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EFFECT OF PHOSPHORUS RATES AND METHODS OF ZINC APPLICATION ON MAIZE YIELD AND ITS COMPONENTS

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ABSTRACT

A field experiment was carried out at Demo, El Fayoum Governorate during two successive seasons 2004 and 2005 to study the effect of different levels of phosphorus (0, 15, 30 and 45 P_2O_5/ /fed) and methods of zinc application (soil application and foliar spray), and their combination on growth characters, mineral content and yield and its components of maize plant (*Zea mays* L, c.v. Single hybrid 10).

The most important results could be summarized as follows:

1. Plant height, dry weight, ear weight, 100-grain weight, yield and yield components were increased significantly by increasing rate of phosphorus up to 45 kg P_2O_5/fed.
2. Zinc application by both methods has its positive effect on improving increasing maize yield and its components.
3. The interaction between phosphorus rates and methods of zinc application had a significant effect on grain yield /fed and yield components in both seasons.
4. In general, the highest yield and yield components were obtained when the plants received 45 kg P_2O_5/fed combined with zinc application as foliar spray.

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal in Egypt. Therefore, many studies were conducted to increase its yield and improve its quality through proper fertilization and good management as well as releasing new high varieties. Maize grain contents are 10% protein, 71.7% carbohydrates, 4.3% oil, 1.7% crude fiber and 1.5% ash.

Phosphorus is very important element to plant growth and plays a key role in metabolic processes such as the conversion of sugar into starch and cellulose (Mengel and Kirkby, 1987). Thompson and Troch (1979) showed that P is needed in cell divisions, at formation, transformation of starch, seed germination, synthesis of nucleoproteins and some other vital processes. Haldar amd Mandal (1981) and El-Shefie (1994) studied the effect of P and Zn application in different soils on the growth and nutrients uptake of rice and broad bean; they found that application of P and Zn significantly increased the dry matter of shoots, grains and roots. Zinc has also a role in starch metabolism in plants. Jyung *et al*. (1975) compared the behaviour of two cultivars of navy bean grown under Zn-deficient conditions. They found that in the cultivar susceptible to Zn deficiency the starch content, the activity of the enzyme starch synthetase and the number of starch grains were all more depressed than in the unsusceptible cultivar.

This work was carried out to evaluate the effects of phosphorus and zinc as well as the interaction on growth, chemical composition and yield of maize.

MATERIALS AND METHODS

A field experiment was carried out at Demo, El-Fayoum Governorate during two successive seasons 2004 and 2005 to study the effect of different rate of phosphorus fertilizer, methods of zinc application and their combinations on maize (c.v. single hybrid 10) yield, yield components and chemical composition.

The experiment was carried out in a factorial split plot design with four replicates, where the phosphorus rates represented by the main plot and the methods of zinc application represented by the sub plot. Phosphorus was added to the soil as superphosphate at four rates which were equivalent to (0, 15, 30 and 45 kg P_2O_o/fed.)

The method of zinc application was as follows:

1. Soil application before sowing at the rate of 2 kg/fed as Zn-EDTA (12% Zn).
2. Foliar was performed twice, at 45 and 65 days after sowing with a concentration of 0.6 Zn-EDTA/L, with a total volum of 400L/fed.

Nitrogen was applied at the rate of 98.8 kg N/fed in the form of anhydrous ammonia before planting. Potassium was added as potassium sulphate at the rate of 24 kg K_2O/fed and was added to dry soil before transplanting. Some physical and chemical properties of the soil are given in Table (1).

Table (1): Some soil physical and chemical properties of the experimental soil.

Property	Value
Mechanical analysis:	
Coarse sand (%)	10.44
Fine sand (%)	27.41
Silt (%)	15.35
Clay (%)	46.80
Soil texture	Clay
Chemical analysis:	7.85
pH(1:2.5,soil:water suspension)	1.19
EC (dS/m)(soil paste extract)	4.50
$CaCO_3$ (%)	1.50
Organic matter %	
Available nutrients (mg/kg):	43.7
N(K_2SO_4-extract)	6.54
P ($NaHCO_3$-extract)	230
K (NH_4OAC pH 7.0)	1.0
Zn (DTPA-extract)	
Soluble ions (me/L) in soil past extract:	
Ca^{++}	2.40
Mg^{++}	1.61
Na^{+}	6.00
K^{+}	0.30
$CO_3^{=}$	0.00
HCO_3^{-}	0.30
Cl^{-}	5.70
$SO_4^{=}$	2.20

