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EVALUATION OF PHOSPHORUS FERTILIZATION AND FOLIAR APPLICATION OF ZINC SOURCES ON GROWTH AND NUTRIENTS UPTAKE OF SQUASH PLANTS

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ABSTRACT

A felid experiment was carried out in three replicates during summer season of 2010 to evaluate the effect of phosphorus rates(0,20 and 30 kg fad^{-1}.) and foliar application of zinc resources ($ZnSO_4$, Zn EDTA, $ZnCl_2$ and Zn(NH4)PO_4) at 10 mg zinc l^{-1}on plant growth, fruits and some nutrient contents and uptake by squash plants.

Results showed that, the dry matter yield (shoots and leaves), physical fruit quality (length and diameter cm) and fruit yield (fresh and dry weight g. plant) were significantly increased by application of phosphorus rates and foliar spraying of zinc sources at all treatments, compared with the control; the highest values of the previous parameter were recorded with Zn ammonium phosphate followed by Zn EDTA more than $ZnSO_4$ and $ZnCl_2$, compared with the control. Also, the best values of protein% and some nutrient contents and uptake were significantly increased due to the application of phosphorous rates and zinc sources at all treatments, compared with the control.

Generally, from these results it can be concluded that the foliar application of phosphorus rate and foliar spraying of zinc sources improved all growth characteristics and nutrients uptake of squash plant.

Keywords: Phosphorus rates, source of zinc, nutrients uptake and plant growth.

INTRODUCTION

Phosphorus is one of the inorganic macronutrients needed by all plants for the manufacture of phosphate containing nucleic acids, ATP and membrane lipids. Phosphorus element is an essential nutrient for crop growth and high yield with good quality. Nasr aala *et al* (1998) stated that the phosphorus element is an essential nutrient for crop growth and height with good quality. El-Far and Ramadan (2000) indicated that application of 46.6 kg P_2O_5 fad^{-1} and 36 kg K_2O fad^{-1} gave the highest effect on yield and its attributes. Similarly, Ali and Mowafy (2003) found that, the adding phosphorus fertilizer caused significant increase in seed yield and all their attributes. Zinc is an essential component of various enzyme systems for energy production, protein synthesis, and growth regulation. Zinc-deficient plants also exhibit delayed maturity. Zinc is not mobile in plants so zinc deficiency symptoms occur mainly in new growth. Poor mobility in plants suggests the need for a constant supply of available zinc for optimum growth. Uptake of zinc also is adversely affected by high levels of available phosphorus and iron in soils. Rehm, *et al* (1980) observed that, the corn response to orthophosphate, polyphosphate and zinc sources; also they found significant differences among zinc sources for zinc uptake by corn plant; Hergert *et al* (1984) reported that the zinc uptake by corn plant was affected by zinc sources, also they stated that uptake of zinc with EDTA application was superior to other sources. Gangloff *et al* (2002**)** found that the $ZnSO_4$, Zn lignosulfonate and ZnEDTA all produced similar increases in dry matter (15-21%) when compared to the control. Thaloot, *et al* (2005) indicated that foliar spraying with zinc had positive effect on yield and yield attributes of sunflower plants. Mirvat, *et al* (2006) reported that, the foliar spraying of zinc significantly affected chemical constituents including protein content, NPK%, as well as oil %; they added that, the increasing zinc concentration from 0.5 to 1.0 g./l significantly increased the characteristics chemical constituents. Akhtar, *et al* (2009) found that the three mg/L zinc chlorides solution for foliar treatment on *Mentha piperita* plants was most effective for vegetative growth as well as quantitative yield of its essential oil.

In general zinc have main role in synthesis of proteins, enzyme activating, oxidation and revival reactions and metabolism of carbohydrates. By utilizing of fertilizers contain zinc and other micronutrients, performance on quality of crops is increasing and with shortage of this elements due to decline in plant photosynthesis and destroy RNA, amount of solution carbohydrates and synthesis of protein decreased and then performance and quality of crop will be decreased (Mousavi *et al*. (2007); while, zinc deficiency occurs generally in agricultural soils of the world. According to FAO report of thirty countries, more than 30 percent of these countries agricultural soils encounter zinc deficiency; most of this amount is unavailable for plants. High $CaCO_3$, high pH, low organic matter and moisture of soil and high bicarbonate of irrigation water have most effects on zinc absorbability, (Kalantari and Kazmeinkah, 2004). The objective of this investigation is to evaluate the effect of phosphorus rate and resources of zinc on plant growth, some nutrient contents and uptake by squash plants.

