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EFFECT OF SPRAYING ORGANIC FERTILIZER EXTRACT, POTASSIUM AND ZINC FERTILIZER ON GROWTH AND YIELD OF JERUSALEM ARTICHOKE *HELIANTHUS TUBEROSUS* L. AND ITS CONTENT OF INULINE

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Abstract

An experiment was conducted to study the effect of spraying organic fertilizer extract and fertilization with potassium sulpate and spraying hydrous zinc sulphate on growth and yield parameters of Jerusalem artichoke plant and its content of Inuline. Results showed that spraying organic fertilizer increased significantly the leaf area, leaves content of total chlorophyll and tuber content of inline for two seasons, also fertilization with level 10 or 20kg.H^{-1}increased significantly leaf area, leaves content of total chlorophyll, percentage of potassium and zinc in leaves, average tuber weight, yield per unit area, percentage of dry weight in tuber and tuber content of total carbohydrates and inline for two seasons. In addition to that spraying hydrous zinc sulphate in a concentrations 2 or 4g.L^{-1} leaf area for the second season, leaves content of total chlorophyll for two seasons, percentage of potassium for the second season and zinc in leaves for two season, average tuber weight, yield per unit area, percentage of dry weight in tuber and tuber content of total carbohydrates and inline for two seasons compared to non-spraying and non-fertilization plant which gave the lowest values. Also the interaction between the studied factors affects significantly in all studied parameters.

Key words : Organic fertilizer extract, Chemical fertilizer, Jerusalem artichoke (*Helianthus tuberosus* L.).

Introduction

Jerusalem artichoke plant (*Helianthus tuberosus* L.) is one of the Astraceae family plants. Summer herbaceous plant, do not resist the frost and need a warm weather at least for five months. It adenoid storage tuber and its suitable for human food. It is tuber enter in the making of pickles fructose production because of its tubers content of the Inulin. In addition to that its tubers use to production ethyl alcohol, and Its tubers are suitable for Urine Diabetes disease(Matlob *et al.*, 1989).

For the futuristic development of Jerusalem artichoke plant in Iraq its necessary to interested in the agricultural farming service and economization whatever plant needed of minerals nutrient necessary for growth and yield, that stimulation biological processes like photosynthesis (Havlin, *et al.,* 2005). The soil rich with organic matter and nutrient is suitable for high production and yield quantity of Jerusalem artichoke plant (Matlob *et al.*,1989).

Organic fertilization is one of the important ways that supplying plants with essential nutrient without any negative effect on the soil or human (Cook, 1972), that organic fertilization in deferent recourses include a wide of soluble organic compounded like sugars, proteins, amino acids and humus organic acids (Muslat and Muslh, 2012) and the extract of organic fertilizer is an important role in development to soil fertility and plant nutrition because its effects on increasing cell wall penetration and promoted plant enzymes (Tan, 2004).

Chemical fertilizer playsan important role in the continuance and increasing agricultural production, but when application this fertilizer should be used in an appropriate amount for every species of plant. Abdullah (2005) mentioned that fertilization potato with potassium fertilizer (potassium sulphate) increasing leaves, total chlorophyll content in leaves, the percentage of potassium

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in leaves and dry weight of tuber, average tuber weight and total yield.

Zinc plays an important rolein the metabolism of the plant, that it a main component for many enzymes like Dehydrogenase and Ribonuclease, also it activated a lot of enzymes required for the plant growth. More than that zinc arranged protein industrialization, chlorophyll production and amino acid (Tryptophan) formation which it the prime component of the Indo acetic acid (IAA) that necessary to division and elongation of plant cells (Awad, 1987). To improvement the parameters of Jerusalem artichoke plant and because they are a few studies in Iraq, this study was carried out to found suitable fertilizer structure form local organic fertilizers and potassium, zinc fertilizer to improvement growth and yield parameters.

Materials and Methods

A field experiment was conducted during growth seasons 2016- 2017 2017-2018 in Karabla province on Jerusalem artichoke plant. Randomize simples were taken from field soil in a different pleases at 0-30cm depth to analysis it at the soil Lab. of the Faculty of Agriculture/ University of Kufa (Table 1). Soil preparation by cultivation two time in orthogonal way sat 25cm depth, than leveling, The field diving with three replicates (every one contain 18 experiment unit, its area was 6.75m^2), every experiment unit contain three rows(3m length and 0.75m wide) in the direction from north to south with one meter bund between each experiment unit, and the distance between one row and anther (0.75m) with gravity water system. Manure was added to the soil at 56m^3.H^{-1} and Triple super phosphate Ca $H_4(PO4)_2$ H_2Oat the level 280kg,H^{-1}.Local tubers variety(whole tuber) taken from local market were planning in 10/3/2017 for the first season and in 1/3/2017 for the second season. Tuber weight (40 -60)g were planting in the upper triple of the rows in 7-10depth at 25cm between on plant and other in one side. The crop sty in the land from the planning until harvest for sex months(Matlob *et al.*, 1989).

An experiment was conducted in Randomized Complete Block Design (R.C.B.D) as a factorial experiment in three factors and three replicate. Means were compared by Multiple Range Test Duncan test at the probability of 0.05. data were analysis by (GenStat 12th Edition) program under employment Windows computer. An experiment was included three factors.

First: spraying organic fertilizer at two concentration *i.e.* (0 and 500) ml. L^{-1} signing M0 and M1. Extract was prepared by soaking organic fertilizer (compost) local production with percentage (1:3) that mean Prepared the concentration 500ml. L-1by taken 500ml form the extract (Akanbi *et al.*, 2007), extract simple was taken to make a chemical analysis table 2 according to Black (1965). Extract mix with Sodium Tripolyphosphate ($Na_5P_3O_{10}$) in percent (1ml. L^{-1}) spraying on the morning with two sprayers first after one month form planting, second after two months from the first sprayer. Control treatments spraying with distillate water only. Second factor: fertilization with potassium sulpate K_2SO_4(K_20) siging K0, K1 and K2 with three levels *i.e.* (0, 75 and 150) (Hassen, 2012), added to the soil with three doses, first after three weeks form planning, second after 30days form the first doses, third after three months form planting (Matlob *et al.*, 1989).Third factors: spraying hydrous zinc sulphate $ZnSO_4.7H_2O$ (35% Zn) in three concentrations *i.e.* (0, 2 and 4)g.$L^{-1,}$ two sprayers.

