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Effect of the Organic fertilizer source and the level of mineral fertilizer in concentration of N, P, K and total tuber yield of potato (*Solanum tuberosum L.*)

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ABSTRACT

To investigate the influence of the manure (plant residues) on the growth and yield of potato in calcareous soil, a field experiment were conducted in field located in physical education college areas, Baghdad University- Jadiriya compus in fall season 2015-2016 in a sandy loam soil, the study included two factors the first factor is four sources of manure O_0 (without application) O_1 (poultry) O_2 (wheat straw) O_3 (palm fronds) with volume was 30 Ton h^{-1} and the second factor included the application three levels of chemical fertilizer M_0 (without application) M_1 (120 kg N + 60 kg P + 200 kg K) M_2 (240 kg N + 120 kg P + 400 kg K) layed out in a (RCBD) with three replication, manures and the phosphate fertilizer were added two weeks per planting, seeds of potatoes class (Desiree) planted on 22 September 2015, adding the nitrogen and the potassium fertilizer in three equal interval 21, 45, 70 days after planting. At the maturity stage measurement the N, P, K in leaves in the maturity stage on 22 January 2016 tubers were taken off and measurement the total yield of tubers were measured. Data statistically analyzed and the averages of treatments were compared using the less signification difference test at the level of probability 0.05% the results showed:

1. The treatment of poultry was outperformed other than the treatments of wheat straw and palm fronds as a indicators concentration of nutrients in dictators at the maturity stage where nitrogen was 3.72% , phosphorus was 0.41 % potassium was 4.11 % and the total yield was 49.94 Ton h^{-1} .
2. Wheat straw treatment gave lower values in the studied indicators measuring treatment of poultry and palm fronds its gave 0.33 % , 3.77 % , 7.94 % , the concentration of nitrogen, phosphorus, potassium, in the leaves at maturity stage Sequentially 40.92 Ton h^{-1} the total yield of tubers.
3. The treatment of the mineral fertilizer M_2 showed superiority in studied indicators M_0 and M_1 gave 4.77 % , 0.45 % , 4.67 % the concentration of nitrogen, phosphorus, potassium in the leaves at the maturity stage and 50.09 Ton h^{-1} the total yield of tubers.
4. Integration of organic fertilizer and mineral fertilizer application M_2O_1 has given 5.30 % , 0.51 % , 4.92 % , of nitrogen, phosphorus, potassium, respectively in the leaves at the maturity stage Sequentially and 57.22 Ton h^{-1} total yield of tubers.

Keywords: Organic fertilization, Fertilization mineral , Potato , Palm fronds , Wheat straw.

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INTRODUCTION

Potatoes (*Solanum tuberosum* L.) belong to (Solanaceae) family and its one of the important food crops on the local and global levels, and it makes up the daily diet for more than 75-90 % of the world's population because they are considered as a rich vegetables in nutrients and give a large amount of energy as compared to other crops and its intervention in a lot of the food industry. The increase in population has led to increased demand for food, that is why the attention focused heavily on rising food crops production rates regardless of the quality, which led to the increased use of large addition rates (fertilizer and pesticides) and use large amounts of nitrogen fertilizers used when rates increased cultivation of vegetables crops compared to other crops given the possibility cultivated in more than one season in a year, which led to the aggravation of the adverse health and environmental effects and especially the increase of residues of nitrates which is one of the most dangerous compounds on human health attention lately the quality of the food product and food safety issues and aggravation of the phenomena of food and water remains of fertilizers, pesticides and other pollution increased interest in food is organic origin(Othman,2007).