MATERIALS AND METHODS

A field experiment was carried out using a randomized complete block design with three replicates to evaluate the effect of phosphorus rates (o, 20 and 30 kg P_2O_5 fad^{-1}, as a superphosphate 15% P_2O_5); and some sources of zinc ($ZnSO_4$, Zn EDTA, $ZnCl_2$ and $Zn(NH4)PO_4$ at 10 mg zinc l^{-1}) on plant growth and some nutrient contents and uptake.

The experiment was conducted during summer season of 2010 (at the Experimental Farm of Al-Azhar University- Nasr City- Cairo Governorate) on plots of 10.5 m long consisting of five rows (3.5 m length and 60 cm apart).The soil sample (0-30 depth) was routinely analyzed according to Klute,(1986) for physical properties; and chemical properties of the soil (i.e. EC, pH and soluble ions according to Page *et al*., 1982) to detect the changes that might take place in soil characteristics. The results are presented in Table 1.

Squash plants (*Cucurbita pepo L*.) were sown in the first week of May and fertilized according to the general recommendations by Ministry of Agriculture; excluding phosphorus and zinc. Then, foliar spraying with (10 mg zinc l^{-1}) as $ZnSO_4$, Zn EDTA, $ZnCl_2$ and Zn (NH4) PO_4; and two foliar spraying for all treatments; at 30 days after sowing and 40 days after sowing at the rate of 400 l/fad.

Table 1: Some physical and chemical properties of investigated soil.

Particle size distribution (%)			Texture	pH (1:2.5)	$EC (dSm^{-1})$	Soluble ions in 1:5 soil water extract (meq /100g).							
Sand	Silt	Clay	Sandy loam	7.6	1.02	Ca^{++}	Mg^{++}	Na^{+}	K^{+}	$CO3^{--}$	$HCO3^{-}$	$SO4^{--}$	Cl^{-}
74.3	13.7	12.0				0.98	0.85	1.69	1.11	0.0	1.82	1.11	1.69

At the end of the season the plants were harvested, washed with distilled water, dried at 70°c and ground, then representative portions were wet digested using a mixture of $HClO_4$ and H_2SO_4 (1:1) to determine NPK and micronutrients; total N was determined by micro-Kjeldahl technique; total P was determined by ascorbic acid method; total K was determined using flame photometer; according to Page *et al*. (1982). The micronutrients (Fe, Mn and Zn) were determined by Inductively Coupled Plasma Spectrometer (ICP) Plasma 400. Also the obtained data were statistically analysis according to the methods recorded Sendecor and Cochran (1980)

RESULTS AND DISCUSSION

Dry matter yield (shoots and leaves).

Data presented in Table 2 show that the dry matter yield of shoots and leaves were significantly affected by soil application of phosphorus rates and foliar spraying of zinc sources at all treatments; and the highest values of dry matter yield were recorded with 30 kg fad^{-1} superphosphate at all zinc treatments compared with the other treatments and the control. Data reveal that the values of shoots and leaves yield were 9.90 and 12.01 g/plant for the control and increased to (14.03 and 21.01); (16.43 and 24.02) and (18.12 and 28.02) g/plant obtained with 0, 20 and 30 kg fad^{-1}. phosphorus at 10 mg/l^{-1} zinc Ammonium phosphate (ZAP), respectively.

On the other hand, the lowest values of dry matter of shoots and leaves yield were 12.01 and 14.92 g/plant obtained without superphosphate treatment and 10 mg l^{-1} zinc sulfate compared with other treatments and the control. Values which were obtained due to the other treatments for the same parameter were found to be in between. These results agreed to some extent with those obtained by El-Dsouky and Attia (1999) who stated that increasing phosphorus fertilizer rates from 30 to 60 kg P_2O_5 fad^{-1} increased all yield components. Such favorable effects on yield and yield traits may be due to the stimulation effects of P on number and weight of nodules and nitrogen activity which in turn reflected positively on ground nut yield attributes. Furthermore, the increment in yield due to phosphorus fertilizer may be attributed to the activation of metabolic processes, where its role in building phospholipids and nucleic acid is known, (Marschner ,1986).