In this experiment the parameters measured were: Leaf area (Dsm.$plant^{-1}$): measurement according to Watson and Watson (1953), Total chlorophyll content according to Goodwin (1976), Potassium percentage (%): assimilated by Flame Photometer system according to Chapman and Pratt (1961), Leaf content of zinc (mg.kg^{-1}): assimilated by Atomic Absorption spectrophotometer system according to Al-Sahaf (1989), Average tuber weight: the tuber harvested in 25/9/2017 in the first season and in 15/9/2018 in the second season, calculation by diving the yield to the number of tuber per all experiment unit in addition to separation the small tuber (less than 25g) (Singh and Grewall, 1979), Yield per unit area (ton. H^{-1}): calculation form yield per plant and percent to the area of one hacker (10000m^2), Percentage of dry tuber weight (%):According to equivalence (Al-Sahaf, 1989):

Tuber content of carbohydrate (mg. g^{-1} dry weight): assimilated according to Dudoies *et al.*, (1965), Tuber content of Inulin(—):assimilated according to equivalence (Winton and Winton, 1958):

1mg of Inulin = 1.85 ml of 0.01 N potassium permanganate solution.

Results and Discussion

Plant growth parameters

(Table 3) showed that spraying organic fertilizer extract significantly effect on leaf area, that the plant spraying gave the highest leaf area *i.e.* 1392.18 and 1362Dsm^2 compared with control plant (non-spraying plant) which gave the lowest values (1214.58 and 1182.15) Dsm^2 for two seasons respectively.

Also, fertilization with potassium sulphate increased significantly, and the effect increased with increasing fertilizer levels (Table 3).

From the same table, there is not a significant effect for spraying hydrous zinc sulphate on leaf area in the first season. In the second season spraying hydrous zinc sulphate at a concentration, $2g.L^{-1}$ gave the highest leaf area *i.e.* $1289.53Dsm^2$ compared with control treatment which gave the lowest area *i.e.* $1262.05Dsm^2$ and not significantly different for the concentration $4g.\ L^{-1}$.

The triple interaction between factors gave significantly on this parameter, that plant spraying with organic fertilizer, fertilization with 150kg. H^{-1} potassium sulphate and spraying with spraying hydrous zinc sulphate at a concentration $4g.\ L^{-1}$ gave the highest leaf area *i.e.* 1626.30 and 1585.84 Dsm^2 compared with the lowest leaf area *i.e.* 1011.20 and $1007.30Dsm^2$ in the plant (non-spraying with organic fertilizer extract, non-fertilization with potassium sulphate and non-spraying with spraying hydrous zinc sulphate) for two seasons respectively (Table 3).

Result in table 3 reveled that spraying organic fertilizer extract significant effect on the total chlorophyll content in leaves, that plant spraying gave the highest total chlorophyll content *i.e.* 73.13 and 74.05 $mg.100g^{-1}$ fresh weight compared with c non-

chlorophyll content *i.e.* 73.13 and 74.05 $mg.100g^{-1}$ fresh weight compared with c non-spraying plant which gave the lowest values (70.85 and 63,24) $mg.100g^{-1}$ fresh weight for two seasons respectively.

Result in table 4 reveled that spraying organic fertilizer extract significant effect on the total chlorophyll content in leaves, that plant spraying gave the highest total chlorophyll content *i.e.* 73.13 and 74.05 $mg.100g^{-1}$ fresh weight compared with c non-spraying plant which gave the lowest values (70.85 and 63,24) $mg.100g^{-1}$ fresh weight for two seasons respectively.

Also in the same table fertilization with potassium sulphate had significantly effect on the total chlorophyll content in leaves in the first season, that plant fertilization with level 75kg. H^{-1} gave the highest content $74.49mg.100g^{-1}$ fresh weight and did not different from plant fertilization with level $150kg.H^{-1}$ compared with control plant which gave the lowest values 68.75 $mg.100g^{-1}$ fresh weight. In the second the plant fertilization at a level 150kg. H^{-1} the highest content *i.e.* 72.45 $mg.100g^{-1}$ fresh weight compared with the control which gave the lowest content (64.94) $mg.100g^{-1}$ fresh weight.

Results in table 4 spraying hydrous zinc sulphate at a concentration $2g.L^{-1}$gave the highest total chlorophyll content in leaves *i.e.* 76.05 $mg.100g^{-1}$ fresh weight compared with control treatment which gave the total chlorophyll content in leaves *i.e.* $69.16mg.100g^{-1}$ fresh weight in the first season. In the second season, the plant spraying with hydrous zinc sulphate at a concentration $4g.L^{-1}$ gave the highest total chlorophyll content in leaves *i.e.* 71.90 $mg.100g^{-1}$ fresh weight compared with control treatment which gave the lowest total chlorophyll content in leaves *i.e.* 63.99 $mg.100g^{-1}$ fresh weight.

The triple interaction between factors gave significantly on this parameter, that the plant spraying with organic fertilizer, fertilization with 75kg. H^{-1} potassium sulphate and spraying with spraying hydrous zinc sulphate at a concentration $2g.\ L^{-1}$ gave the highest total chlorophyll content in leaves *i.e.* 89.06 $mg.100g^{-1}$ fresh weight in the first season, in the second season plant spraying with organic fertilizer, fertilization with 150kg. H^{-1} potassium sulphate and spraying with spraying hydrous zinc sulphate at a concentration $4g.\ L^{-1}$ gave the highest total chlorophyll content in leaves *i.e.* 79.61 $mg.100g^{-1}$ fresh weight compared with control plant(non-spraying with organic fertilizer extract, non-fertilization with potassium sulphate and non-spraying with spraying hydrous zinc sulphate) which gave the lowest content 51.45 and 52.09 $mg.100g^{-1}$ fresh weight for two seasons respectively (Table 4).