Three plant samples were taken as follow:

a- The first one was taken after 60 days from planting and the second one was taken after 80 days from planting. Plant height, dry weight/plot and nutrient uptake were determined and recorded in both samples.

b- The third samples were taken at harvest stage. Plant height, ear weight (gm), ear grain weight (gm), straw and grain yields as well as 100-grain weight were recorded and grains were also subjected to chemical analysis. Oil content (%) was determined by soxhelt apparatus using hexane as a solvent. Oil yield was calculated by multiplying grains oil percentage by grain yield (kg/fed)

-**Carbohydrate fractions:**

a-Soluble sugars: reducing and non reducing sugars as well as total sugar contents were determined.

b-Total carbohydrate content was determined.

c-Starch content was determined.

Total soluble sugars were determined according to the method described by Dubios *et al*.(1951), reducing sugars were determined according to the method described by Somogi (1952). Non-reducing sugars were obtained by calculating the difference between total soluble sugars and reducing sugar content. Total carbohydrate in maize grain was also determined according to Smith *et al*. (1956) starch content was obtained by calculating the difference between total carbohydrate and total soluble sugar content.

Phosphorus was determined in the digested solution as described by Jackson (1968), potassium content was estimated in the digest referred precviously by using flame photometer according to the method described by Chapman and Pratt (1961), total nitrogen was determined in the previous digest by using microjeldahl method (A.O.A.C., 1990). The crude protein of corn grains was obtained by multiplying the percentage of total nitrogen by 5.75.

The statistical analysis was estimated according to the method of Snedecor and Cochran (1967) and treatment means values were compared against least significant differences test (L.S.D.)at 5% level.

RESULTS AND DISCUSSION

Growth parameters:

Data recorded in Tables (2 and 3) show that phosphatic fertilizers increased plant height, dry weight/plot and nutrients uptake of maize plants as compared with the control. Generally, it could be concluded that the rate of 45 kg P_2O_5/fed proved the superiority in all the treatments during the first and second seasons, This may be attributed to the important role of P in plant metabolism processes, roots growth and proliferation of plants which increase nutrients uptake. However, the increase of nutrients absorption leading to an increase in dry weights (Mengel and Kirkby, 1987). Similar results were obtained by El-Shafie (1994) and Mersal (1996).

Data in the same Tables show that applying zinc increased significantly plant height, dry weight/plot and nutrients uptake of maize plants, but the increase of dry weight with Zn as foliar was higher than the soil application. The positive effect of Zn on plant growth may be due to its effect as a material component of some enzymes or regulatory for the other, Zn has an essential role in tryptothan synthase and metabolism (Ramheld and Marshchner, 1991). Results in Tables (2 and 3) also show the interaction effect between Zn and P on maize dry matter production which was positive, where dry weights obtained at Zn applied with P and they were more effective than the control.

Table (2): Effect of different rates of phosphorus, methods of Zn application and their interaction on growth characters and elements uptake of maize plants at 60 days

Treatments		2004						2005					
		Plant	Dry	Uptake (mg/plot)				Plant	Dry	Uptake (mg/plot)			
P Rate	Zn Method	height (cm)	weight (g/pot)	N	P	K	Zn	height (cm)	weight (g/pot)	N	P	K	Zn
0	*Without Zn*	126	9.9	99	11.9	120	0.108	128	10.2	107	15.3	133	0.142
	Soil appl.	128	13.7	167	42.5	206	0.169	130	12.2	156	41.5	189	0.187
	Foliar appl.	133	18.9	253	73.7	331	0.237	133	18.7	266	82.3	339	0.299
15	*Without Zn*	130	12.9	242	25.8	260	0.172	132	12.0	126	28.8	230	0.196
	Soil appl.	135	19.4	388	67.9	541	0.278	135	15.7	328	61.2	448	0.288
	Foliar appl.	139	27.2	593	114.2	898	0.390	141	24.7	563	116.1	766	0.568
30	*Without Zn*	138	14.7	294	44.1	338	0.213	138	15.5	318	54.3	366	0.286
	Soil appl.	143	20.9	464	77.3	648	0.370	144	21.7	495	91.1	666	0.493
	Foliar appl.	155	29.8	715	134.0	957	0.630	167	29.7	734	154.4	974	0.777
45	*Without Zn*	145	17.8	413	71.2	463	0.320	146	19.3	463	86.9	515	0.444
	Soil appl.	150	23.8	585	104.7	738	0.513	154	24.8	635	121.5	767	0.663
	Foliar appl.	170	33.8	906	172.4	1125	0.867	175	34.8	900.7	201.8	1166	1.067
L.S.D. at 5%													
P		2.237	1.08	5.32	18.80	14.82	0.05	3.17	1.11	26.41	16.20	29.10	0.040
Zn		2.038	0.81	4.61	16.21	11.60	0.04	2.84	0.97	30.12	18.01	28.95	0.035
P x Zn		4.460	2.01	10.12	35.70	26.22	0.11	6.01	2.01	59.01	33.52	59.14	0.094

