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EFFECT OF N, P-COMPOUND FERTILIZER FORMS AND FOLIAR APPLICATION OF ZINC ON WHEAT YIELD AND ITS COMPONENTS GROWN IN ALLUVIAL SOIL

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ABSTRACT : ***Two field experiments were carried out during 2005/2006 and 2006/2007 seasons at Kafr El-Zayat, Gharbia Governorate, to study the effect of usage N P-compound fertilizer applied in two forms, granular and powder (20-10) at rate of 350 kg/fed (70 kg N and 35 kg P_2O_5 /fed.) along with foliar application of applied Zinc, at five levels namely (0, 125, 250, 375 and 500 g Zn/fed) on yield and its components of Sakha 93 wheat cultivar.***

The obtained data showed that granulated compound fertilizer achieved the highest values of yield, yield components and grain contents of macro (N, P and K) and micronutrients (Fe, Zn, Mn and Cu). Zinc application as foliar fertilization at 250, 375 and 500 g Zn/fed induced the greatest increases of all yield components. The highest contents of macro and micronutrients of grains were gained as 500 g Zn/fed was applied. Application of the N P-compound fertilizer in granular form associated with foliar application 500 g Zn/fed gave the best results for all the studied yield components and all grain mineral contents except phosphorus and manganese contents.

Key words: ***Wheat, Compound fertilizer, Granular and Powder, Zinc, Foliar application, Yield, Mineral content.***

INTRODUCTION

Wheat represents one of the most important cereal crops in the world as it is used as a source for human and animal food.

Compound fertilizers, basically contain macronutrients, applied together with micronutrients became a common practice for obtaining higher yields. The effect of compound fertilizers on yield and its components were reported by many investigators. Usage of granular compound fertilizers has an important and significant role on grain and straw yields as well as its components, i.e., straw weight, grain weight and 1000 grain weight (Sabry *et al.* 1999; Mohamed *et al.* 2000; Abo-Shataia *et al.* 2001; Badran and Gaafar, 2004; Ibrahim *et al.* 2004; Nassar *et al.* 2004; Amal El-Guibali *et al.* 2005; Cai and Qin, 2006 and Gyori, 2006).

The macro and micronutrients contents in wheat grains significantly display positive responses to compound fertilizer application. Zinc as an essential micro-nutrient plays substantial role in plant metabolism. Plants can obtain it from soil or even from the atmosphere, through the industrial pollutants; being spread over the cultivated areas.

Moderate levels of Zn play an indispensable role in plant growth and productivity. They act as activators or co-factors in all vital processes of plant life. In contrast, the relatively elevated levels often induce harmful effects on most physiological processes (Mohsen and Magda, 2004).

Therefore, the objectives of this investigation are 1- to study wheat response to N P-compound fertilizer in association with foliar spray of different levels of Zn, 2- to find out an explanation for this response 3- to determine the best level of Zn which gives the highest dry matter yield in association of the compound fertilizers.

MATERIALS AND METHODS

The present investigation was carried out during two successive growing seasons 2005/2006 and 2006/2007 at Kafr El-Zayat, Gharbia Governorate, Egypt to investigate the effect of NP-compound fertilizer and foliar application of different Zinc levels on yield, yield components. Some grain contents of macro- (N, P and K) and micronutrients (Fe, Zn, Mn and Cu) of wheat Sakha 93 cultivar were also appraised. The soil was clay loam with pH 7.3 containing 2.2% organic matter and 3.9% CaCO3 and having E.C. of 0.435 dsm-1. Available N, P, K and Zn were determined according to Jackson (1973), their recorded values were 79, 8.9 and 493 and 0.92 mg kg-1 soil, respectively.

Ten treatments with four replicates were distributed in factorial randomized block design. Plot area was 21 m2. The treatments comprised NP-compound fertilizer (20-10) in two forms, granular and powder applied to soil at a rate of 350 kg/fed. i.e., 70 kg N/fed, 35 kg P2O5/fed. Five levels of Zn as foliar application (0, 125, 250, 375 and 500 g Zn/fed were applied in the form Zn-EDTA (13% Zn). Zinc was sprayed twice; after 30 and 45 days of germination. Wheat grains (Sakha, 93) were sown on 15th and 20th of November and harvested at 10th and 12th of May during the first and second seasons, respectively.