The results in table 3 showed that spraying organic fertilizer extract supervised significantly in leaf area compared to control treatment, that maybe due to the organic fertilizer rich in the nitrogen and phosphorus elements table 2 which enter in the structure of amino acids (DNA and RNA), proteins and co-enzymes and increasing the division and the building of the cells and activation the biological efficiency of the plant, finally growth vegetative parameters of the plant improvement (Al-Sahaf, 1989 and Shaheen *et al.,* 2007). In addition to the rule of the Humic acid which included in the structure of organic fertilizer extract table 2 that increased root growth and nutrients absorption lead to improvement photosynthesis and activation plant hormones like cytokines which stimulation cell division and Auxins which improvement cell elongation at the end plant height increasing (Taiz, and Zeiger, 2006), which contribute in an increasing leaf area (Table 4). Also supervised content of total chlorophyll in leaves as a result of spraying organic fertilizer extract table 4 that due to the availability of nitrogen in the structure of extract table 2 which participate in the formation of Prophyrine groups inter in the chlorophyll building (Taiz, and Zeiger, 2006), and magnesium element within Humic formation which assist chlorophyll building by nitrate reduction inside the plant within it roles as co-enzymes to the nitrite reductase and hydroxylamine reductase (Abu Dhahi and Al-Younes,1988). These results agree with Hanshal *et al.,* (2011) on a potato plant.

As a results observed from the Tables 3 and 4 the plant fertilization with potassium fertilizer affected in leaves area and total chlorophyll content in leaves, that effects may be due that potassium activated photosynthesis and product transfer because potassium stimulate ATP formation necessary for carrying out this product by the phylum, also increasing photophosphorylation, more than that potassium activation cell division and elongation (Havlin *et al.*, 2005), also potassium had ion osmotic organized effect on the opening and closing stomata which increasing absorption water and nutrients which improvement plant growth Al-Sahaf, (1989), in addition to that potassium promoted enzymes responsible for assimilation and formation of chlorophyll and its deficit caused green plastids destruction (Abu Dhahi and Al-Younes, 1988), as the final that increasing leaves area and total chlorophyll content in leaves. The result agrees with Abdullah (2005) that potassium fertilizer increased leaves area in potato plant and Mohsen and El- Khair(2016) that potassium fertilizer increasing total chlorophyll content in leaves of Jerusalem artichoke plant.

Also table 3 showed that zinc fertilizer effect on leaves area on the second season, and on total chlorophyll content in leaves table 4, that me be due zinc nutrient help in the reaction of syrin with Andol cycle to formation amino acid Tryptophane that it origin of Auxin IAA which increasing cell division and elongation (Al-Sahaf, 1989), more than that zinc is a co-factor as the main enzymes important for many bioassay process like photosynthesis, operation of transmutation for sugar to starch and protein synthesis (Mengel and Kirkby, 2001), and this physiological roles go to make a positive effect to increasing the leaves area, or that me be to zinc role in activation some enzymes in chloroplast and this made an increasing in chlorophyll content in plant (Marshner, 1995). These results agree with Abd El-Baky *et al.*, (2010) on potato.

The result in table 5 there was no significant effect on the spraying organic fertilizer extract in the percentage of potassium in leaves in the first season. Meanwhile, there was a significant effect on spraying organic fertilizer extract in the percentage of potassium in the second season, that the plant spraying gave the highest percentage *i.e.* 2.93% compared with control treatment which gave the lowest percentage *i.e.* 2.50%. Also, the result in the same table supervised the treatment of potassium fertilizer. Treatment at level 150kg. H-1 supervised in the first season and gave the highest percentage of potassium *i.e.* 3.70 and 3.01% compared with a non-fertilization plant which gave the lowest percentage *i.e.* 2.68 and 2.40% for two seasons respectively (Table 5).

The results reveled there is no significant difference in spraying hydrous zinc sulphate on the potassium percentage in the first season. Meanwhile spraying hydrous zinc sulphate at a concentration 4kg.L^{-1} increased significantly the potassium percentage to 3.06% compared with control treatment which gave the lowest percentage (2.29)% (Table 5).

Results in table 5 showed that triple interaction effected significantly on this parameter. That plant not spraying with organic fertilizer extract and fertilization potassium sluphate at a level 150kg. H^{-1} and not spraying with hydrous zinc sulphate gave the highest percentage *i.e.* 4.63% compared with the lowest percentage *i.e.* 1.34% that came from plant spraying with organic fertilizer extract and fertilization potassium sluphate at a level 75kg. H^{-1} and not spraying with hydrous zinc sulphate in the first season. In the second season plant spraying with organic fertilizer extract and added potassium sluphate at a level 150kg. H-1 and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest percentage *i.e.* 4.43% compared with control treatment which gave the lowest percentage *i.e.* 1.05%.

The results showed that no significant effect on organic fertilizer extract in a concentration of zinc in leaves in the first season. Meanwhile spraying organic fertilizer extract had significantly affect which gave the highest concentration *i.e.* 4.25mg. kg^{-1} compared with control treatment which gave the lowest concentration *i.e.* 38.59mg. kg^{-1} (Table 6).

Also, the result in the same table showed that potassium fertilizer treatments supervised in the concentration of zinc in leaves, that treatment 150kg. H^{-1} potassium sluphate gave the highest concentration *i.e.* 36.98mg. kg^{-1} compared to the lowest concentration *i.e.* 32,02mg.kg^{-1} in treatment 75kg. H^{-1} which not different for control treatment in the first season. In the second treatment, 150kg.H^{-1} gave the highest concentration *i.e.* 42.11mg. kg^{-1} compared to control treatment which gave the lowest concentration *i.e.* 38,16mg. kg^{-1} (Table 6).