Table (3): Effect of different rates of phosphorus, methods of Zn application and their interaction on growth characters and elements uptake of maize plants at 80 days

Treatments		2004						2005					
		Plant	Dry	Uptake (mg/plot)				Plant	Dry	Uptake (mg/plot)			
P Rate	Zn Method	height (cm)	weight (g/pot)	N	P	K	Zn	height (cm)	weight (g/pot)	N	P	K	Zn
0	*Without Zn*	184	27.6	226	27.6	160	0.856	187	29.6	252	41.4	187	1.07
	Soil appl.	206	33.8	311	87.9	263	1.284	206	34.6	329	103.8	288	1.49
	Foliar appl.	212	38.2	470	110.8	325	1.680	217	39.6	503	134.6	511	1.94
15	*Without Zn*	193	34.3	415	61.711	288	1.440	193	39.6	499	91.1	352	1.90
	Soil appl.	210	39.6	562	18.8	364	1.940	210	41.3	603	144.6	405	2.27
	Foliar appl.	215	45.1	749	162.4	550	2.390	227	48.5	825	203.7	626	2.86
30	*Without Zn*	199	42.0	609	113.4	420	1.848	205	45.5	692	145.6	482	2.41
	Soil appl.	213	44.4	746	142.1	533	2.575	222	48.3	840	183.5	613	3.04
	Foliar appl.	220	57.1	1056	234.1	799	3.540	232	54.0	1033	245.0	801	3.73
45	*Without Zn*	204	45.9	734	179.0	560	2.525	211	47.3	804	218	610	2.93
	Soil appl.	218	49.7	1093	208.7	770	3.231	229	50.9	937	255	830	3.66
	Foliar appl.	227	62.6	1271	294.2	1214	4.707	239	68.6	1373	384	1235	5.42
L.S.D. at 5%													
P		2.34	1.59	8.15	0.06	16.32	0.05	3.09	1.75	30.10	4.92	20.17	0.11
Zn		2.04	1.39	7.31	0.41	14.21	0.04	2.70	1.52	35.24	5.68	19.26	0.10
P x Zn		4.60	2.81	16.05	0.61	32.27	0.10	n.s	3.17	36.15	10.55	40.11	0.23

In general, data show clearly that the best growth characters and mineral uptake were a cheived by applying P at the rate of 45 kg P_2O_5/fed combined with zinc foliar spray at 60 or 80 days from sowing.

Data in Table (4) show that increasing phosphorus level from (0 to 45 kg P_2O_5/fed) significantly increased, ear weight, ear grain weight, 100-grain weight, grain and straw yields in two growing seasons. These increments may be due to the enhancing effect of the metabolism processes that occurred in the plants received phosphorus. Also, this superiority may be due to the phosphorus effect which is involved in the energy transfer processes in both photosynthesis and respiration (Hearn, 1981). Marschner (1986) reported that the increment in maize yield due to phosphorus application may be attributed to the activation of the metabolic processes and by the abundance of phosphorus in the leaf tissues, where its role more important in building of phospholipids and nucleic acid. Moreover, Mengel and Kirkby (1987) illustrated that photosynthesis and translocation of photosynthatse from leaves to seeds was promoted in plants well supplied with P. The obtained results are confirmed by those obtained after Singaram and Kothandaraman (1994), Bugbee and frink (1995), Mallarine (1996) and Bordoli and Mallarino(1998).

