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BIOCHEMICAL STUDIES ON THE EFFECT OF Zn AND Cu ON THE CONTENT OF SOME CONSTITUENTS OF CORN GRAINS

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ABSTRACT

The present work was carried out in field experiment at Ghazala Farm, Zagazig, Sharkia Governorate to study the effect of foliar application of Zn and Cu on the grain yield and some biochemical constituents of corn grains. ***The results obtained revealed that:-***

The yield of corn grains was increased by the foliar application of any treatments from Zn or Cu. Total and insoluble nitrogen content in corn grains were increased by all treatments and the highest values of soluble nitrogen were recorded by a mixture of 100 ppm Zn + Cu. Carbohydrate fractions slightly increased by any levels of Zn or Cu treatments, and the highest value recorded by the second level from Zn + Cu. The oil content of corn grains was reduced by the adding all treatments especially in case Zn treatments. The application of 50 or 100 ppm Cu improved the total free amino acids content in corn grains while Zn treatments was decreased amino acids content. Phosphorus content in corn grains was increased by Zn treatments, while Cu treatments caused decreased phosphorus content. Also, Potassium content in corn grains was increased by the applications of Zn treatments and gave slightly decrease by Cu treatments.

In conclusion*, the result of the present work suggested that the foliar application of any treatment from Zn on the corn grain, were increase increased yield, nitrogen fraction, and carbohydrate fraction, P content but reduced oils content, and potassium content of corn grains, while, the application treatment from Cu increased the yield, nitrogen faction , carbohydrate content at low concentration and total free amino acid content, but improve oil content compared with foliar from Zn and reduce P, K contents. Also, treatment application from mixed Zn and Cu on corn grain increased total N content, yield but reduce P,K and total free amino.*

Key words: Biochemical Studies, Zn & Cu, Corn Grains.

INTRODUCTION

Trace-elements are essential as plant growth, Although these elements are required in very small amounts, they are absolutely essential as

they play a major role in plant metabolism because of its great importance in direct or indirect contribution with enzymes. Zn plays a role in the synthesis of hetero axine and its application increased the total and soluble nitrogen, as well as the protein content in plants (El-Sherbieny *et al*, 1981)

Fageria *et al,* (2002), Mahmood *et al,* (2006) and Ziaein & Malkout (2001) found that Cu and Zn increased the biological value of protein, carbohydrate Fractions and starch content of grains. However, Barsoum (1980) reported the application of Zn, Fe, Cu and Mn as a foliar spray promoted carbohydrate metabolism in plant since it increased carbohydrate content of grains.

Also, Oury *et al,* (2005) and Hogye & Fangrneier (2008), found that the Foliar spray of Zn, Cu, Mn improved the total amino acids contents in wheat grains such as Zn may be diluted by increasing yield.

Therefore, the aim of this work was to study the effect of spraying different levels of Zn and Cu on the yield components, nitrogen fractions, carbohydrate fractions, oil content, free amino acids and some nutrients of corn grains.

MATERIALS AND METHODS

A randomized complete block experiment with three replications was conducted at Ghazala Farm, Zagazig, Sharkia Governorate in the season (2010/2011) to study the effect of Zn and Cu on the yield and some biochemical contents of corn grains. Foliar application treatments were applied single or several combinations in two equal parts, the first part was applied at thining stage (25 day from swing) and the second part was applied at knee high stage (50 day from sowing). The treatments applied as following:

1- Control 2- 50 ppm Zn 3- 100 ppm Zn 4- 50 ppm Cu
5- 100 ppm Cu 6- 50 ppm Zn+Cu 7- 100 ppm Zn + Cu.

Methods Of Analysis:

- Total nitrogen was determined according to the method described by A.O.A.C. (1970).
- Soluble nitrogen was extracted with 50 ml ethyl alcohol (75%) and dried at 55° under vacuum and dissolved in mixture of distilled water and chloroform (1:1). The soluble nitrogen was determined according to the method described by Mengle and Helal (1968).
- Insoluble nitrogen was determined by subtracting the amount of soluble from the total nitrogen.
- Carbohydrate fractions were determined according to the method of Magnetski *et al* (1959).

- Free amino acids were extracted fractionated and determined as described by Block *et al* (1958).
- Phosphorus determined according to the method adapted by Agiza *et al* (1960).
- Potassium, was determined using atomic absorption apparatus in the acid digest according to the method of Chapman and Parker (1961).
- Oil percentage was determined by extracting in soxhelt apparatus by Petroleum ether according to the method described in A.O.A.C. (1970).

RESULTS AND DISCUSSION

It can be easily seen from Table 1. The grain yield increased when corn plants were treated with all treatments application when compared with control. Such results might be due to the effect of micro elements on some physiological processes in plant. The highest grain yield recorded by treating Zn + Cu, but the lowest increase of grain yield was obtained by applied the first level of one. These results agree with those obtained by Sharaf *et al* (1984) who found. that foliar application of Zn, Fe and Mn significantly increased the yield of grain and straw if compared with control. Also, Natasha and Mary (2006) found that Zu, Fe and Cu improved the quality of corn grains . With regard the weight of 100 kernels the data revealed that, it was generally increased as a result of all treatments.