Table 2: Effect of phosphorus rate (kg fad^{-1} .) and zinc foliar application on the growth characteristics of squash plants.

Treatments		Dry weight ($g\ plant^{-1}$)		Whole plant	Physical fruit quality		Fruit yield/plant	
P-rates kg fad^{-1}.	Zn-sources	Shoots	leaves		Length (cm)	Diameter (cm)	Fresh weight (g/plant)	Dry weight (g/plant)
0	Control	9.90	12.01	21.91	9.01	2.10	40.03	7.01
	Zinc sulphate	12.01	14.92	26.93	10.53	2.30	41.44	7.12
	Zinc cheated	12.52	19.83	32.35	11.52	2.50	43.12	7.13
	Zinc chloride	11.71	14.01	25.72	10.21	2.20	42.13	7.21
	ZAP	14.03	21.01	35.04	12.34	2.55	44.21	7.50
	Mean	12.03	16.36	28.39	10.72	2.33	42.19	7.19
20	Control	13.31	19.03	32.34	11.02	2.40	43.12	7.21
	Zinc sulphate	14.20	22.04	36.24	12.01	2.56	43.91	7.32
	Zinc cheated	16.22	24.02	40.24	13.04	2.57	44.54	7.41
	Zinc chloride	15.31	23.01	38.32	13.03	2.58	47.05	7.61
	ZAP	16.43	24.02	40.45	13.54	2.60	49.41	8.11
	Mean	15.09	22.42	37.52	12.53	2.54	45.61	7.53
30	Control	14.90	22.32	37.22	13.55	2.61	51.01	8.34
	Zinc sulphate	16.11	22.73	38.84	14.02	2.73	55.03	8.52
	Zinc cheated	17.13	25.01	42.14	14.52	2.75	56.06	8.61
	Zinc chloride	17.91	26.52	44.43	15.01	2.77	59.56	8.73
	ZAP	18.12	28.02	46.14	15.53	3.10	61.42	8.94
	Mean	16.83	24.92	41.75	14.53	2.79	56.62	8.63
L.S.D. at 5%								
*A		0.01	0.21	0.60	0.15	0.020	0.99	0.17
**B		0.12	0.25	0.75	0.17	0.025	1.15	0.20
***AB		0.22	0.43	0.30	0.30	0.043	1.99	0.35

• A for phosphorus rate kg/fad.
**** B for zinc sources.**
***** AB for interaction between.**

Also, data in the same Table reveal that the mentioned trend of dry matter yield of shoots and leaves was observed for whole plant. These increases in dry matter yield (shoots and leaves) with application of phosphorus rates may be due to that help developing a more extensive root system and thus enabling plants to extract water and nutrients from more depth; secondly, foliar spraying with zinc encouraged the vegetative growth and increased the plant capacity for building metabolites. Such response may be due to that zinc is known to as an activator of several enzymes in plants and is directly involved in the biosynthesis of growth substances such as auxin which produces more plant cells and more dry matter, these results are in a partial agreement with those obtained by Thaloot, *et al* (2005)**.**

Physical fruit quality (length and diameter, cm.).

Data in Table 2 show that the values of length and diameter significantly affected by phosphorus rates and foliar application of zinc sources for all treatments compared with the control; also, the height values of length and diameter cm were recorded with 30 kg fad^{-1} P_2O_5 at all zinc sources treatments, compared with 20 kg fad^{-1} phosphorus and without phosphorus treatments at all zinc sources. The lowest values of length and diameter were 9.01 and 2.10 cm at the control and increased to 15.53 and 3.10 cm with 30 kg fad^{-1} phosphorus at 10 mg l^{-1} zinc Ammonium phosphate

(ZAP), while the values which were obtained from other treatments for the same parameter were found to be in between. These results are in a good agreement with those obtained by Ali *et al*. (2008) and Graham *et al*. (2000) stated that the zinc is essential element for crop production and optimal size of fruit, also it required in the carbonic enzyme which present in all photosynthetic tissues, and required for chlorophyll biosynthesis.

Fruit yield (fresh and dry weight gm/ plant).