Table (4): Effect of different rates of phosphorus, methods of Zn application and their combination on maize yield and its components

Treatments		2004						2005					
		Plant	Ear	weight	100	Yield		Plant	Ear	weight	100	Yield	
P Rate	Zn Method	height (cm)	weight (g)	grain of ear (g)	grain weight (g)	Grain ardab /fed	Straw ton/fed	height (cm)	weight (g)	grain of ear	grain weight (g)	Grain ardab /fed	Straw ton/fed
0	*Without Zn*	279	116	97	22.6	15.2	2.2	279	122	102	23.5	17.9	2.3
	Soil appl.	281	176	149	22.9	17.3	2.4	282	178	152	23.7	19.4	2.6
	Foliar appl.	284	208	180	25.4	18.5	2.8	286	210	182	26.8	20.6	2.8
15	*Without Zn*	280	150	130	24.2	17.9	2.3	282	159	136	25.8	20.4	2.6
	Soil appl.	285	186	159	25.9	20.1	2.8	285	199	168	26.2	21.3	2.9
	Foliar appl.	287	221	192	27.8	21.1	2.9	289	226	194	28.6	22.4	3.1
30	*Without Zn*	285	171	149	25.3	20.6	2.6	288	173	150	26.3	21.1	3.3
	Soil appl.	290	202	169	27.5	20.9	2.9	290	210	177	28.9	22.3	3.4
	Foliar appl.	298	229	195	30.5	22.9	3.3	300	230	195	31.4	22.8	3.6
45	*Without Zn*	290	174	149	27.4	21.1	2.9	290	179	153	28.8	21.8	3.8
	Soil appl.	292	204	170	29.9	21.6	3.4	294	218	183	30.6	23.1	3.9
	Foliar appl.	313	235	198	33.7	24.3	3.6	318	238	200	34.3	24.3	4.1
L.S.D. at 5%													
P		4.01	3.11	4.66	0.89	0.48	0.08	1.54	3.22	3.16	0.76	0.68	0.18
Zn		3.56	4.21	5.11	0.83	0.40	0.05	1.35	3.25	3.11	0.67	0.65	0.14
P x Zn		7.87	7.65	10.15	1.51	1.01	0.102	2.80	6.51	6.42	n.s	1.25	n.s

Data in the same Table show that where zinc was applied as foliar spray gave the highest values of plant height, ear weight, ear grain weight, 100-grain weight, grain and straw yield. Such values were surpassed those obtained by added zinc as soil application in both seasons. The highest grain yield (average 24.3 ard/fed.) was obtained with 45 kg P_2O_5/fed combined with zinc as foliar spray. This result may be due to the role of Zn as a co-factor in the enzymatic reactions of the anabolic pathways in plant growth. Similar findings are obtained by Abd El-Maksoud *et al*.(1993) and Sohu *et al*.(1994) who found that the addition of Zn-EDTA to the soils fertilized with NPK increased dry mater yield of plants.

The effect of the interaction between phosphorus and methods of zinc application on increasing the yield and its components was found to be significant. From the data presented in Table (4), it could be noticed that the highest values of yield were achieved with foliar Zn application, followed by the trail resulted from applying Zn without phosphorus application.

Chemical constituents:

Data presented in Tables (5 and 6) reveal that application of P enhanced the N, P, K and Zn uptake by grain and straw up to 45 kg P_2O_5/fed in the two seasons. On the other hand, lower values resulted from the control. The favourable effect of phosphorus fertilization on nutrients uptake by grains and straw may be due to the direct effect of this essential element in increasing photosynthesis activity and subsequently chemical content such as N, P, K and Zn content. Theses results are in harmony with those obtained by El-Ashmoony (1991), El-Koumey *et al*.(1993) and El-Shafie(1994).

Table (5): Effect of different rates of phosphorus, methods of Zn application and their interaction on N, P, K and Zn uptake by grain of maize crop.