The total area planted with potatoes in the world is more than 20 million hectares Russian issued in terms of total size 30 % the state unit area is decreasing not exceed 11 Ton h⁻¹ compared with the average global production 15 Ton h⁻¹ while in America, production per hectare ranges around 40 Ton h⁻¹ and in Holland is 50 Ton h⁻¹ total cultivated area of potatoes in Iraq is 51000 h in 2005 in production of 15.843 Ton h⁻¹.(The Arab Organization For Agricultural Development, 2006) for the production of high quality and good or what is known as a perfect production organic fertilizer in sufficient quantities fit for higher need of nutrients because of the global concern for the environment. The researches focus currently on the role of chemical fertilizer and their impact on soil and water contamination as a result of this bad effects resulted from the excessive use of chemical fertilizers where it tended concerns in many countries of the world to encourage organic production to fill part of the global market need products for the importance of the potato crop, the idea of production using organic fertilization came for its advantages in giving a good and healthy production which reflects positively on the human consumption, human health and preserving the environment (Shaker, 2013), Organic fertilizer is considered one of the most modern trend on the from that plays a role in improving the qualitative production and working to improve some of the physical and chemical properties of soil which is reflected on the improvement of production quality. The important role of organic matter in soil comes from the degradation products that become one of the transitional compounds that must be constantly replenished by application of organic wastes to maintain soil properties and contribute in an efficient agricultural production through the supply of the necessary nutrient for plant growth (Sanchez, 2002). Since the Iraqi soils especially central and southern regions with low content of organic matter where organic matter must be applied to meet of the crop nutrients and improve soil conditions, which takes to increase production improve the quality and quantity of it (Othman, 2007). This study aims to find out the best source of organic fertilizer and the level of mineral fertilizer that gives the height production of tubers and the best concentration of nutrients N, P, K in maturing stage of plant growth.

MATERIALS AND METHODS

A field experiment was carried out in the one of the College of Agriculture fields in the vicinity of the Faculty of Physical Education college, Baghdad University Jadiriya campus at season 2015-2016 in sandy loam soil classified according to (Soil Survey staff, 2006) to the Great soil groups. After selecting the required space for the implementation of this experiment and has prepare soil for planting by performing orthogonal tillage, smoothing and leveling. Soil samples were taken from the 0-30 cm from different locations of the field and mixed well, air dried and ground and passed through a 2 mm openings Diameter sieve, sample was taken for the purpose to measuring some physical and chemical properties (table 1). The land was divided into three blocks, each block to 12 experimental units and each experimental unit to three furrows (Each furrows is 3 m length and the distance between furrows is 0.75 m) 1m distance left between the experimental units and 2m were left between blocks, irrigation channels were digged between blocks, 10 days before planting on September

Table 1: Some of the physical and chemical characteristics of the soil before planting study

Adjective	Value	Measuring unit	
pH 1:1	7.32	—	
Electrical conductivity(Ec)	3.2	ds m ⁻¹	
Organic matter	25.6	gm Kg ⁻¹ soil	
Gypsum	0.73	=	
Lime	23.87	%	
Cation exchange capacity	21.43	C mol C kg ⁻¹	
Ions dissolved in the soil solution			
Ca ⁺⁺	16.83	ml L ⁻¹	
Mg ⁺⁺	9.20	=	
Na ⁺	7.66	=	
K ⁺	1.03	=	
Cl ⁻	24.50	=	
HCO ₃ ⁻	2.50	=	
CO ₃	Null	=	
Available Nitrogen	30	mg Kg ⁻¹ soil	
Available Phosphorus	15	=	
Available potassium	90	=	
Bulk Density			
	1.5		
Soil separate	Clay	15.60	%
	Silt	12.00	=
	Sand	72.40	=
Texture		Sandy Loam	=

Table 2: Some chemical properties of organic wastes

Adjective	Unit	Animal waste (Poultry)	Plant residues (Palm fronds)	Plant residues Wheat (straw)
Electrical conductivity	ds m ⁻¹	27	14	20
pH	—	7.41	7.18	7.13
C/N	—	7.3	8.0	8.9
Organic carbon	gm Kg ⁻¹	151	123	118
Total Nitrogen	=	20.5	15.3	13.2
Total phosphorus	=	11	12	9
Total potassium	=	39	22	18

19-2015 organic fertilizer applied at on the amount of 30 ton h⁻¹(table 2) to the experimental plots, allocated according to each transaction amount and has applied to the top of furrow at a depth of 25 cm and phosphate fertilizer with the organic fertilizer were add to the experiment, that carried out under Randomized Complete Block Design (RCBD) as a factorial experiment of two factors include four sources of manure O₀ (without adding) O₁(poultry) O₂ (wheat straw) O₃ (palm fronds) with amount was 30 Ton h⁻¹ and three levels of the chemical fertilizer M₀ (without application) M₁(120 kg N + 60 kg P + 200 kg K) M₂ (240 kg N+120 kg P + 400 kg K), planted the tubers of potatoes class Desiree on 22 September 2015 After a calibration irrigation of the field and planted a 12 tuber per furrow where summit of furrow at 10 cm depth and 25 distances. Urea (46 % N) Source was applied and tri superphosphate (20 % P) as a source of phosphorus and potassium sulphate (41.5 %K) as a source of potassium. nitrogen and potassium fertilizers were applied to each furrow by incise it in a gull to furrow bottom line of planting Agriculture by 10 cm and depth of 25 cm, applied in three equal does after 20 days of planting, after 20 days from the first applied and after 20 days of a second applied to the plant maturity, where four leaves were taken from chosen at randomly from the