At harvest stage, the yield of grain and straw yields (kg/fed) were recorded. Ten plants were taken randomily from each plot to estimate the following components:

1-Dry weight of straw g/plant.

2-Dry weight of grains g/plant.

3-Dry weight of 1000 grains.

Grain contents of N, P, K, Fe, Zn, Mn and Cu were determined using the procedure described by A.O.A.C. (1990).

RESULTS AND DISCUSSION

1.Effect of compound fertilizer forms on yield and yield components:

Data in Table (1) show that There were significant differences between addition of granular and powder compound fertilizers in terms of their influence on both straw and grain yield. Such results were assigned for the two tested seasons. Nevertheless, differences between the dry, grain weights and weight of 1000 grains resulted from application of two compound fertilizers were insignificant. Again this helds true for the two studied seasons. Similar results were recorded by Cai and Qin (2006) and Gyori (2006). They demonstrated that applying NP-compound fertilizers to both wheat and maize gave the highest yields. The granular compound fertilizer seemed to be the best choice form for improving the yield and yield components for wheat Sakha 93 cv. (high yield production variety). This could be explained as in powdered fertilizer losses of N is higher due to leaching and/or volatilization and P is more subjected to fixation.

2. Effect of foliar application of Zinc:

Data in Table (1) show that generally foliar application of Zn significantly increased all the studied characters. Increasing the levels of Zn up to the 500 g Zn/fed., as foliar fertilization, significantly increased all studied parameters. This increase was more obvious at the rate of 500.

The economical treatment for yield and most studied parameters was achieved as Zn was applied at a rate of 500 g Zn/fed. This could be interpreted as the cost of such addition of Zn was far less than the profit gained from the yield increase. These data were in agreement with those obtained by El-Masry (2001), Nassar *et al.* (2002), Badran and Gaafer (2004), Nassar *et al.* (2004), Mohsen-Ibrahim and Magda (2004) and Nazim-Hussain *et al.* (2005). They demonstrated that a significant improvement in number of grains per spike and 1000 grain weight was found with foliar fertilization of wheat. This finding may be attributed to role of Zn in a promoting the growth. It is known that Zn takes pant in enzymatic activities, photosynthetic process as well as synthesis part of protein, carbohydrates and lipids (Badran and Gaafer, 2004; Nassar *et al.* 2004; Mohsen-Ebrahim and Magda, 2004 and Amal El-Guibali *et al.* 2005).

Table 1

3. Interrelationship between application of N, P compound fertilizer and foliar spray of Zn.

Usage of NP-Compound fertilizer in two forms in association with zinc sprayed at different levels on yield and yield components of Sakha 93 cv. are displayed in Table (1). Data show that all the investigation characters were affected by compound fertilizer forms and zinc levels. The highest values assigned for the economical yields (grain and straw) were recorded through application of the granular compound fertilizer and 500 g Zn/fed. Whereas the least means for all studied characters were obtained whenever the powdered compound fertilizer used with zero zinc rate. Such synergetic effects were reported by some investigators working with wheat (Nassar *et al.* 2004) and (Amal El-Guibali *et al.* 2005). They clarified that application of 90 kg N/fed and 0.6 g Zn/kg coating the grains caused increases of yield components of wheat.

4. Mineral composition of wheat grains.

Table (2) show the effect of application of compound fertilizer in two different forms together with zinc sprayed at different levels on some macro and micro-nutrients content of wheat grains.

4.1. Effect of compound fertilizer forms:

Concerning the effect of compound fertilizer forms on mineral composition of wheat grains, data presented in Table (2) clear up that all the studied macro-nutrient (N, P and K) and micro-nutrient (Fe, Zn, Mn and Cu) contents of grains showed a positive significant increase due to usage of both the granulated form and the powdered one in comparison to the control treatment. Similar findings were obtained by Gyori, (2006) ans Loncaric *et al.* (2006). They found that macro and micro nutrient content of wheat grain was increased by mineral fertilizer application.