Treatments		2004				2005			
P Rate	Zn Method	Kg/fed			g/fed	Kg/fed			mg/fed
		N	P	K	Zn	N	P	K	Zn
	Vithout Zn	28.7	10.0	10.9	38.7	34.8	12.7	14.3	56.5
	oil appl.	35.8	12.1	13.2	82.9	41.3	15.4	15.9	87.1
	oliar appl.	49.9	14.4	17.2	88.7	56.8	17.6	20.4	111.9
5	*Vithout Zn*	40.1	13.6	16.4	72.5	47.7	16.5	19.9	94.8
	oil appl.	58.5	15.9	20.8	105.6	53.1	18.2	23.7	124.7
	oliar appl.	73.7	18.3	23.7	129.6	67.7	21.5	26.9	154.7
0	*Vithout Zn*	54.5	16.7	25.0	83.5	51.9	18.4	27.3	129.9
	oil appl.	66.5	18.0	27.3	127.3	84.3	21.4	31.1	153.7
	oliar appl.	88.5	21.7	31.4	189.6	87.8	23.3	33.2	180.6
5	*Vithout Zn*	54.5	18.6	28.4	113.8	58.3	20.3	31.4	166.5
	oil appl.	66.5	19.8	30.8	168.6	76.4	22.8	34.6	197.3
	oliar appl.	88.5	24.1	31.1	240.9	90.8	26.2	39.0	220.4
.S.D. at 5%									
P		2.32	0.61	0.92	1.93	4.10	2.06	1.85	4.35
Zn		2.10	0.53	0.81	1.57	4.62	2.16	1.58	4.22
P x Zn		5.02	1.40	1.61	3.33	9.15	n.s	n.s	8.73

Results in Table (5 and 6) also show that N, P, K and Zn uptake by maize plants increased by Zn application combined with phosphorus fertilizers. The increase of N, P, K and Zn uptake by maize plants treated with Zn as soil application was lower than those treated with Zn as foliar application and P together. The effect of Zn on N, P, K and Zn uptake of maize plants can be discussed on the basis of the effect of Zn application on the plant growth and its effective role in different enzymatic functions.

Table (6): Effect of different rates of phosphorus, methods of Zn application and their interaction on N, P, K and Zn uptake by straw of maize crop.

Treatments		2004				2005			
P Rate	Zn Method	Kg/fed			g/fed	Kg/fed			g/fed
		N	P	K	Zn	N	P	K	Zn
0	***Without Zn***	11.25	1.95	29.3	28.2	13.57	2.57	32.8	37.4
	Soil appl.	15.07	3.65	42.5	46.2	17.09	4.66	46.9	56.9
	Foliar appl.	18.90	4.40	53.6	63.3	20.98	5.24	55.2	74.5
15	***Without Zn***	18.70	3.65	57.0	41.0	22.62	4.73	67.3	55.2
	Soil appl.	24.20	6.06	82.5	68.8	27.46	7.51	88.7	80.9
	Foliar appl.	36.53	7.13	93.6	89.1	39.60	6.60	98.6	107.5
30	***Without Zn***	23.13	5.65	63.8	56.5	30.97	8.48	93.6	81.5
	Soil appl.	28.03	7.38	95.9	94.4	34.44	10.23	102.9	122.8
	Foliar appl.	38.50	9.54	110.2	138.1	44.89	12.31	123.8	166.5
45	***Without Zn***	29.4	7.06	91.1	82.3	40.66	10.64	120.8	121.6
	Soil appl.	40.99	9.41	114.2	134.4	50.70	13.36	136.4	176.9
	Foliar appl.	49.05	11.10	127.1	196.9	59.31	14.70	148.5	273.2
L.S.D. at 5%									
P		0.94	0.13	1.21	19.26	1.35	0.41	3.60	3.58
Zn		0.76	0.11	1.02	16.34	1.52	0.38	3.51	3.18
P x Zn		1.82	0.28	2.51	37.54	3.01	1.02	7.14	7.13

Also, the addition of Zn make the plants grow well, consequently the absorbing efficiency of plants increases (Mengel and Kirkby, 1987). Similar results are obtained by El-Shafie(1994) and Mahgoub (1995).

Chemical constituents of maize grain:

Data presented in Table (7) show that P application increased the N, protein; oil content (%) and oil yield/fed during the first and the second seasons. The positive response was observed when P level was increased from 0 to 45 kg P_2O_5/fed. This increment may be due to the enhancing effect of the metabolism processes that occurred in plant when it receives phosphorus. Also, this superiority may be due to the phosphours effect which involved in the energy transfer processes in both photosynthesis and respiration (Hearn, 1981).

Marschner (1986) reported that the increment in crop yield and its components due to phosphorus application may be attributed to the activation of the metabolic processes and the abundance of phosphorus in leaf tissues, resulted in building of phospholipids and nucleic acid.

With respect to oil content (%) and oil yield (kg/fed.), Table (7) indicated that the increase in oil content and oil yield were mainly due to the increment in the plant yield. Similar finding is obtained by Lchimura *et al*.(1995).