Data tabulated in Table 2 reveal that the fresh and dry weight g/ plant of squash fruit significantly affected due to the bravoes treatments; the height values of fresh and dry weight were obtained with 30 kg fad^{-1} phosphorus, followed 20 kg fad^{-1} phosphorus, then, without phosphorus treatments at all zinc sources, compared with the control. These increases in fresh and dry weight of fruits with application of phosphorus rates and zinc sprays may be attributed to its vital role activity in the function of enzymes for the biological processes in plants which lead to increase in yield components. In this concern, Mirvat *et al* (2006) reported that, increasing phosphorus levels increased each of leaves and stem weight/plant, number of pods and seeds/plant, weight of pods and seeds /plant, 100-seed weight, seed and oil yields, oil percentage of groundnut plant; while, Ali and Mowafy (2003) observed that application of foliar spray with Zn slightly improved peanut yield and it's attributed as well as quality. Also, Thalooth *et al.,* (2005) indicated that foliar praying with Zn had a positive effect on yield and yield attributes of sunflower plants.

Concerning the relative increase of fresh weight of fruit yield per plant, data in the same table show that the highest relative increase were 53.43 % obtained with 30 kg/Fad superphosphate and 10 mg/l^{-1} zinc phosphate, compared with the lowest relative increase were 3.52 % obtained without phosphorus treatment and 10 mg/l^{-1} zinc sulfate compared with the control. These results are in harmony agreement with those obtained by Mousavi (2011) who stated that, the zinc is essential micronutrients for proteins production in plants; also zinc is main composition of ribosome and is essential for their development. Amino acids accumulated in plant tissues and protein synthesis decline by zinc deficit. One of the sites of protein synthesis is pollen tube that amount of zinc in there tip is 150 micrograms per gram of dry matter.

Macro and micronutrients content by squash plant.

Data presented in Table 3 show that the NPK contents were significantly affected by soil application of phosphorus rate and foliar spraying of zinc at all treatments; and the best values of NPK were obtained at 30 kg fad^{-1} phosphorus at all zinc treatments compared with the other treatments and the control. Data revealed that the values of NPK content were 1.12, 0.06 and 0.36 % for the control and increased to (1.72, 0.14 and 0.77 %); (1.85, 0.21 and 0.85 %) and (1.90, 0.26 and 0.93 %) obtained with 0, 20 and 30 kg fad^{-1}. phosphorus at 10 mg l^{-1} zinc phosphate, respectively. While the lowest values were obtained with zinc sulphate at all phosphorus rate treatments compared with the control.

Table 3: Effect of phosphorus levels and zinc sources added as foliar application on nutrients content in fruit of squash plants.

Treatments		Macronutrients (%)			Micronutrients (ppm)			Protein
P-rates (A)	Zn-sources (B)	N	P	K	Fe	Mn	Zn	(%)
0	Control	1.12	0.06	0.36	55.11	8.13	11.17	6.66
	Zinc sulphate	1.33	0.10	0.64	74.42	17.32	20.56	7.91
	Zinc cheated	1.21	0.13	0.72	80.51	18.42	26.36	7.20
	Zinc chloride	1.51	0.13	0.75	77.53	17.31	27.52	8.98
	ZAP	1.72	0.14	0.77	84.32	23.24	30.56	10.23
	Mean	1.38	0.11	0.65	74.38	16.88	23.23	8.21
20	Control	1.62	0.17	0.75	81.42	19.23	25.42	9.64
	Zinc sulphate	1.75	0.18	0.82	86.22	22.41	28.21	10.41
	Zinc cheated	1.81	0.19	0.83	89.13	27.75	31.32	10.77
	Zinc chloride	1.82	0.19	0.82	83.41	25.24	33.45	10.83
	ZAP	1.85	0.21	0.85	90.13	30.45	35.87	11.01
	Mean	1.77	0.19	0.81	86.06	25.02	30.85	10.53
30	Control	1.80	0.23	0.80	88.61	28.84	31.12	10.71
	Zinc sulphate	1.83	0.24	0.84	91.23	31.47	36.48	10.89
	Zinc cheated	1.86	0.25	0.86	94.42	32.65	38.68	11.07
	Zinc chloride	1.85	0.26	0.87	93.71	29.65	39.75	11.01
	ZAP	1.90	0.26	0.93	99.51	35.49	45.55	11.31
	Mean	1.85	0.25	0.86	93.50	31.62	38.32	11.01
L.S.D at 5%								
*A		0.005	0.002	0.01	0.22	0.29	0.46	0.340
**B		0.006	0.002	0.12	0.25	0.34	0.54	0.040
***AB		0.110	0.004	0.22	0.43	0.59	0.93	0.069