The results showed that spraying hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest concentration of zinc in leaves *i.e.* 38.03 and 42.66mg. kg^{-1} compared with a non-spraying plant which gave the lowest concentration *i.e.* 34.15 and 36.15mg.kg^{-1} for two seasons respectively (Table 6).

The triple interaction effected significantly on this parameter. That plant not spraying with organic fertilizer extract and fertilization potassium sluphate at a level 150kg. H^{-1} and spraying with hydrous zinc sulphate at a

Table 1: Physical and chemical properties of the field soil.

Properties	Unit	Season 2016-2018	Season 2017-2018
pH	.....	7.50	7.80
Ec	$dcs.m^{-1}$	1.19	4.30
Organic matter	g.kg-1	4.20	15.6
N	$mg.L^{-1}$	36.4	7.60
K	$mg.L^{-1}$	69.20	72.90
P	$mg.L^{-1}$	1.13	1.60
Zn	$mg.L^{-1}$	0.26	0.24
SO_4	$mmol.L^{-1}$	4.10	5.20
Soil texture	.....	Clay texture	Clay texture
Sand	g.kg-1	184	204
Silt	g.kg-1	320	260
Clay	g.kg-1	496	536

concentration $2g.L^{-1}$gave the highest concentration *i.e.* 43.20mg. kg^{-1} compared with lowest concentration *i.e.* 28.20mg.kg^{-1} that produce from plant non-spraying with organic fertilizer extract and not fertilization with potassium sluphate and spraying with hydrous zinc sulphate at a concentration $4g.L^{-1}$ in the first season. In the second season plant spraying with organic fertilizer extract and not fertilization with potassium sluphate and spraying with hydrous zinc sulphate at a concentration $4g.L^{-1}$ gave the highest concentration *i.e.* 47.00mg.kg^{-1} compared with lowest concentration 23.40mg,kg^{-1} from plant non-spraying with organic fertilizer extract and fertilization with potassium sluphate at a level $75kg.H^{-1}$ and non-spraying with hydrous zinc sulphate (Table 6).

Table 2: Properties of the organic fertilizer extract.

Properties	Unit
EC	13.5
pH	8.35
Humic acid	12.60
Fulvic acid	7.30
N	%4.72
P	% 1.14
K	% 1.99
Zn	% 0.035

Increasing the percentage of potassium table 5 and

Table 4: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the total chlorophyll content in leaves (mg.$100g^{-1}$ fresh weight).

2017 – 2018	Concentration of Zinc sulphate $gm.L^{-1}$			2016 – 2017	Concentration of Zinc sulphate $gm.L^{-1}$			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
60.79f	68.99g	61.29i	52.09k	64.49 c	72.62 f	69.40 g	51.45l	K0	Mo
62.63e	70.35de	64.55h	53.00j	73.33 b	73.53 f	66.55 h	79.93d	K1	
66.30d	72.4 c	64.82h	61.66i	74.74 a	60.33 j	76.86 e	87.03b	K2	
69.10c	70.23de	70.99d	66.08g	73.01 b	62.04 i	80.78 d	76.23e	K0	M1
71.69b	69.83ef	72.31 c	72.94c	75.66 a	84.38 c	89.06 a	53.54k	K1	
78.61a	79.61a	78.03b	78.19b	73.49 b	79.98 d	73.67 f	66.84h	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate $gm.L^{-1}$			Potassium sulphate fertilizer $kg.H^{-1}$	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate $gm.L^{-1}$			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
64.94c	69.61c	66.14 e	59.08g	K0	68.75b	67.33 e	75.09 c	63.84 f	K0
67.16 b	70.09 c	68.43 d	62.97f	K1	74.49a	78.95 a	77.80 b	66.73e	K1
72.45a	76.02 a	71.42 b	69.92c	K2	74.11a	70.15 d	75.26 c	76.93b	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate $gm.L^{-1}$			Organic fertilizer extract	Mean of organicfertilizer fertilizer extract	Concentration of Zinc sulphate $gm.L^{-1}$			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
63.24 b	72.80 c	70.93 d	68.82 e	MO	70.85 b	55.58 f	63.55 e	70.59d	M0
73.13 a	65.53 f	81.17 a	75.46b	M1	74.05 a	72.40 c	73.77 a	73.22 b	M1
	72.14 b	76.05 a	69.16 c	Mean of Zinc sulphate		71.90c	68.66b	63.90c	Mean of Zinc sulphate

Table 5: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the percentage of potassium in leaves (%).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
2.13c	2.82 cdef	2.52efghi	1.05j	2.72bcd	3.12abcde	2.65abcde	2.40 bcde	K0	Mo
2.87b	2.76 cdefgh	2.66 defghi	3.21 bcde	3.75ab	3.91 abc	3.79 abc	3.55abcd	K1	
2.51bc	3.66 b	1.86 i	2.01fhi	3.46abc	2.34 cde	3.43 abcd	4.63a	K2	
2.68 b	1.86 i	3.36bcd	2.82cdefg	2.65c	3.67 abcd	2.14 cde	2.15cde	K0	M1
2.61b	3.78 ab	2.01 fghi	2.04fghi	2.14b	3.43 abcd	1.67 de	1.34e	K1	
3.51a	3.51 bc	4.43 a	2.61 defghi	3.95a	3.67 abcd	3.79 abc	4.39ab	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
2.40b	2.34 de	2.94 bc	1.93 e	K0	2.68b	3.39 abc	2.39 bc	2.27 c	K0
2.74a	3.27 ab	2.33 de	2.62 cd	K1	2.94b	3.67ab	2.73 bc	2.44bc	K1
3.01a	3.58a	3.14 abc	2.31 de	K2	3.70a	3.00bc	3.61 abc	4.51a	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of organicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
2.50b	3.08a	2.34b	2.09 b	MO	3.31a	3.12a	3.29a	3.52a	M0
2.93a	3.05a	3.26a	2.49 b	M1	2.91a	3.59a	2.53a	2.62a	M1
	3.06a	2.80a	2.29b	Mean of Zinc sulphate		3.35a	2.91a	3.07a	Mean of Zinc sulphate

the concentration of zinc table 6 when spraying organic fertilizer extract in the second, that mine be due to the structure of the organic fertilizer extract table 2 which rich with this nutrient that increasing absorption by the leaves when spraying this extract. Also that may be the content of this extract with Humic and Fulvic acids which increase the penetration of this nutrient through cell tissues and thus caused high accumulation of nutrients in the leaves (Arancon *et al.*, 2006). These results agree with Abdullah (2005) on potato.