middle of furrow to measure N, P, K in the leaves, at maturity stage on 22 December 2016 where tubers taken off, after cutting the vegetative parts one day before and as much as total tubers increased than of ten plants per furrow at the center of each experimental where they were calculated to :

The yield of experimental unit = The yield of one plant X The number of plant in the experimental unit.
The total yield = (The yield of experimental unit X 10000) / Experimental Unit area.

RESULTS AND DISCUSSION

The impact of manure source and level of mineral fertilizer and the overlap between them in the concentrations of nutrients in maturity stage.

Nitrogen

Table 3 Moral shows the signification influence of manure fertilizers on the mature stage where the poultry treatment O₁ gave the highest concentration of nitrogen reached 3.72% an increase of 51% compared to the average concentration of nitrogen in the treatment comparison O₀ that was 2.46% as table 3 showed significant differences in influencing this trait between the treatment of poultry O₁ and wheat straw O₂ which reached 3.72% at an increase 17% compared to the average concentration in the leaves of wheat straw treatment that was 3.18%, there was no significant difference in this trait among exporters of poultry manure and palm fronds, the impact of mineral fertilizer level was significant for this trait it Where was at treatment M₂ that gave the highest concentration of nitrogen reached 4.77% an increase 155% compared to the average concentration of nitrogen in the leaves in the maturity stage in a compared treatment M₀ that was 1.87%, the same table moral influence shows in this adjective between my paperwork M₂ and M₁ giving the highest average concentration of nitrogen in leaves reached 4.77% an increase 43% compared to the average concentration of nitrogen in the leaves in the maturity stage in the M₁ treatment. The impact of the overlap between the source of organic manure and the level of mineral fertilizer was significant for this trait outperforming the Treatment of overlap M₂O₁ that given the height concentration of nitrogen in the leaves at the maturity stage that was 5.30% an increase 221% compared to the average concentration of nitrogen in the leaves in the maturity stage in the M₀O₀ treatment that was 1.65%.

Table 3: The effect of the organic fertilizer source and the level of mineral fertilizer in the concentration of nitrogen in the leaves in the maturity stage%

The average effect of manure source	M ₂	M ₁	M ₀	The mineral fertilizer The organic fertilizer
	400-120-240 K-P-N	200-60-120 K-P-N	0-0-0 K-P-N	
2.46	3.82	1.93	1.65	O ₀ Without the organic fertilizer
3.72	5.30	4.09	2.18	O ₁ Poultry
3.18	4.71	3.10	1.73	O ₂ Wheat straw
3.59	5.25	3.62	1.92	O ₃ Palm fronds
	4.77	3.33	1.87	The average effect of mineral fertilizer
M X O		O	M	L.S.D.(0.05)
0.41		0.23	0.20	

Phosphorus

Table 4 shows the signification influence from the manure source and the level of mineral fertilizer in the concentration of phosphorus in the leaves in the maturing stag excelled as the poultry treatment O₁ giving the highest concentration of phosphorus reached 0.41% an increase of 37% compared to the average concentration of phosphorus in the treatment comparison O₀ that was 0.30% the table showed significant differences in influencing this trait between the treatment of poultry O₁ and wheat straw O₂ in the concentration of phosphorus in the leaves at the maturity stage an increase 24% compared to the average concentration in the leaves of wheat straw treatment that was 0.33%, there was no significant difference in this trait among exporters of poultry manure and palm fronds and the wheat stew and palm fronds, the impact of mineral fertilizer level was significant for this trait it excelled as treatment M₂ giving the highest concentration of phosphorus reached 0.45% an increase 155% compared to the average concentration of phosphorus in the leaves in the maturity stage in a compared treatment M₀ that was 0.24%, the same table table 4 shows signification in this property between treatments M₂ and M₁ giving the highest average concentration of phosphorus in leaves that reached 0.45% at increase of 88% compared to the average concentration of phosphorus in the leaves in the maturity stage in the M₁ treatment that was 0.37% . The impact of the overlap between the source of organic manure and the level of mineral fertilizer was significant for this trait outperforming the Treatment of interaction M₂O₁ that given the height concentration of phosphorus in the leaves at the maturity stage that was 0.51% an increase 168% compared to the average concentration of phosphorus in the leaves in the maturity stage in the M₀O₀ treatment that was 0.19%