*** A for phosphorus rate kg fad^{-1}.**
**** B for zinc sources.**
***** AB for interaction between.**

Concerning the effect of phosphorus rate and zinc sources on micronutrients content, data reveal that the mentioned trend of NPK content was observed for Fe, Mn and Zn content. These results are in a partial agreement with those obtained by, Mirvat *et al* (2006) reported that, the foliar spraying of zinc significantly affected on chemical constituents including protein content, NPK%, as well as oil % ; they added that increasing zinc concentration from 0.5 to 1.0 g l^{-1} significantly increased the characteristics chemical constituents. Also, Fayed and El-Moatasem (1995) stated that the Zn application increased Fe uptake compared with the untreated control and they added that, these increases were mainly attributed to the effect of zinc application on dry matter yield; also the zinc cheated forms increased Fe uptake in straw and grain more than mineral forms.

With regard to the effect of phosphorus rate and zinc sources foliar sprays on protein content, data in Table3 reveal that the best values were recorded with 30 kg phosphorus rate at ZAP treated compared with other treatments and control. In this respect, other scientists reported that seed protein content was increased by zinc application. It has been shown that in zinc deficiency condition, activity of RNA polymerase enzyme and protein synthesis enzyme are decreased extremely and rate of amino acids transformation declined. So by applying zinc, seed protein content will be increased due to increasing the activity of RNA polymerase enzyme and protein synthesis enzyme (Akhtar *et al*., 2009; Rahman *et al*., 2008, and Sangwan and Raj, 2004).

Macro and micronutrients uptake (mg plant^{-1}) by squash plant.

Data in Table 4 show that the NPK uptake were significantly affected by soil application of phosphorus rate and foliar spraying of zinc sources at all treatments; also, the highest values were recorded with up to rate of 30 kg P_2O_5 phosphorus and foliar sprays of ZAP compared with other treatments and control. The values of NPK uptake were 78.51, 4.21 and 25.24 mg plant^{-1}, respectively at the control and increased to (129.00, 10.50 and 57.75), (150.04, 17.03 and 68.94) and (169.86,23.24 and 83.14) mg plant^{-1}, obtained at 0 , 20 and 30 kg (P_2O_5) phosphorus Fad^{-1} and foliar spray of ZAP , respectively, compared with other treatments, also, mostly, data reveal that the mentioned trend of NPK uptake was observed for Fe, Mn and Zn uptake.

Concerning the interaction effects between different rates of phosphorus fertilizer and foliar spraying with zinc on Fe, Mn and Zn uptake data in Table 4 indicated that increases of P rate and spraying of Zn increasing Fe, Mn and Zn uptake of squash fruit.

Table 4: Effect of phosphorus rate and zinc sources added as foliar application on nutrients uptake in fruit of squash plant.

Treatments		Macronutrients (mg/plant)			Micronutrients (µg/plant)		
P-rates (A)	Zn-sources (B)	N	P	K	Fe	Mn	Zn
0	Control	78.51	4.21	25.24	386.32	56.99	78.30
	Zinc sulphate	94.70	7.12	45.57	529.87	123.32	146.39
	Zinc cheated	86.27	9.27	51.34	574.04	131.33	187.95
	Zinc chloride	108.87	9.37	54.08	558.99	124.81	198.42
	ZAP	129.00	10.50	57.75	632.40	174.30	229.20
	Mean	99.08	8.05	46.59	534.78	121.40	167.05
20	Control	116.80	12.26	54.08	587.04	138.65	183.28
	Zinc sulphate	128.10	13.18	60.02	631.13	164.04	206.50
	Zinc cheated	134.12	14.08	61.50	660.45	205.63	232.08
	Zinc chloride	138.50	14.46	62.40	634.75	192.08	254.55
	ZAP	150.04	17.03	68.94	730.95	246.95	290.91
	Mean	133.28	14.16	61.29	648.05	188.37	232.33
30	Control	150.12	19.18	66.72	739.01	240.53	259.54
	Zinc sulphate	155.92	20.45	71.57	777.28	268.12	310.81
	Zinc cheated	160.15	21.53	74.05	812.96	281.12	333.03
	Zinc chloride	161.51	22.70	75.95	818.09	258.84	347.02
	ZAP	169.86	23.24	83.14	889.62	317.28	407.22
	Mean	159.48	21.40	74.22	806.87	272.88	330.67
L.S.D at 5%							
A		0.68	2.27	0.65	1.18	1.47	1.29
B		0.79	2.63	0.75	1.36	1.70	1.50
AB		1.37	4.56	1.30	2.36	2.94	2.59