Form the result in the Table 5, 6 fertilization with potassium fertilizer increasing the percentage of potassium and the concentration of zinc for two seasons, that my be due to the roles of potassium which activation more than 80 enzymes like Synthetases, Oxidoreductases, Dehydregenases, Transferases and Kinases, and this enzymes had important roles in many basic efficiency like energy, starch and protein formation, nitrogen assimilation, respiration and photosynthesis in plant, more than that the availability of potassium in plant which it important roles to building best root system in plant (Abu Dhahi and Al-Younes,1988). And this result as the same on the researchers Marcano and Diaz (1994) and Ghoneim (2005) on sweet potato and Jerusalem artichoke plant which mentioned that a significant increased of potassium in leaves.

Also form the results in Table 5, 6 that the plant spraying with hydrous zinc sulphate supervised in the percentage of potassium and the concentration of zinc for two seasons, that mine be due to the roles of zinc nutrient in stimulation efficacy of photosynthesis in plant which increasing the manufactured of food in leaves, and thus improvement growth plant or spraying zinc promoted root growth (Keiko *et. al*., 2004). This result agrees with Abd-El- Baky (2010) on a sweet potato plant.

Yield parameters

Table 7 showed that was no significant effect on the spraying organic fertilizer extract in the average tuber weight in the first season, meanwhile there was a significant effect on this parameter in the second season, that spraying organic fertilizer supervised and gave the highest average compared to the control treatment which

Table 6: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the concentration of zinc in leaves(mg.kg^{-1}).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
39.00b	39.00 g	41.60 e	36.40h	34.05d	28.20 i	40.60 b	33.36f	K0	Mo
37.56c	42.50 d	46.80 a	23.40k	35.91c	40.15 b	33.36 f	34.23e	K1	
39.22b	40.55 f	40.51 f	36.61h	37.66a	29.06 h	43.20 a	40.73b	K2	
37.33c	47.00 a	33.80 i	31.20j	36.44bc	36.96 c	40.30 b	32.06g	K0	M1
44.83a	43.90 c	46.94 a	43.66c	34.13d	35.16 d	34.32 e	32.93f	K1	
45.00 a	42.91 d	46.33ab	45.78b	36.31b	40.90 b	36.40 c	31.63g	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
38.16c	43.00 b	37.70 e	33.80 f	K0	35.24b	32.58 g	40.45 a	32.71g	K0
41.20b	43.20 b	46.87 a	33.53 f	K1	35.02b	37.65 c	33.84 f	33.58f	K1
42.11a	41.73 c	43.42 b	41.19 d	K2	36.98a	34.98 e	39.80 b	36.18d	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of orga-nicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
38.59b	40.68 d	42.97 b	32.13 f	MO	35.87A	32.47 e	39.05 a	36.10d	M0
42.38a	44.60 a	42.35 c	40.21 e	M1	35.62A	37.67 b	37.00 c	32.20e	M1
	42.64 a	42.66 a	36.17 b	Mean of Zinc sulphate		35.07 b	38.03 a	34.15c	Mean of Zinc sulphate

gave the lowest value. Also, the result in the same table showed a significant effect on the potassium sulphate treatment. That treatment 150kg.H^{-1}potassium sluphate supervised in this parameter and gave the highest average tuber weight compared to the control treatment which the Lowest weight two seasons.

Also form the results in table 7 notice that spraying hydrous zinc sulphate at a concentration 2g.L^{-1} supervised and gave the highest weight *i.e.* 45.44g in the first season and at a concentration 4g.L^{-1} supervised and gave the highest weight *i.e.* 44.23g in the second season compared to control treatment which gave the lowest weight *i.e.* 41.88g and 41.69g for two seasons respectively.

From the interaction between three factors the results showed that the plants non- spraying with organic fertilizer extract and not fertilization with potassium sluphate and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest weight *i.e.* 49.00g compared to plant non-spraying with organic fertilizer extract and fertilization with potassium sulphate at a level 150kg,H^{-1} and spraying hydrous zinc sulphate at a concentration 4g.L^{-1} which gave the lowest weight *i.e.* 34.43g in the first season. Meanwhile plant spraying with organic fertilizer extract and not fertilization with potassium sluphate at a level 75kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 4g.L^{-1} gave the highest weight *i.e.* 50.00g compared to plant non-spraying with organic fertilizer extract and not fertilization with potassium sulphate and spraying hydrous zinc sulphate at a concentration 4g.L^{-1} which gave the lowest weight *i.e.* 38.16g in the first season (Table 7).

Table 8 showed that spraying plant with organic fertilizer extract had a significant effect on yield per unit area. Plant spraying with extract gave the highest yield compared with plant spraying distilled water only which gave the lowest yield. Also, form same Table plant fertilization with potassium sluphate at a level 150kg.H^{-1} gave the highest yield *i.e.* 25.00 and 23.24 Ton.H^{-1} significantly compared to a non-fertilization plant which gave the lowest yield *i.e.*22. 85 and 20.59Ton.H^{-1} respectivly.

