (2015), who noticed an increase in tuber nitrogen content when treated with organic fertilizer especially Palm frond compost. Bioactive fertilizers plays many different important roles in plant life such as nitrogen fixation, secretion of growth stimulating material, organic acid production, protection against pathogens and an increase in nutrient uptake, All ending up in an increase in plant growth (Al-Haddad, 2003).

Results point out no significant differences in phosphorus percent (table 9) when decomposed organic remnants were applied. Rice compost, palm frond compost and humic treatment gave the highest percent in comparison with the chemical treatment, which gave the lowest percent. No significant differences between bioactive fertilizers were noticed in phosphorus percent, the comparison treatment gave the highest value whereas the fungi Trichoderma treatment gave the lowest value. As for the interaction effect between organic remnants and bioactive fertilizers results show a significant increase in phosphorous percent, the interaction treatment between (Palm compost and Humic) and the comparison treatment gave the highest percent this treatment did not differ significantly from most treatments except for the (Palm frond and Mycorrhizae) treatment, which gave the lowest percent. This increase could also be a result of the role played by organic fertilizer, where organic fertilizers contain a percentage of phosphorus as well as their role in improving soil characteristics such as soil ventilation which increase element uptake such as phosphorus.

This increase could also come from decomposed organic remnants capability to improve most of the soils physical and chemical characteristics, which increases availability and absorption of elements such as nitrogen phosphorus potassium, which increases its concentration in the plant body in turn increases photosynthesis and the material produced in leaves, which are then transported and stored in tubers, which explaines the increase in nitrogen and phosphorus in tubers (Al-Zobaie, 2000). These results agree with what was mentioned by Al-Bayati (2017), Al-Sharifi (2015), who stated that organic remnant use ended up in an increase of Phosphorus in tubers. This increase could also be because of the role played by added bioactive fertilizers, mycorrhizae fungi plays a role in phosphorus absorption by a coexisting relationship with the plant roots which increase the absorption of this element by outer hyphae, which increase phosphorus plant content (Thiab, 2012). Phosphorus increase in tubers from interaction treatments returns to the common role played by previously mentioned fertilizers.

The results in table 10 shows no significant differences in potassium percent with organic remnant applications and bioactive fertilizers nor the interaction between them.

Conclusion

1. Organic fertilizer significantly affected most studied traits.

2. Biological fertilizere did not have a clear role in improving traits.

3. The overlap between organic and biological fertilizers had a clear role in improving most of the studied traits.

4. Some organic combinations, rather than chemical fertilizers, can be used to improve potato production.

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