Table 4: The effect of the organic fertilizer source and the level of mineral fertilizer in the concentration of phosphorus in the leaves in the maturity stage%

The average effect of manure source	M ₂	M ₁	M ₀	The mineral fertilizer
	400-120-240	200-60-120	0-0-0	The organic fertilizer
	K-P-N	K-P-N	K-P-N	
2.46	3.82	1.93	1.65	O ₀ Without the organic fertilizer
3.72	5.30	4.09	2.18	O ₁ Poultry
3.18	4.71	3.10	1.73	O ₂ Wheat straw
3.59	5.25	3.62	1.92	O ₃ Palm fronds
	4.77	3.33	1.87	The average effect of mineral fertilizer
M X O		O	M	L.S.D.(0.05)
0.41		0.23	0.20	

Potassium

Table 5 shows the manure signification effect of source and the level of mineral fertilizer in the concentration of potassium in leaves in the maturely stage excelled as the poultry treatment O₁ giving the highest concentration of potassium that reached 4.77% at an increase of 19% compared to the average concentration of potassium in the treatment O₀ that was 3.46% the table 5 showed no significant differences in between the treatment poultry O₁ and palm fronds O₃ and of wheat straw and palm fronds but found a signification differences between the poultry and the wheat straw treatment in the concentration of potassium in the leaves at the maturity stage an increase 10% of the poultry treatment compared to the

average concentration in the leaves of wheat straw treatment that was 3.74%, the impact of mineral fertilizer level was significant for this trait it excelled as treatment M₂ giving the highest concentration of potassium reached 4.67% an increase 52% compared to the average concentration of potassium in the leaves in the maturity stage in a compared treatment M₀ that was 3.08%, the same table moral influence shows in this adjective between my paperwork M₂ and M₁ giving the highest average concentration of potassium With an increase the M₂ treatment 26%% compared to the average concentration of potassium in the leaves in the maturity stage in a compared treatment M₁ that was 3.70%.The impact of the overlap between the source of organic manure and the level of mineral fertilizer was significant for this trait outperforming the Treatment of overlap M₂O₁ that given the height concentration of potassium in the leaves at the maturity stage that was 4.92% an increase 70%compared to the average concentration of phosphorus in the leaves in the maturity stage in the M₀O₀ treatment that was 2.81%. through tables 3,4,5The impact of manure source and level of mineral fertilizer and the interaction between them in the concentration of each of the N,P,K in the leaves at the maturity stage noting that the addition of organic and mineral fertilizer or both positively affect the concentration of nutrients in the leaves in the maturity

Table 5: The effect of the organic fertilizer source and the level of mineral fertilizer in the concentration of potassium in the leaves in the maturity stage%

Average effect of manure source	M ₂	M ₁	M ₀	Mineral fertilizer
	400-120-240	200-60-120	0-0-0	Organic fertilizer
	K-P-N	K-P-N	K-P-N	
3.46	4.19	3.40	2.81	O ₀ Without the organic fertilizer
4.11	4.92	4.16	3.27	O ₁ Poultry
3.74	4.69	3.53	3.01	O ₂ Wheat straw
3.94	4.89	3.71	3.23	O ₃ Palm fronds
	4.67	3.70	3.08	Average effect of mineral fertilizer
M X O		O	M	L.S.D.(0.05)
0.48		0.28	0.24	