Form the table 8 the results showed that plants

Table 7: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the average tuber weight (g).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
40.74 e	38.16i	44.06e	40.00h	45.66b	45.66b	49.00 a	43.00f	K0	Mo
40.57 e	44.10e	35.30k	42.32f	43.18c	45.33de	46.00 cde	38.23g	K1	
44.49 b	44.04e	48.22c	41.23g	42.52c	34.43h	47.00 bcd	46.13cde	K2	
41.51 d	40.11h	44.18e	40.25h	39.17d	43.00f	37.02 g	37.50g	K0	M1
43.12 c	50.00a	37.03j	42.33f	43.33c	43.33c	48.00abc	37.66g	K1	
46.46 a	49.00b	46.33d	44.07e	47.16a	47.00a	45.66 de	48.82ab	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
41.12 c	39.13 f	44.12c	40.12e	K0	42.42c	44.00bc	43.01 c	40.25d	K0
41.84b	47.05 a	36.16g	42.32d	K1	43.25b	44.83b	47.00 a	37.94e	K1
45.48 a	46.52 b	47.27a	42.65d	K2	44.83a	40.71d	46.33 a	47.47a	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of organicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
41.93 b	42.10 b	42.52b	41.18c	MO	43.78a	41.58de	47.33 a	42.45d	M0
43.69 a	46.37 a	42.51b	42.21b	M1	43.21a	44.77b	43.56 c	41.32e	M1
	44.23 a	42.b	41.69c	Mean of Zinc sulphate		43.17b	45.44 a	41.88c	Mean of Zinc sulphate

spraying with hydrous zinc sulphate at a concentration 4g.L^{-1} gave the highest weight *i.e.* 24.56 and 22.83 Ton. H^{-1} compared to plant non-spraying with hydrous zinc sulphate which gave the lowest yield for two seasons respectively.

From the interaction between three factors the results showed that the plants spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 150kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest yield *i.e.* 26.65 and 26.96 Ton.H^{-1} for two seasons respectively compared to plant non-spraying with organic fertilizer extract and non-fertilization with potassium sulphate and spraying hydrous zinc sulphate at a concentration 2g.L^{-1} which gave the lowest weight *i.e.* 21.57Ton.H^{-1} in the first season and 19.6357 Ton.H^{-1} from the plant non-spraying with organic fertilizer extract and fertilization with potassium sulphate at a level 150kg.H^{-1} and spraying hydrous zinc sulphate at a concentration 4g.L^{-1} which gave the lowest weight *i.e.* 21.57Ton.H^{-1} in the second season (Table 8).

The increasing in the yield parameters may be due to the structure of the extract table 2 which content many nutrient like Nitrogen, Potassium and Phosphorus, also Auxin, Cyctokinain and Gibberellins table 2 which make good balance between shoot system and yield that increasing the number of stolons and do best arrangement between Gibberellins and ABA hormones (Taiz and Zeiger,2006), that increasing tuber weight table 7 finally increasing yield per unit area.

Also potassium fertilization had significant effect in the yield parameters Table 7, 8, that increasing may be due potassium roles in an increasing leaves area table 3 and that positive affect in an increasing on the efficacy of the photosynthesis, activated enzymes and CO_2 assimilation inter plant which increasing carbohydrates manufacture that transportation by potassium supported form the sink to the sources (tubers) after increases tuber weight (Al-Sahaf,1989) finally increasing yield per unit (Table 8). This result agreement Anwar *et al*., (2011) and Abou El-Khair and Mohsen (2006) on the Jerusalem artichoke plant.

Also form Tables 7, 8 showed that significant supervised in the yield parameter as a result of spraying hydrous zinc sulphate, that increases mine be due to the

Table 8: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the yield per unit area(Ton.H^{-1}).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
20.35e	20.89efg	20.2fghij	19.89ij	22.48d	23.11fg	21.79hi	22.55Ghi	K0	Mo
21.08d	22.52d	19.78ij	20.96ef	23.94b	24.70 bcd	24.62bcde	22.52Ghi	K1	
21.54c	19.63i	24.59c	20.41 fghi	23.98B	24.46 bcde	23.64 defg	23.85Cdef	K2	
20.83d	20.15 hij	20.19 ghij	22.17d	23.23c	25.30b	21.57i	22.82Fgh	K0	M1
22.93b	26.87a	20.79 efgh	21.15e	23.70bc	23.20fg	23.48 efg	24.42 bcde	K1	
24.94a	26.9	25.99b	21.88d	26.03a	26.59a	26.65 a	24.85bc	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
20.59c	20.52 e	20.24e	21.03d	K0	22.85c	24.20bc	21.68 e	22.68d	K0
22.00b	24.69 b	20.28e	21.05d	K1	23.82b	23.95bc	24.05 bc	23.47c	K1
23.24a	23.29 c	25.29a	21.14d	K2	25.00a	25.52a	25.14 a	24.35b	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of organicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
20.99b	21.01 d	21.55c	20.42e	MO	23.47b	24.09b	23.35 cd	22.97d	M0
22.90a	24.66 a	22.32b	21.73c	M1	24.32a	25.03a	23.90 bc	24.03b	M1
	22.83 a	21.93b	21.07c	Mean of Zinc sulphate		24.56a	23.62 b	23.50b	Mean of Zinc sulphate

Means which take same letters do not different significantly between each other according to Multiple Range Test Duncan test at probability of 0.05.

roles of zinc in plant which increases plant content of NPK that important roles in plant, more than that zinc activated the enzymes in the important bioassay operation like photosynthesis and respiration (Aydn and Sevinc, 2006), and the same result of researchers Abd El-Baky *et al.*, (2010) on sweet potato plant and Rahman *et al.*, (2011) on potato.

Quality tuber parameters

The results in table 9 signaled that there was the non-significant difference to the spraying of organic fertilizer extract in the tuber dry weight percentage in the first seasons. Meanwhile spraying of organic fertilizer extract gave the highest percentage *i.e.* 21.97 compared to control treatment which gave the lowest v spraying of organic fertilizer extract in the tuber dry weight percentage in the first seasons vulvas *i.e.* 21.18 for the tuber dry weight percentage parameter in the second seasons Also form the same Table the result showed that fertilization plant with potassium sulphate at a level 150kg.H^{-1} gave the highest percentage.

