THE EFFECT OF ZN FERTILIZATION ON THE ELEMENT CONTENT OF RYEGRASS

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ABSTRACT

The effect of Zn fertilization on Zn, P, K and Mn uptake of ryegrass was studied in a greenhouse experiment for 8 chernozem soils with three replicates under uniform NPK supply and irrigation. The applied Zn rates were 0, 2.5 and 5 mg/kg Zn. Zn fertilization increased the plant Zn content and decreased the plant P and Mn content significantly.. For K there was no significant effect.

INTRODUCTION

The appropriate nutrient supply is one of the most important factor of the success for intensive plant production. Beyond the three most important macro elements (NPK) fertilization, the micronutrient replacement is also of great importance. In Hungary the 40-45% of agricultural areas has Zn deficient (Kádár, 1987) , it is reasonable to accomplish NPK ferilizers with Zn, especially for those cultures that reqiure lots of Zn (e.g. maize) .In our paper we studied the effect of Zn fertilization on the element uptake of plant.

MATERIALS AND METHODS

A pot experiment was conducted using 8 chernozem agronomical soils. Pots were filled with 2250g air dry soils.. The treatments included NPK , NPK + 2.5 mg/kg Zn and NPK + 5mg/kg Zn levels with three replicates. Each pot received uniform application of 100 mg N/kg soil as NH_4NO_3, 80 mg P_2O_5/kg soil as KH_2PO_4 and 120 mg K_2O/kg soil as KH_2PO_4 and KCl. The zinc was added as $ZnSO_4*7H_2O$ in aqueous form. Soils were kept at constant moisture by daily irrigation, which was 75% of maximum water capacity of the soils. The experimental plant was ryegrass (Lolium perenne L.). 1.7 g seeds were sown in the soils per pots. After the first (33. day) and second (53. day) harvest 100 mg/kg N was added to the pots as NH_4NO_3 solution.

For the initial soils total-N, phosphate, potassium and pH values were measured from 0.01 molar $CaCl_2$ soil extraction, calcium and magnesium content was measured from ammonium –lactate soil extraction. The Zn content was measured from $CaCl_2$-DTPA solutions. The most important soil properties for the initial soils are summarised in Table 1.

At the end of the experiments the plants Zn, K, Mn and P content was measured for the first cut.

Table 1. Main soil characteristics of the initial soil samples.

Nr.	Soil Type	*K_A	Hu%	pH	Total N mg/kg	PO_4^{3-} mg/kg	K mg/kg	AL-Ca mg/kg	AL-Mg mg/kg	Zn DTPA mg/kg	Zn LE mg/kg	Zn EDTA mg/kg
1	Leached chernozem	43	2,73	5,86	17,51	1,78	51,62	8180	559,39	1,88	2,85	3,51
2	Meadow chernozem	45	3,16	7,29	68,63	0,86	47,01	8960	1018,25	0,94	1,90	1,63
3	Meadow chernozem	42	2,66	7,21	53,4	0,97	56,28	12060	284,41	0,55	1,10	1,15
4	Meadow chernozem	46	2,69	7,4	30,83	1,16	65,82	23189	564,12	1,07	2,42	1,73
5	Meadow chernozem	42	2,09	7,45	45,39	1,06	83,23	13170	419,35	1,32	2,68	1,30
6	Calcareous chernozem	42	2,83	7,45	36,43	0,74	35,77	10940	702,96	0,59	1,28	0,83
7	Meadow chernozem	43	3,05	7,36	29,68	1,17	53,94	7660	609,51	2,32	5,29	3,85
8	Calcareous chernozem	43	3,02	7,18	58,92	1,03	187,29	1164	129,65	2,23	5,26	4,18

RESULTS AND DISCUSSION

The average dry matter production of the first cut is summarized in Table 2. The dry matter production of the different soil samples varied greatly. Under control treatment (uniform NPK doses) the greatest yield was experienced at soil sample 15. (7.2 g/pot) and soil sample 16. had the smallest dry matter production (0.93g/pot).The low AL-Mg content of certain soils (Table 1.) gives explanation for the small yield in case of soil 16., 1., 3, 4., 6.
The data were evaluated with two variable variance analysis. Accordingly significant positive relationship was found between Zn application and the dry matter production. Between the soils and dry production there was also significant relationship.
Based on the data of Table 1. and Table 2. the positive effect of Zn fertilization can prevail even for those soils that Zn content exceed the critical value recommended by the Hungarian Plant Nutrition Recommendation System. High phosphate content of soil samples 2. and 8. gives explanation for this result, but in some cases e. g. soil sample 14. the increment of yield is not construable. The results of the three investigated Zn extraction methods corresponded with each other.