Also, the previous results could be related to the presence of zinc, which plays an important role by activating several enzymes, and hence the metabolic activities, viz auxin metabolism, protein synthesis, nucleic acid and carbohydrate metabolism and utilization of N and P(Khanda and Dixit, 1995). Also, Prabhurai *et al*. (1995) indicated that the application of P and Zn increased seed and oil yields.

Table (7): Effect of different rates of phosphorus, methods of Zn application and their interaction on N, protein, oil content (%) and oil yield (kg /fed) in grains of maize crop

Treatments		2004				2005			
P Rate	Zn Method	N %	protein %	Oil %	Oil kg/fed	N %	protein %	Oil %	Oil kg/fed
0	*Without Zn*	1.35	7.70	6.00	127.7	1.39	7.92	6.20	155.4
	Soil appl.	1.48	8.44	6.65	161.1	1.52	8.66	6.73	182.8
	Foliar appl.	1.91	10.89	7.14	184.9	1.97	11.23	7.50	216.3
15	*Without Zn*	1.60	9.12	6.08	157.4	1.65	9.41	6.28	179.4
	Soil appl.	1.73	9.86	6.85	192.8	1.78	10.15	7.03	209.6
	Foliar appl.	2.09	11.92	7.39	218.3	2.16	12.31	7.81	244.9
30	*Without Zn*	1.70	9.69	6.30	181.7	1.76	10.03	6.50	192.0
	Soil appl.	2.00	11.40	7.19	210.4	2.70	11.80	7.51	234.5
	Foliar appl.	2.30	13.11	7.98	255.8	2.35	13.40	8.21	262.1
45	*Without Zn*	1.85	10.55	6.37	188.2	1.91	10.89	6.63	202.3
	Soil appl.	2.20	12.54	7.70	232.8	2.27	12.94	8.00	258.7
	Foliar appl.	2.60	14.82	8.32	283.0	2.67	15.22	8.71	296.3
L.S.D. at 5%									
P			0.717		1.456		0.356		0.58
Zn			0.477		2.653		0.400		1.68
P x Zn			n.s		5.306		0.803		3.36

Biochemical constituents:

The obtained results in Table (8) reveal that soluble sugar contents (RS, NRS and TSS) of maize grains were significantly increased by increasing P rate from 0 to 45 kg P_2O_5/fed.

Table (8): Effect of different rates of phosphorus, methods of Zn application and their interaction on carbohydrate fractions in grains

Treatments		2004					2005				
P Rate	Zn Method	RS	NRS	TSS	Starch	TC	RS	NRS	TSS	Starch	TC
0	*Without Zn*	0.130	1.51	1.68	57.51	59.19	0.135	1.55	1.70	58.14	59.84
	Soil appl.	0.139	1.63	1.85	60.71	62.56	0.141	1.63	1.85	61.34	63.19
	Foliar appl.	0.189	1.74	1.97	63.80	65.77	0.160	1.75	1.98	65.81	67.79
15	*Without Zn*	0.135	1.64	1.73	59.70	61.43	0.140	1.65	1.75	61.80	63.55
	Soil appl.	0.153	1.78	1.94	64.50	66.66	0.158	1.79	2.00	65.61	67.61
	Foliar appl.	0.170	1.98	2.00	69.71	71.71	0.173	1.98	2.00	71.35	73.35
30	*Without Zn*	0.138	1.71	1.85	61.30	63.15	0.145	1.78	1.85	63.73	65.58
	Soil appl.	0.167	1.87	2.19	67.80	69.99	0.170	1.88	2.20	68.41	70.61
	Foliar appl.	0.181	2.00	2.29	73.80	76.09	0.187	2.02	2.31	77.10	79.41
45	*Without Zn*	0.143	1.78	1.95	63.68	65.63	0.151	1.90	2.00	66.76	68.76
	Soil appl.	0.170	1.89	2.29	69.18	71.47	0.180	1.98	2.30	71.80	74.10
	Foliar appl.	0.188	2.10	2.37	76.91	79.28	0.192	2.20	2.41	79.81	82.22
L.S.D. at 5%											
P					0.683	1.672				1.488	1.774
Zn					1.350	0.756				0.637	1.071
P x Zn					2.716	1.513				1.275	2.143

Also, grain contents of starch and total carbohydrate were significantly increase by increasing P rate. In this connection, Falerios *et al*. (1996) showed that P deficiency decreased starch production and endosperm dry weight, but with minimum effect on the activity of ADP-glucose pyrophosphorylase and alanin transminase. Also, Mengel and Kirkby (1987) illustrated that photosynthesis and translocation of photosynthatse from leaves to seeds was promoted in plants well supplied with P.