Table 1. Effect of Zn and Cu on the corn grain yield and weight of 100 kernels

Treatments	Gm/Plant	Kg/Plot 1/300 Feddan	Kg/Feddan	Weight of 100 kernel (gm)
1- Control	205	16.45	4935	25.72
2- 50 ppm Zn	212	18.25	4575	26.50
3- 100 ppm Zn	219	19.51	5853	28.60
4- 50 ppm Cu	222	19.78	5934	29.06
5- 100 ppm Cu	226	19.96	5988	28.92
6- 50 ppm Zn+Cu	231	20.31	6093	27.11
7- **100 ppm Zn+Cu**	229	20.08	6024	28.98
L.S.D 5%	-	**0.832**	-	-
1%	-	**1.166**	-	-

Results, recorded in Table (2) showed that the content of insoluble and total nitrogen were increased by spraying Zn or Cu treatments. The highest increase noticed with spraying corn plants 100 ppm Zn + Cu, when compared with the other treatments. This is probably from the fact Zn plays an important role in protein synthesis. These results agree with those reported by Sharaf *et al* (1984) and Hogye & Fangrneier (2008).

El-Sherbiny *et al* (1981) who reported that the content of total nitrogen in grains increased by the application of Zn or Cu either mixed or not. From the same table, it can be noticed also that the values of soluble nitrogen slightly increased by treatments where Zn application reduced the soluble nitrogen. This may be explained on the bases that Zn and Cu increase the nitrogen fixation as well as the synthesis of insoluble nitrogen. Such results agree with those obtained by Lixandra *et al* (1979) who found that the application of some trace-elements to plants increased the nitrogen content in soybean plants.

Table 2. Effect of Zn and Cu on the content of nitrogen fractions of corn grains(gm/100gm dry weight).

Treatments	Soluble N	Insoluble N	Total N	Ratio Gol./insol
1- Control	0.144	1.265	1.409	0.114
2- 50 ppm Zn	0.135	1.502	1.637	0.090
3- 100 ppm Zn	0.129	1.623	1.752	0.079
4- 50 ppm Cu	0.159	1.409	1.568	0.113
5- 100 ppm Cu	0.156	1.382	1.538	0.113
6- 50 ppm Zn + Cu	0.162	1.448	1.610	0.112
7- 100 ppm Zn + Cu	0.168	1.492	1.660	0.113

Data in Table (3) show that the total free amino acids in corn grains was slightly decreased by foliar spray all treatments, but the foliar Cu treatments slightly increased the total free amino acids in corn grains, especially valine, aspartic, tyrosine and methionine. Also, it can be noticed that, the acidic amino acids showed comparatively the highest values when compared with other groups amino acids in corn grains. Also, from the same table, it can be easily seen that, inter the group aliphatic free amino acids, glycine was higher than alanine or valine.

Similar results were obtained in aromatic free amino acids and acidic free amino acids. This may be consumed in the biosynthesis of protein which may be stimulated by the treatment and accompanied with the decrease of soluble nitrogen. These results are in agreement with these obtained by Schedeve & Dep (1977), Sharaf & Youssef (1987) and Sitohy & Sharaf (1986).

Date represented in Table (4) showed that foliar application of any micronutrient in most cases increased the insoluble and total carbohydrate fractions of corn grains and the greatest increase was recorded by the second level of Zn + Cu when compared with control. This may be due to the increase in the concentration of photosynthetic pigments which was reflected on carbohydrates biosynthesis. The highest values of soluble carbohydrate fractions was obtained by 100 ppm Zn treatments. This means that Zn and Cu enhanced the carbohydrate metabolism in the plants. It is interesting to note that

Table 4. Effect of Zn and Cu on the content of carbohydrate fractions in corn grains (Gm/100 gm dry weight).

Treatment	Carbohydrate fractions			Ratio sol/insole
	Sol.	Insole.	Total	
1- Control	11.77	66.76	78.53	0.176
2- 50 ppm Zn	11.06	67.96	79.02	0.163
3- 100 ppm Zn	12.09	68.55	80.64	0.176
4- 50 ppm Cu	10.30	68.94	79.24	0.149
5- 100 ppm Cu	11.24	68.95	80.27	0.163
6- 50 ppm Zn+Cu	11.82	68.82	80.64	0.172
7- **100 ppm Zn+Cu**	11.34	69.68	81.02	0.163

Table 5. Effect of Zn and Cu on the content of oil and some properties in corn grains.

