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Effect of Timing and Rate of Zinc on Wheat Yield

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Abstract : The effects of Zn on growth and yield components of wheat were studied in old land (east Delta) Mansoura center, Governorate of Dakahlia, Egypt, at 2013/2014 and 2014/ 2015. To investegat the effect of three Zn treatments were given to wheat along with other essential nutrients. A completely randomized block design was used in the field experiment were carrid out to infstegat the effect of three Zn consentration (control (0), 5 and 10 gm Zn/l., as $ZnSO_4 \cdot 7H_2O$) on wheat cultivar (Sakha 93). Dry matter of wheat increased by increasing rates of Zn above the optimum rate, the higher rates of Zn application decressed the dry weight of crop plants from the control had lower Zn concentrations. The data also revealed that Zn concentration in the second growth stage was lower compared to the first growth stage and the uptake of Zn by the plants was higher as dry matter yield was higher for second growth stage. Results showed that foliar Zn fertilization had significantly improved Zn level in grain.
Keywords : zinc, rates, timing, growth, yield and components, wheat.

Introduction

Field experiments were conducted at the special farm at Beddien village followed to Mansoura center, Dakahlia Government, Egypt, during the growing seasons in at 2013/2014 and 2014/ 2015, respectively. Wheat plants needs to zinc as all cearial crops and zinc is important for humens[1,2,3]. However, all farmers not intrested for supplemented plants with zinc elements so that apears sumposess deficiency on plant and humens in worldwide. Zinc decreased concentration in plants obtand to low yield and quality. Almost humans dpending on wheat as main sorce in food so that any decrease in zinc plants lead to decrease in humens and health proplems[4,5,6,7,8,9]. Most of researcher and orgnization of agricuture traing increasing zinc and other elemints in grains crearial especialy wheat by breeding and cultuvers operationg as foliar plants in several times to increase concentration of zinc in grains[10,11,12].

Materials and Methods

Field experiments were conducted at the special farm at Beddien village followed to Mansoura center, Dakahlia Government, Egypt, during the growing seasons in at 2013/2014 and 2014/ 2015, respectively. The experimental design was complete block design with three replications comprising three Zn treatments (0, 5 and 10 gm Zn/l as $ZnSO_4 \cdot 7H_2O$) at 35,65 and 95 days after planting, and wheat cultivar (Sakha 93). Plantings were done on 13 Novamber 2013 and 15 novamber 2014 at a seeding rate of 160kg/ha. The area of each plot was $10.5m^2$. There were 27 plots. During planting 120 kg P_2O_5 ha^{-1} supplied as superphosphate and 100 kg N ha-1 in the form of urea were applied as the basic fertilizers with an experimental drill. Wheat was harvested at full maturity.

The plant samples were incinerated in a muffle furnace at 525ºC for 6 h, dissolved 1:1 in 5 mL HNO_3, and then transferred to 50 mL volumetric flasks and brought to volume with distilled water. The solutions were analyzed with an atomic absorption spectrophotometer to determine Zn concentration and other micronutrients were measured using atomic absorption spectrophotometer.. Total N was determined in the dry grains using Kjeldahl method; total P was photometrical determined, while total K was determined using flame photometer.

Samples of five guarded plants were taken at random from the three middle rows of each plot of the three replications at 60 days after planting to measure the following growth parameters, plant height, stem dry weight/plant, leaves dry weight and number of leaves/plant. At harvest, ten guarded plants were taken at random from the three middle rows of each plot of the three replications to determine speklit weight, 1000-grainweight and grain number /speklit at 160 DAP. All plants from each plot of the different rate and timming were collected to estimate yield/ha. The results were analyzed statistically by analysis of variance and multiple comparisons of means according to[13], the least significant differences (LSD) was used to compare the treatments mean at 5% level of probability.

Results and Discussions

Zinc applied foliar spray showed inhibitory effects on root biomass compared to controls. In contrast to roots, Zn supplementation significantly increased grain biomass compared to controls, irrespective of the supply method. Zinc foliar spray significantly increased shoot biomass on the condition that Zn was absent in the nutrient solution. However, a combination of Zn applied to root treatment with foliar Zn treatment significantly reduced shoot biomass compared to controls.

Different Zn supply times showed different effects on Zn distribution in wheat tissues. This suggests that with more Zn in the medium, more Zn will be rent in roots. In contrast to Zn supplied to roots, Zn foliar spray significantly reduced root Zn distribution; however, Zn foliar spray increased shoot and grain Zn distribution compared to the control, irrespectively of Zn levels in the nutrient solution

Table (1): Effect of foliar application of zinc on growth and some chemical contents of wheat plants at 105days after planting at 2013/2014 and 2014/ 2015 seasons.