Also, the content of total carbohydrates tended to increase by adding zinc. Jyung *et al*.(1975) provide the evidence about close relationship between zinc nutrition and starch formation.

The grow variety of anvy bean susceptible to zinc deficiency in growth chamber and they found that under zinc deficient conditions the starch synthetase activity and the starch content were decreased by 64% and 94% of their normal levels, respectively. They also showed that in the plants grown in the field under low zinc supply, the starch synthetase activity was reduced by 80% of that in plants grown under adequate supply.

Economical study:

Data in Table (9) indicate that the net return increase with increasing phosphorous rates. It also increases with Zn foliar application. Phosphorus rates (45 kg P_2O_5) and Zn foliar application gave the maximum net return.

Table (9): Economical study

Treatments		Yield			Income (LE)			Cost (L.E)				Net return L.E
P Rate	Zn Method	Grain (Ardab)	Straw (ton)	Total	Grain L.E	Straw L.E	Total L.E	P_2O_5	Micro	Another	Total	
0	*Without Zn*	16.55	2.25	4.57	2317	450	2767	0	0	600	600	2167
	Soil appl.	18.35	2.50	5.07	2569	500	3069	0	135	600	735	2336
	Foliar appl.	19.55	2.80	5.54	2737	560	3297	0	65	600	665	2632
15	*Without Zn*	19.15	2.45	5.13	2681	490	3171	56	0.0	600	656	2515
	Soil appl.	20.70	2.85	5.75	2898	570	3468	56	135	600	791	2677
	Foliar appl.	21.75	3.00	6.05	3045	600	3645	56	65	600	721	2924
30	*Without Zn*	20.85	2.95	5.87	2919	590	3509	112	0.0	600	712	2797
	Soil appl.	21.60	3.15	6.17	3024	630	3654	112	135	600	847	2807
	Foliar appl.	22.85	3.45	6.65	3199	650	3849	112	65	600	777	3072
45	*Without Zn*	21.45	3.35	6.35	3003	670	3673	168	0.0	600	768	2905
	Soil appl.	22.35	3.65	6.78	3129	730	3859	168	135	600	903	2956
	Foliar appl.	24.30	3.85	7.25	3402	770	4172	168	65	600	833	3339

Ardab of corn =140kg ***Price of grain (ardab) = L.E 140***

Price of straw (ton) = L.E 200 ***Price of P_2O_5 (100kg) = L.E 56***

Price of Zinc kg = L.E 65 ***Another cost = L.E 600***

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تاثير معدلات الفوسفور وطرق اضافة الزنك على الذرة, ومكوناتة

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**** قسم تغذية النبات - المركز القومى للبحوث**

أقيمت تجربتان حقليتان بمنطقة دمو بمحافظة الفيوم خلال عامى 2004 و 2005 لدراسة تأثير معدلات مختلفة من التسميد الفوسفاتى وطرق اضافة الزنك (اضافة للتربة – واضافة بالرش) والتفاعل بينهما على صفات النمو ومحتوى العناصر والمحصول ومكوناتة على نبات الذرة صنف هجين فردى 10

وتتلخص أهم النتائج المتحصل عليها فيما يلى:

1- زاد ارتفاع النبات – الوزن الجاف- وزن الكوز-وزن المائة حبة ومحصول الحبوب والقش والمكونات الكيميائية للمحصول زيادة معنوية بزيادة معدلات الفوسفور حتى 45 كجم فو$_2$أ$_5$/فدان
2- لطرق اضافات الزنك تأثير محسن على المحصول ومكوناتة
3- أظهرت نتائج التداخل بين التسميد الفوسفورى والزنك معا الى زيادة معنوية فى محصول الحبوب ومكوناتة فى كلا الموسمين
4- أظهرت النتائج ايضا أن أعلى محصول ومكوناتة فى وجود معدل من الفوسفور مقدارة 45 كجم فو$_2$أ$_5$/فدان مع اضافة الزنك رشا
5- وجد أن افضل عائد اقتصادى عند اضافة الفوسفور بمعدل 45 كجم فو$_2$أ$_5$/فدان مع اضافة الزنك رشا.

3959 3960 3961 3962 3963 3964 3965 3966 3967 3968 3969