Spraying hydrous zinc sulphate at a concentration 2g.L^{-1}gave the highest percentage *i.e.* 22.85 and 22.47% which non different form the treatment 4g.L^{-1} compared to the control treatment which gave the lowest percentage *i.e.* 21.31 and 20.43% table 9 for two seasons respectively.

The triple interaction between factors showed that results showed that plants non-spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 75kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 4g.L^{-1} gave the highest percentage *i.e.* 24.59% compared to plant non-spraying with organic fertilizer extract and non-fertilization with potassium sulphate and non-spraying with hydrous zinc sulphate which gave the lowest weight *i.e.* 21.57Ton.H^{-1} in the first season. Meanwhile plants spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 150kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest percentage *i.e.* 24.31% compared to plant non-spraying with organic fertilizer extract and fertilization with

Table 9: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the tuber dry weight percentage(%).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
21.38c	21.33 e	23.00 b	19.81f	21.2d	21.56 efg	22.26cde	20.00h	K0	Mo
21.09c	21.29 e	22.98 b	19.00g	22.67b	24.59A	23.04 bcd	20.38gh	K1	
21.09c	21.30 e	22.87 b	19.12g	22.50bc	21.07 efgh	23.43 abc	23.00bcd	K2	
20.64d	22.77 b	19.16 g	20.00f	21.68d	20.80 fgh	23.25 bc	21.00efgh	K0	M1
22.07b	22.00 cd	22.55 bc	21.66de	21.82cd	23.38 abc	21.82 def	20.28gh	K1	
23.21a	22.34 bc	24.31 a	23.00b	23.58a	24.19 ab	23.35 abc	23.22bc	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
21.0c	22.05 c	21.08 d	19.90e	K0	21.47C	21.18 d	22.75 bc	20.50d	K0
21.57b	21.64 c	22.76 b	20.33e	K1	22.24B	23.98 a	22.43 c	20.33d	K1
22.15a	21.82 c	23.59 a	21.06d	K2	23.04A	22.63 bc	23.39 ab	23.11bc	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of org-anicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
21.18b	21.30 c	22.95 a	19.31d	MO	22.14A	22.40a	22.91 a	21.12b	M0
21.97a	22.37 b	22.00 b	21.55c	M1	22.36A	22.79a	22.80 a	21.50b	M1
	21.83 b	22.47 a	20.43c	Mean of Zinc sulphate		22.59a	22.85 a	21.31b	Mean of Zinc sulphate

potassium sulphate at a level 150kg,H^{-1} and non-spraying with hydrous zinc sulphate which gave the lowest weight *i.e.* 19.12Ton.H^{-1} in the second season (Table 8).

The results in table 10 showed that there wasthe non-significant difference to the spraying of organic fertilizer extract in the tuber content of total soluble carbohydrate in first seasons. Meanwhile spraying organic fertilizer extract supervised and gave the highest content *i.e.* 141.89mg.g^{-1} dry weight compared to the non spraying plant which gave the lowest content in the second season.

Also, form the same Table the result showed that fertilization plant with potassium sulphate at a level 150kg.H^{-1} gave the highest content dry weight in the first season and fertilization plant with potassium sulphate at a level 75kg.H^{-1} gave the highest content dry weight in the first season compared to the control treatment for two seasons respectively. The result showed that spraying hydrous zinc sulphate at a concentration 4g.L^{-1} gave the highest tuber content of total soluble carbohydrate the dry weight which non different form the treatment 2g.L^{-1} compared to the control treatment which gave the lowest content dry weight in the first season. Meanwhile that spraying hydrous zinc sulphate at a concentration 2g.L^{-1}gave the highest tuber content of total soluble carbohydrate compared to the plant spraying hydrous zinc sulphate at a concentration 4g.L^{-1} control treatment which gave the lowest content dry weight in the second season (Table 10).

The result showed that showed that plants non-spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 150kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest tuber content of total soluble carbohydrates *i.e.* 157.60mg.g^{-1} dry weight compared to plant non-spraying with organic fertilizer extract and non-fertilization with potassium sulphate and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} which gave the lowest content *i.e.* 77.60mg.g^{-1} dry weight in the first season. Also, plants spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 150kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest tuber content of total soluble carbohydrates *i.e.* 167.59mg.g^{-1} dry weight compared to

Table 10: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the tuber content of total soluble carbohydrate(mg.g^{-1} dry weight).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
131.86e	147.30f	111.60o	136.7j	95.10c	125.70 abcde	77.60 f	82.00f	K0	M o
136.06c	140.20h	157.10c	110.9o	123.9ab	136.10abc	135.00abcd	100.70cdef	K1	
127.36f	119.00 m	125.30l	137.8i	132.53a	145.50 ab	157.60 a	94.50ef	K2	
133.23d	108.90p	135.00k	155.8d	112.03bc	102.00 cdef	112.90bcdef	121.20 bcde	K0	M 1
149.86a	137.30 ij	167.59a	144.7g	110.26bc	110.40bcdef	128.40 abcde	92.00ef	K1	
142.59b	115.87n	151.40e	160.5b	111.00bc	138.30 ab	95.00 ef	99.70def	K2	

Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
132.55c	128.1e	123.30f	146.2c	K0	103.56b	113.85 bcd	95.25 d	101.60 cd	K0
142.96a	138.7d	162.34a	127.8e	K1	117.10a	123.25 abc	131.70 ab	96.35d	K1
134.97b	117.4g	138.35d	149.1b	K2	121.76a	141.90 a	126.30 ab	97.10d	K2

Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of organicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
131.76b	135.5c	131.33d	128.4e	MO	117.18a	135.76 a	123.40 ab	92.40 c	M0
141.89a	120.6f	151.33b	153.6a	M1	111.10a	116.90 ab	112.10 b	104.30 bc	M1
	128.0b	141.33a	141.0a	Mean of Zinc sulphate		126.33 a	117.75 a	98.35b	Mean Zinc sulphate

plant spraying with organic fertilizer extract and non-fertilization with potassium sulphate and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} which gave the lowest content *i.e.* 108.90mg.g^{-1} dry weight in the second season (Table 10).