- **A for phosphorus rate kg fad^{-1}.**

**** B for zinc sources.**

***** AB for interaction between.**

Finally, phosphorus element is an essential nutrient for crop growth and height with good quality; zinc is required in small amounts but critical concentrations to allow several key plant physiological pathways to function normally. These pathways have important roles in photosynthesis and sugar formation, protein synthesis, fertility and seed production, growth regulation and defense against disease. Where zinc is deficient, these physiological functions will be impaired and the health and productivity of the plants will be adversely affected, resulting in lower yields (or even crop failure) and frequently in poorer quality crop products (Alloway, 2002).

Also, foliar applications of micronutrients are more suitable than the soil application, due to the rapid overcoming on deficient, easy to use, reduce the toxicity caused by accumulation and prevent of elements stabilization in the soil. There is increasing evidence showing that foliar or combined soil plus foliar application of zinc fertilizers under field conditions are highly effective and very practical way to maximize uptake and accumulation of zinc in plants.

REFERENCES

Akhtar, N., M. A. Sarker., H. Akhter and K. Nada (2009) Effect of planting time and micronutrient as zinc chloride on the growth, yield and oil content of *Mentha piperita*. Bangladesh J. Sci. Ind. Res., 44(1)125-130

Ali, A.A.G. and S.A.E. Mowafy (2003) Effect of different levels of potassium and phosphorus fertilizers with the foliar application of zinc and boron on peanut in sandy soils. Zagazig J. Agric.Res., 30: 335-358.

Ali, S., K.A. Riaz, G. Mairaj, M. Arif, M. Fida and S. Bibi (2008) Assessment of different crop nutrient management practices for yield improvement. Australian Journal of Crop Science, 2(3):150-157.

Alloway. B.J., (2002) Zinc-the vital micronutrient for healthy, high-value crops. International Zinc Association (IZA).

El-Dsouky, M.M. and K.K., Attia (1999) Effect of inoculation with phosphate solublizing bacteria, organic manuring and phosphate fertilization on peanut grown on sandy calcareous soil. Assiut J. Agric. Sci., 30: 177-188.

El-Far, I.A. and B.R. Ramadan (2000) Response of yield, yield components and seed quality of peanut to plant density and PK fertilization in sandy calcareous soil. Proc. 9th Conf. Agron., Minufiya Univ., 1-2 Sept., pp: 453-466.

Fayed, R. M. and M. O. El-Moatasem (1995). Effect of zinc and iron fertilization on their uptake and rice yield. Al-Azhar J. Agic. Res., (22)27-35.

Gangloff, W.J.; Westfall, D.G.; Peterson, G.A.; and Mortvedt, J.J. (2002) Relative Availability Coefficients of Organic and Inorganic Zn Fertilizers. J. Plant Nutr., 21(2): 259-273.

Mirvat, E.G., M.H. Mohamed, and M.M. Tawfik (2006) Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. Journal of Applied Science Research, 2(8): 491-496.

Graham, R.D., R.M. Welch, and H.E. Bouis (2000) Addressing micronutrient nutrition through enhancing the nutritional quality of staple foods. Advances in Agronomy 70: 77-161.

Hergert, G.W., G.W. Rehm and R.A. Weise, (1984) Field evaluations of zinc sources and B applied in ammonium phosphate suspension. Soil Sci. Soc. Am. J., 48:1190-1193.

Kalantari,F., and K. kazmeinkah (2004) The role of using zinc on quality and quantity of potato in soils of east azarbaijan. The Joint Agriculture and Natural Resources Symposium, Tabriz- Ganja, May 14-16.

Klute, A. (1986). Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods (2^{nd} ed.) Amer. Soc. Agron. Monograph No. 9 Madison, Wisconsin, USA.

Marschner, H. (1986)Mineral Nutrition of Higher Plants. Inst. of Plant Nutrition, Univ. of Hoheheim, F.R.G. Academic. Prss, Harcout, Brace. Jovanvich Publisher. London.