Treatments		Plant Height (cm)	DW Lea (g)	DW Stem (g)	Number of teller	Chllo A mgkg-1	B mgkg-1	C mgkg-1	N/ leaves%	Protein/ leaves%	P%	K %	Zn mgkg-1
At 35	0	85	12.7	22.3	22.5	2.21	1.110	0.85	2.4	14.16	0.248	2.200	20.8
	5gm zn/l	93	13.6	23.5	23.7	2.23	1.080	0.88	2.6	15.34	0.264	2.169	22.3
	10gmzn/l	96	14.1	24.1	24.4	2.27	1.120	0.92	2.9	17.11	0.278	2.151	23.2
At 65	0	102	14.6	24.9	25.9	2.34	1.180	0.95	3.1	18.29	0.288	2.182	23.4
	5gm zn/l	108	15.9	25.3	26.3	2.42	1.230	0.98	3.4	20.06	0.309	2.169	22.3
	10gmzn/l	112	16.5	25.7	27.4	2.54	1.220	1.03	3.5	20.65	0.325	3.154	24.6
At 95	0	115	17.5	26.4	28.6	2.65	1.280	1.03	3.7	21.83	0.347	2.168	21.8
	5gm zn/l	125	18.0	28.2	29.2	2.73	1.350	1.12	3.8	22.42	0.358	2.145	24.9
	10gmzn/l	128	18.3	28.6	29.5	2.81	1.393	1.23	3.9	23.01	0.362	3.159	25.1
LSD 5%		**28.94**	**4.932**	**6.065**	**7.931**	**0.87**	**0.143**	**0.0083**	**1.316**	**6.1**	**0.0503**	**0.68**	**2.331**

Table (2) : Effect of foliar application of zinc on yield and some chemical of grains of wheat plants at 2013/2014 and 2014/ 2015.

Treatments		Length of panicle	W. spilet (g)	1000 grain	Yield/m2 (g)	Yield/ha (ton)	N in grains%	Protein in grains%	P %	K %	Fe ppm	Mn ppm	Zn ppm
At 35	0	21.3	2.83	22.6	1146.1	11.461	2.8	16.52	1.348	2.214	38	35	57
	5gm zn/l	21.9	2.91	23.2	1241.4	12.414	3.1	18.29	1.288	2.169	53	79	68
	10gmzn/l	22.7	2.99	23.9	1274.2	12.742	3.3	19.47	1.208	2.151	62	102	77
At 65	0	23.2	3.01	25.3	1313.2	13.132	3.6	21.24	1.288	2.182	64	86	57
	5gm zn/l	24.3	3.23	25.9	1403.2	14.032	3	17.71	1.295	2.169	53	78	65
	10gmzn/l	23.0	3.06	25.7	1257.6	12.576	3.5	20.65	1.203	3.154	76	103	61
At 95	0	22.9	2.88	24.9	1235.5	12.355	3.8	22.42	1.287	2.168	48	77	59
	5gm zn/l	23.6	2.83	24.1	1239.5	12.395	4.1	24.19	1.208	2.145	79	106	57
	10gmzn/l	23.4	2,81	24.0	1238.5	1238.5	4.4	25.96	1.2	3.159	81	101	68
LSD 5%.		**2.005**	**0.13**	**2.05**	**39.32**	**4.975**	**9.162**	**44.12**	**5.03**	**4.68**	**1.33**	**3.42**	**0.122**

Discussion

Zn foliar spray significantly increased Zn concentration in grain. However, approximately 80% of Zn was distributed in shoots, only 10% in grain. This raises the question as to whether Zn in grain was derived from nutrient solution or from other wheat organs such as roots and shoots. It is generally accepted that Zn accumulation in grain is controlled by homeostatic mechanisms in the plant that regulate Zn absorption, translocation, and loading and unloading rates of phloem sap[3,14,15] reported that grain Zn originates from two sources: first, directly from the soil and second, from the remobilization of stored Zn in leaves. In wheat, re-translocation from leaves is important for Zn allocation to the grain[14]. The redistribution of Zn may depend on age of the plant as well as on Zn content of the source organs[16]. For example, senescence or limited Zn supply may limit redistribution, especially during grain filling[17,18,14]. This was consistent with[17] who reported that in wheat, remobilization of Zn from old leaves into generative organs is much greater under low supplies than adequate supplies of Zn. In contrast,[19,20] reported that remobilization of Zn from older into younger tissues was greater with adequate compared to deficient Zn supply. Although the source of grain Zn was uncertain in the hydroponic experiment, we determined that if wheat could absorb enough Zn from the solution, then Zn re-translocation to the grain from other organs was lower. The translocation of Zn in wheat plants was also low. It has been determined that over-expression of a Zn transporter can provide a new strategy for increasing Zn content of wheat[21,15,14] had determined that increased expression of genes encoding Zn transporters can increase Zn uptake in plants. Furthermore, with respect to root-to-shoot allocation of Zn, the Zn pump HMA4 seems to be a major player in decocts. However, it remains to be tested whether HMA4 might be used for transgenic bio-fortification approaches in cereals[9].The following format illustrates the different styles that may be used by the authors for their results and discussion.

Conclusion

Zinc application increaed vegetative and yield characters. The application of was due to the increased enzymatic activity and the organic recycling of the plant nutrients. The highest of plant hieght, dry weight of plants and number of tiller were found in treatment were obtained to increase of zinc concentration. The highest of length of panicle, number of grains, weight of 1000 grain, yield/m^2 and yield/ha due to treatment at 95 day after sowing also, chlorophyll A, chlorophyll B and carotiene, grain content from nitrogen and protien concentration of zinc in grains of wheat plants. Foliar spry plants with zinc salphate with concentration 10g/l and at panicle stage may be to increase grain yield of wheat.

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