The results in table 11 showed that there was a significant effect on spraying organic fertilizer extract on the tuber content of Inuline in the first season, that plant spraying with extract gave the highest content *i.e.* 100.32 and 83.42mg.g^{-1} dry weight compared to a non-spraying plant which gave the lowest content *i.e.* 83.70 and 63.10mg.g^{-1} dry weight for two seasons respectively.

Results showed that there was a significant effect on spraying organic fertilizer extract on the tuber content of Inuline in the first season table 11, that plant fertilization with potassium sluphate at a level 75kg,H^{-1} gave the highest content *i.e.* 97.40mg.g^{-1} dry weight in the first season and plant fertilization with potassium sluphate at a level 150kg,H^{-1} gave the highest content *i.e.* 79.25mg.g^{-1} dry weight in the second season compared to control treatment which gave the lowest content *i.e.* 85.90 and 67.02 mg.g^{-1} dry weight for two seasons respectively. Also, form the same Table Result showed that spraying hydrous zinc sulphate had no significant effect on the tuber content of Inuline in the first season. Meanwhile and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} which gave the highest content *i.e.* 74.95mg.g^{-1} dry weight compared with control treatment which gave the lowest content *i.e.* 70.54mg.g^{-1} dry weight in the second season (Table 11).

From the interaction between three factors the results showed that the plants spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 75kg,H^{-1} and spraying with hydrous zinc sulphate at a concentration 2g.L^{-1} gave the highest content *i.e.* 117.43mg, g^{-1} dry weight compared to plant non-spraying with organic fertilizer extract and fertilization with potassium sulphate at a level 75kg,H^{-1} and non-spraying hydrous zinc sulphate which gave the lowest content *i.e.* 68.93mg.g^{-1} dry weight in the first season. Also spraying with organic fertilizer extract and fertilization with potassium sluphate at a level 150kg,H^{-1} and spraying with

Table 11: Effect of organic fertilizer extract, potassium sulphate fertilizer, hydrous zinc sulphate on the tuber content of inuline (mg.g-1dry weight).

2017 – 2018	Concentration of Zinc sulphate gm.L^{-1}			2016 – 2017	Concentration of Zinc sulphate gm.L^{-1}			Treatment	
Interaction between M ×K	Zn2	Zn1	Zn o	Interaction between M ×K	Zn2	Zn1	Zn o	Potassium sulphate fertilizer	Organic fertilizer extract
55.54f	51.08m	65.27i	50.27n	84.52 b	79.11 fgh	76.12 gh	98.33 bcde	K0	M o
67.10d	91.20d	52.89l	57.22j	84.58b	86.81 efg	98.00bcde	68.93 h	K1	
66.69e	50.70mn	55.22k	94.16c	82.02b	79.63 fgh	76.03 gh	90.41defg	K2	
78.50c	75.28g	95.06b	65.18i	87.29b	83.48efgh	84.33 efgh	94.07cdef	K0	M 1
79.94b	68.88h	90.10e	80.86f	110.24a	108.44abc	117.43 a	104.85abcd	K1	
91.82a	108.64a	91.20d	75.62g	103.44a	104.33abcd	112.00 ab	94.00 cdef	K2	
Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer kg.H^{-1}	Mean of Potassium sulphate fertilizer	Concentration of Zinc sulphate gm.L^{-1}			Potassium sulphate fertilizer fertilizer
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
67.02c	63.18g	80.16b	57.72h	K0	85.90b	81.29cd	80.22 d	96.20b	K0
73.52b	80.04b	71.49e	69.04f	K1	97.40a	97.62ab	107.71a	86.89bcd	K1
79.25a	79.67c	73.21d	84.89a	K2	92.73a	91.98bc	94.01b	92.20bc	K2
Mean of organic fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract	Mean of org-anicfertilizer fertilizer extract	Concentration of Zinc sulphate gm.L^{-1}			Organic fertilizer extract
	Zn 2	Zn1	Zn o			Zn 2	Zn1	Zn o	
63.10b	64.32 e	57.79 f	67.21d	MO	83.70 b	81.85b	83.38 b	85.89b	M0
83.42a	84.26 b	92.12 a	73.88c	M1	100.32 a	98.75a	104.58a	97.64a	M1
	74.29 b	74.95 a	70.54c	Mean of Zinc sulphate		90.30a	93.98 a	91.76a	Mean of Zinc sulphate

Notice : all tables (Means which take same letters do not different significantly between each other according to Multiple Range Test Duncan test at probability of 0.05.).

hydrous zinc sulphate at a concentration 4g.L^{-1} gave the highest content *i.e.* 108.64mg,g^{-1} dry weight compared to plant non-spraying with organic fertilizer extract and not fertilization with potassium sulphate and non-spraying hydrous zinc sulphate which gave the lowest content *i.e.* 50.02mg.g^{-1} dry weight in the second season (Table 11).

Increasing in the tuber dry weight percentage and tuber content of Inuline by spraying organic fertilizer abstract that my be due to the humic acid in the content of the extract table 2 which increasing nutrient absorption by the plant and thus improvement vegetative growth of the plant like leaves area table 3 and total chlorophyll table 4 this increasing on the efficacy of the photosynthesis, activated enzymes and CO2 assimilation inter plant which increasing carbohydrates manufacture and soluble amino acids that transportation form the sources to sink (tubers) (Calvo *et al.*, 2014) that finally increasing the tuber dry weight percentage and tuber content of Inuline. That the same result by-*et al.*, (2011) on potato.

Noticed form the results in Table 9, 10 spraying hydrous zinc sulphate increasing tuber dry weight percentage and total soluble carbohydrates in tuber, that me be due to the physiological roles of zinc nutrient this increasing on the efficacy of the photosynthesis, activated enzymes and nitrogen and CO2 assimilation inter plant which increasing carbohydrates manufacture and soluble amino acids that transportation form the sources to sink (tubers) (Taiz and Zeiger, 2006).

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