Mousavi, S. R. (2011) Zinc in Crop Production and Interaction with Phosphorus. Australian Journal of Basic and Applied Sciences, 5(9): 1503-1509.

Mousavi, S.R., M. Galavi and G. Ahmadvand (2007) Effect of zinc and manganese foliar application on yield, quality and enrichment on potato (*Solanum tuberosum* L.) Asian Journal of Plant Sciences, 6: 1256-1260.

Nasr aala, A.E., A.A.Osam fatma and K.G. Soliman (1998) effect of increased phosphorus and potassium or sulfer application in there different combinations on yield,components and chemical coposition of Peanut in a newly recliamed sandysoil. Zagazig J. Agric. Res., 25:557-579.

Page, A. L., R. H. Miller and D. R. Keeny (1982) Methods of Soil Analysis. Part π. Chemical and microbiological properties (2^{nd} ed.) Amer. Soc. Agron. Monograph no. 9 Madison, Wisconsin, USA.

Rahman, M.T., M. Jahiruddin, M.R. Humauan, M.J. Alam and A.A. Khan (2008) Effect of sulphur and zinc on growth, yield and nutrient uptake of boro rice (cv. *Bree Dhan* 29). Journal of Soil Nature, 2(3): 10-15.

Rehm, G.W., R.A. Wiese, and G.W. Hergert (1980) Response of corn to zinc source and rate of zinc band applied with either orthophosphate or polyphosphate. Soil Sci. 129:36-44.

Sangwan, P.S., M. Raj (2004) Effect of zinc nutrition on yield of chickpea (*Cicer arietinum* L.) under dryland conditions. Indian Journal of Dryland Agriculture and Development, 19(1): 01-03.

Sendecor, G. W. and W. G. Cochran (1980) Statistical Methods 6^{th} Ed- low state niv. Press, Ames. Iowa U.S.A.

Thalooth, A.T., N.M.Bader and M.H.Mohamed (2005) Effect of foliar spraying with Zn and different levels of phosphatic fertilizer on growth and yield of sun flower plants grown under saline condition.Egypt.J.Agron., 27:11-22.

تقييم التسميد الفوسفاتى والرش بمصادر زنك مختلفة على نمو وإمتصاص بعض المغذيات لنبات الكوسه

سالم سالم عبد الحليم شاور و أحمد حمدى رزق
قسم الأراضي والمياه – كلية الزراعة – جامعة الأزهر- القاهره –مصر.

أقيمت تجربه حقلية خلال موسم الصيف 2010 لدراسة تـأثير الاضـافة الارضـية لعنصـر الفوسفور بمعدلات صـفر و 20 و 30 كيلو جرام /فدان وكذلك الاضـافة الورقيـه لبعض مصـادر الزنـك المختلفـه (كبريتـات الزنـك ، الزنـك المخلبـى ، وكلوريـد الزنـك و فوسـفات الزنـك بتركيـز10 مليجرام/ لتر زنك. وتقييم تأثيرها على نمو نبات الكوسة وكذلك امتصاصـه لبعض العناصـر الغذائيـه خلال موسم نمو2010م .

وتتلخص أهم النتئج المتحصل عليها فيما يلى:.

أثـرت المعاملـه بمعدلات الفوسـفور المختلفـة وكـذلك مصـادر الزنـك المختلفـه معنويـا علـى جميع التقديرات المدروسه، حيث كانت أفضل النتـائج المتحصـل عليهـا بالنسبه لانتـاج المـاده الجافـه (للسيقان والاوراق جم/للنبات)، وصفات جودة الثمار(الطول والقطر) وإنتاج الثمار جم/ نبات مع إضافة 30 كجم فوسفور /فدان مع الرش بجميع مصادر الزنك. وأيضاً كانت أفضل القيم المتحصـل عليها لمحتوى النبات من البروتين وبعض المغذيات مع استعمال 30 كجم فوسفور والرش بفوسفات الزنك بالمقارنه بالمعدلات والمصادر الاخرى والكنترول.

وعمومـاً شـوهد أن المعاملـة بعنصـر الفوسـفور والـرش بعنصـر الزنـك تحسـن مـن صـفات النمو والمحتوى العنصرى لنبات الكوسة.

قام بتحكيم البحث

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