The results of variance analysis for the plant Zn content is represented in Table 3. The significant effect of Zn fertilization on the Zn content of leaves manifested for all soils except sample 16.

Table 3. Mean Zn content of ryegrass , 1st cut

	Zn content of plant (mg/kg)				Difference between treatments in dry weight	
	Zn doses (mg/ kg soil)					
	0	2.5	5		2.5-0	5-0
7	44.38	46.39	49.12	46.63	2.02	4.75

9	26.94	39.60	46.66	37.73	12.66	19.71
10	25.80	39.43	45.74	36.99	13.62	19.93
11	31.92	42.60	43.04	39.18	10.68	11.12
12	27.36	39.71	48.94	38.67	12.35	21.58
13	15.15	25.17	31.40	23.91	10.01	16.24
14	25.28	37.42	43.70	35.46	12.13	18.42
17	41.17	43.11	47.97	44.08	1.94	6.80
mean	29.75	39.17	44.56	37.8	9.42	5.39

$SD_{5\%}$ between Zn treatments = 2.28
$SD_{5\%}$ between soils = 3.73
$SD_{5\%}$ between any two combinations = 6.45

Table 4. Mean K content of ryegrass

	K content of plant (g/100g)				Difference between treatments in K content	
	Zn doses (mg/ kg soil)					
	0	2.5	5		2.5-0	5-0
7	9.38	9.09	9.61	9.36	-0.29	0.53
9	5.39	5.55	8.99	6.64	0.16	3.44
10	8.36	9.05	9.35	8.92	0.69	0.30
11	9.14	9.55	10.19	9.63	0.41	0.64
12	10.25	10.30	10.41	10.32	0.05	0.12
13	5.77	5.79	5.98	5.85	0.02	0.20
14	8.97	9.15	8.68	8.93	0.18	-0.47
17	9.38	9.09	9.61	9.36	-0.29	0.53
mean	5.39	5.55	8.99	6.64	0.16	3.44

$SD_{5\%}$ between Zn treatments = 1.85
$SD_{5\%}$ between soils = 1.21
$SD_{5\%}$ between any two combinations = 0.65

	Mn content of plant (mg/kg)				Difference between treatments in Mn content	
	Zn doses (mg/ kg soil)					
	0	2.5	5		2.5-0	5-0
7	51.33	45.67	38.67	45.22	-5.67	-12.67
9	72.33	73.67	65.33	70.44	1.33	-7.00
10	90.33	81.33	76.00	82.56	-9.00	-14.33
11	57.33	62.33	52.33	57.33	5.00	-5.00
12	64.00	62.33	67.33	64.56	-1.67	3.33
13	50.33	44.33	47.00	47.22	-6.00	-3.33
14	63.37	54.33	58.67	58.79	-9.03	-4.70
17	56.33	50.33	53.00	53.22	-6.00	-3.33
mean	63.17	59.29	57.29	59.92	-3.88	-5.88

$SD_{5\%}$ between Zn treatments =
$SD_{5\%}$ between soils =
$SD_{5\%}$ between any two combinations =

	P content of plant (mg/g)				Difference between treatments in P content	
	Zn doses (mg/ kg soil)					
	0	2.5	5		2.5-0	5-0
7	4.90	4.20	3.84	4.31	48.95	4.90
9	3.09	2.86	2.55	2.83	30.88	3.09
10	3.98	3.87	3.50	3.79	39.84	3.98
11	4.18	3.77	3.34	3.76	41.76	4.18
12	3.89	3.87	3.92	3.89	38.88	3.89
13	3.00	2.99	2.22	2.74	30.02	3.00
14	5.28	4.83	4.75	4.95	52.81	5.28
17	6.70	6.50	6.70	6.63	67.00	6.70
mean	4.38	4.11	3.85	4.11	43.77	4.38

$SD_{5\%}$ between Zn treatments =
$SD_{5\%}$ between soils =
$SD_{5\%}$ between any two combinations =