4.2. Effect of foliar application of Zn :

Data in Table (2) show that increasing the foliar supply of Zn from Zero to 500 g Zn/fed progressively caused significant increase for all the studied criteria, except for P content, which was decreased by increasing Zn rate. There was slight decrease in P contents of grains as Zn addition was progressively increased. This finding could be related to dilution effect. It is worthy to mention that the weights of grains were elevated as Zn application was increased. These results are in agreement with those reported by Nassar *et al.,* (2002), Amal-El-Guibali *et al.* (2003) on flax, Nassar *et al.* (2004) and Amal-El-Guibali *et al.* (2005).

Table 2

The aforementioned results could be explained according to Zn-role in plant. Zinc delays the senescence of wheat plant through increasing the levels of Indole Acetic Acid (IAA) and chlorophyll. Consequently, contents of nitrogen and some nutrients, in particularly, needed for carbohydrate metabolism and protein synthesis increase (Hemantaranjan and Garage, 1984). On the contrary in zinc deficient plants under the lowest level of Zn or untreated one, metabolic processes are hindered.

4.3. Interrelationship between application of N, P compound fertilizers and foliar spray of Zn:

Generally, data in Table (2) cleared up that under different zine levels, the most studied criteria were increased with compound fertilizers as granular or powder and also the studied characters were increased with raising zinc level from zero up to 500 g Zn/fed.

The highest values of all determined nutrients were recorded under the application of compound fertilizers as granular combined with 500 g Zn/fed., except P and Mn content. The least mean values for all studied elements in grain were gained with fertilizing wheat plants with compound fertilizers as powder and zero g Zn/fed. Similar trends were observed by many investigators (Nassar *et al.* 2004 on wheat and Amal El-Guibal, *et al.* 2005) on wheat.

CONCLUSION

From the abovementioned results it could be concluded that usage of the compound fertilizers in the granular form was the best treatment for increasing the grain and straw yields of wheat. From the economical point of view applying compound fertilizers as granular in association with foliar application of zinc at 500 g Zn/fed., gave the highest yield of wheat and best characters of its yield components.

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تأثير صور السماد المركب (نتروجين وفوسفور) مع التسميد الورقى بالزنك على محصول القمح ومكوناته النامى فى أرض رسوبية

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الملخص العربي

أقيمت تجربة حقلية بكفر الزيات . محافظة الغربية . خلال الموسم الشتوى ٢٠٠٥/٢٠٠٦ وكررت موسم ٢٠٠٦/٢٠٠٧ لدراسة تأثير إضافة بعض صور السماد المركب (نيتروجين وفوسفور) بنسب ١٠.٢٠ مع إضافة الزنك رشاً ورقياً بمستويات صفر ١٢٥ ، ٢٥٠ ، ٣٧٥ ، ٥٠٠ جرام زنك لكل فدان والتداخل بينهما على محصول القمح صنف سخا ٩٣ ومكوناته والتركيب الكيماوى للحبوب .

اشتملت كل تجربة على معاملات السماد المركب (ن فو٢أه ، بنسب ٢٠ ، ١٠) في صورتين محبب وناعم كإضافات أرضية بمعدلات ٧٠ ، ٣٥ كجم ن فو٢أه ، لكل فدان على التوالى (٣٥٠ كجم سماد مركب) ، وكانت مستويات رش الزنك ورقياً ١٢٥ ، ٢٥٠ ، ٣٧٥ ، ٥٠٠ جرام زنك/فدان .

وقد أوضحت النتائج أن السماد المركب في صورة محببة حقق أعلى القيم للمحصول ومكوناته ومحتويات الحبوب من العناصر الكبرى والصغرى مقارنة باستخدام السماد الناعم . في حين أدى الرش بالزنك بمعدل ٢٥٠ ، ٣٧٥ ، ٥٠٠ جرام زنك/فدان إلى حدوث استجابة في كل صفات المحصول ومكوناته . وكانت أعلى قيم محتوى الحبوب من العناصر عند الرش بمعدل ٥٠٠ جرام زنك/فدان ، واستخدام السماد المركب في صورة محببة مع الرش بالزنك بمعدل ٥٠٠ جرام زنك/فدان يحقيق أعلى قيم للمحصول ومكوناته وكذلك محتوى الحبوب من العناصر المقدرة فيما عدا محتواها من عنصرى الفوسفور والمنجنيز .