Treatments	Oil content		Oil properties		
	%	mg/plant	A.value	Sap.value	Iod.value
1- Control	0.055	11.28	0.65	186.1	149.5
2- 50 ppm Zn	0.039	8.27	0.65	186.1	149.7
3- 100 ppm Zn	0.035	8.02	0.65	187.5	149.7
4- 50 ppm Cu	0.044	9.51	0.71	187.5	149.4
5- 100 ppm Cu	0.047	11.01	0.73	188.1	149.5
6- 50 ppm Zn+Cu	0.035	8.73	0.59	188.4	149.8
7- **100 ppm Zn+Cu**	0.045	10.31	0.55	187.5	149.6

Ashour and Hegazi (1972) found that Zn as foliar spray on wheat plants increased the total carbohydrate content of grains.

Data in Table (5) indicated that spraying of Zn or Cu treatments decreased the concentration of oil content in corn grains. The highest decrease in oil content resulted from the added 100 ppm Zn and mixture the first level from Zn or Cu(50 ppm). In this respect, it is worthy to mention that El-Moursi and Saad (1980) noticed that oil content of soybean seed was decreased by some micronutrients applied.. On the other hand, the oil properties of corn grains, acid value, saponification value iodine value did not show any substantial changes as treating the plants with zn treatments, while cu treatments caused slightly increased the acid value. These results are in full agreement with those obtained by Sitohy and Sharaf (1986).

The results in Table (6) show that, the effect of Zn and Cu treatments upon the content of P and K in corn grains. P content in corn grains was increased by sprayed with the first level and second level of Zn treatments. Wheares, the lowest value of P was obtained from plants sprayed with Cu treatments. In this connection, Fuehring (1969), Barsoum

Table 6. Effect of Zn and Cu on the content of phosphorus and potassium in corn grains

Treatment	Phosphorus		Potassium	
	%	mg/plant	%	mg/plant
1- Control	1.584	324.92	3.689	756.24
2- 50 ppm Zn	1.896	402.10	4.112	899.94
3- 100 ppm Zn	1.793	392.66	4.199	919.61
4- 50 ppm Cu	1.443	320.45	3.406	756.15
5- 100 ppm Cu	1.481	333.18	3.316	749.42
6- 50 ppm Zn + Cu	1.284	296.71	4.001	924.45
7- 100 ppm Zn + Cu	1.277	292.58	3.311	758.22

(1980) and Ashour and Hegazi (1972), suggested that Zn treatment caused an increase in P content in grains.

From the same Table (6) that potassium content in corn grains was increased by Zn treatment when compared with control . Similar results were obtained by Fuehring (1969) show that potassium content in grains was at a maximum value in plants sprayed with Zn treatments.

In conclusion, the result of the present work suggested that the foliar applications of any treatment from Zn on the corn grain, were increase increased yield, nitrogen fraction, and carbohydrate fraction, P content, but reduced oils content and potassium content of corn grains, while, the application treatment from Cu increased the yield, nitrogen faction, carbohydrate content at low concentration and total free amino acid content, but improve oil content compared with foliar from Zn and reduce P, K contents. Also, treatment application from mixed Zn and Cu on corn grain increased total N content, yield but reduce P,K and total free amino.

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دراسات كيميائيه حيوية علي تاثير كلا من الزنك والنحاس علي بعض المكونات في حبوب الذرة الشامية

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اقيمت تجربة حقلية في مزرعة غزالة التابعة لمركز الزقازيق شرقية لدراسة تاثيركلا من الزنك والنحاس علي المكونات البيوكيميائية في حبوب الذره وكانت النتائج التى **سجلت من هذه الدراسة كالتالي:**

- زيادة محصول حبوب الذره باضافة جميع معاملات الزنك او النحاس.
- لوحظ زيادة في محتوى حبوب الذره من النيتروجين الكلي والنيتروجين الغير ذائب عند اضافة كل من الزنك والنحاس ،وعلي العكس سجل محتوي النيتروجين الذائب اعلي قيمة عند اضافة مخلوط من ١٠٠ جزء في المليون من الزنك والنحاس.
- زاد محتوي الكربوهيدرات الكلية في الحبوب باضافة اي تركيز من الزنك او النحاس، وكانت اعلي زيادة سجلت باضافة مخلوط من التركيز الثاني منهما (١٠٠ جزء في المليون).
- اختزل محتوي الزيت في حبوب الذرة باضافة جميع المعاملات وخاصة عند استخدام معاملات الزنك سجل نقص ملحوظ.
- أدت أضافت ٥٠ او ١٠٠ جزء في المليون من النحاس الي تحسين محتوي الحبوب من الاحماض الامينية الحرة بينما ادت معاملات الزنك الي نقص محتوى الحبوب من الاحماض الامينية.
- أدت إضافة معاملات الزنك الي زيادة في محتوي كلا من الفوسفور والبوتاسيوم بينما ادت اضافة النحاس الي نقص في محتوي الفوسفور.