stage It is found tables outweigh compost transactions in the concentrations of nutrients in the leaves at the stage of maturity compared to transactions mineral fertilizer the overlap of the organic and mineral fertilization M₂O₁ transactions outperformed the control treatment M₀O₀ this is because the major source of organic fertilizers and micro elements necessary for plant and growth the absorption of these nutrients that build a strong root and efficient in the absorption of nutrients from the soil solution as well as the organic fertilizer supply in soil that improves the physical properties to increase their ability of adsorption of water and reduce the loss of nutrients, as well as working to increase the biological activity of the microorganisms and gives a high-quality crop, the high percentage of nutrients in the stock may be due to the important roles of the nutrients they contain organic fertilizers and its role in the ongoing processes in plant and its impact on plant efficiency and its ability to absorb nutrients and then the high proportion of these nutrients in the leaves as well as the active contribution of potassium to increase the plant's ability to benefit from the nutrients in the soil and increase the absorption rate of the soil solution, the use of organic fertilizers has secured the nutrients in the soil, the variation in the percentage of nitrogen in the plant is attributable to the difference in the compost additive content of major and minor elements the addition of this fertilizer plant helped to get into a good nutritional state, which led to increased plant efficiency of the uptake and accumulation of

nutrients in the leaves, the decomposition of organic fertilizer works to liberate nutrients to the soil solution in the root zone and then absorbed by the plant, as well as give them the amount of organic acids and natural Almakhlabyat that can contribute to increase the readiness of nutrients. The chemical fertilizer an important role in plant growth and increased winning, which led to its superiority compared to the use of organic fertilizers because of the speed of decomposition and readiness and absorbed by the plant and its impact on the vegetative growth and the availability of nutrients the point is compared to organic fertilizers, which may be due to the decomposition of the largest amount of manure as a result of large-added to the soil to the amount of securities and thus higher content of these nutrients. The addition of compost with the metal leads to increased readiness nutrients better than if addition on each alone and of the reasons for increasing the readiness of the nutrients in the papers is to increase the quantity of them ready in the soil before planting as it indicated results of the analysis of the soil before planting (Table1) to contain a good amount of these nutrients, The addition of compost before planting had an important role in increasing the readiness of these nutrients this helped the roots to grow better and the formation of an effective and robust system radically and efficient in the absorption of nutrients and therefore reflected and positively on plant growth, but at rates varying depending on the amount and source of the organic and mineral fertilizers added to the soil this makes the concentration of nutrients in the leaves at the stage of maturity also mixed This is consistent with what wassaid (AbdulRasul, 2007, Zahawi, 2007 and AL-Mohammadi, 2009).

Effect organic manure source and level of mineral fertilizer in total yield tubers (Ton h⁻¹)

From the table 6 shows moral influence for bumper compost and the level of mineral fertilizers in the total yield of tubers as the poultry treatment O₁ giving the highest total yield of tubers reached 49.94 Ton h⁻¹ an increase of 28% compared to less the sum total of the tubers of comparison treatment O₀ that was 39.16 ton h⁻¹, there were no significant differences between organic poultry fertilization transactions and wheat straw and palm fronds. Notice of the same table the moral effect of level of mineral fertilizers in the total yield of tubers it excelled as treatment M₂ giving the highest sum total of tubers reached 50.26 Ton h⁻¹ an increase was 32% compared with less sum total of the tubers in the treatment M₀ comparison was 37.95 Ton h⁻¹ there were no significant differences between the mineral fertilization. The impact of the overlap between the source of organic manure and the level of mineral fertilizers has been significantly outperformed as the treatment of overlap M₂O₁ giving the highest sum total of tubers reached 57.22 Ton h⁻¹ compared with less sum total of the tubers in the treatment comparison to interference, which amounted to 31.64 Ton h⁻¹.

CONCLUSION

Conclude from this study that treatment of manure (poultry) has surpassed all treatments of organic fertilization in concentrations N,P,K in the leaves at the maturity stage and in the total yield if tubers and outperformed the treatment of mineral fertilizer M₂ the rest of the mineral fertilization transactions in these qualities and outperformed M₂O₁ the rest of the treatment of overlap treatments

Table 6: The effect of the organic fertilizer source and the level of mineral fertilizer in the total yield of tubers Ton h⁻¹

Average effect of manure source	M ₂ 400-120-240 K-P-N	M ₁ 200-60-120 K-P-N	M ₀ 0-0-0 K-P-N	Mineral fertilizer Organic fertilizer
39.16	43.27	42.57	31.64	O ₀ Without organic fertilizer
49.94	57.22	52.18	40.42	O ₁ Poultry
40.92	46.81	39.41	36.55	O ₂ Wheat straw
				O ₃

47.84	53.77	46.55	43.20	Palm fronds
	50.26	45.17	37.95	Average effect of mineral fertilizer
M X O		O	M	L.S.D.(0.05)
20.77		9.11	11.82	

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