Table (1): Effect of compound fertilizer forms and foliar application of zinc on yield and its components of wheat Sakha 93 cv.

Compound fertilizer form (20, 10)	Foliar application of Zn gm/fed	Straw wt/plant (g)		Grain wt/ plant (g)		1000-grain weight (g)		Straw yield (kg/fed)		Grain yield (kg/fed)		Protein % in grains	
		2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007
Granular	0	15.40	15.67	10.06	11.12	47.01	48.77	2310	2351	2434	2480	8.2	8.0
	125	15.67	16.01	10.49	11.82	48.23	48.93	2351	2402	2728	2886	9.4	8.7
	250	15.90	15.98	11.11	11.42	49.60	51.00	2385	2397	2790	2789	9.1	8.9
	375	19.11	18.81	12.78	13.00	49.02	49.74	2867	2822	2775	2761	8.9	8.2
	500	21.01	20.70	11.90	11.53	50.00	49.92	3152	3105	2961	2959	11.6	11.2
Mean		17.42	17.43	11.27	11.78	48.77	49.67	2613	2615.4	2738	2775	9.5	9.0
Powder	0	15.70	15.94	9.99	9.03	48.09	48.75	2355	2391	1891	1860	8.2	8.3
	125	16.01	16.76	10.58	9.28	48.75	49.01	2402	2514	2217	2170	8.2	8.6
	250	16.79	16.83	10.35	9.97	50.26	51.07	2519	2525	2434	2311	8.8	8.7
	375	16.98	16.68	10.49	10.02	49.74	48.90	2547	2502	2310	2291	8.8	8.9
	500	18.48	17.50	12.90	12.41	50.14	49.76	2772	2625	2465	2433	9.8	9.6
Mean		16.79	16.74	10.86	10.14	49.40	49.50	2519	2511.4	2263	2213	8.8	8.8
L.S.D. at 5%													
Forms of fertilizer		NS	NS	NS	NS	NS	NS	16.112	24.07	9.52	5.59		
Zinc levels		2.54	1.70	0.75	0.95	1.35	0.74	12.92	20.66	8.67	6.93		
Forms x Zn		NS	2.39	1.09	1.37	NS	NS	18.26	29.21	12.34	9.83		

Fed = 0.42 hectar

Table (2): Effect of compound fertilizer forms and foliar application of zinc on mineral content of wheat grains.

Compound	Foliar	N %	P %	K %	Fe µg g^{-1}	Zn µg g^{-1}	Mn µg g^{-1}	Cu µg g^{-1}

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fertilizer form (20, 10)	application of Zn gm/fed	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007	2005-2006	2006-2007
Granular	0	1.49	1.40	0.97	0.96	0.42	0.43	146	147	58	60	74	77	8	8
	125	1.64	1.52	0.94	0.92	0.53	0.56	150	153	61	63	90	94	8	9
	250	1.60	1.56	0.90	0.89	0.53	0.56	159	149	55	55	88	87	8	10
	375	1.56	1.44	0.89	0.88	0.55	0.56	186	185	62	62	80	77	9	10
	500	2.03	1.96	0.92	0.90	0.59	0.60	184	182	62	66	76	77	8	8
Mean		1.66	1.58	0.92	0.91	0.52	0.54	165.0	163.2	59.6	61.2	81.6	82.4	8.2	9.0
Powder	0	1.44	1.45	0.99	1.00	0.42	0.43	127	131	48	53	79	79	6	6
	125	1.44	1.50	1.04	1.03	0.47	0.47	149	150	57	57	80	85	9	9
	250	1.55	1.53	0.99	1.04	0.53	0.54	147	142	55	58	80	82	9	7
	375	1.54	1.56	1.04	1.03	0.56	0.54	143	146	52	52	84	83	7	6
	500	1.71	1.68	0.97	0.99	0.61	0.62	140	142	56	55	74	71	7	9
Mean		1.54	1.54	1.01	1.02	0.52	0.52	141	142	53.6	55.0	79.4	80.0	7.6	7.4