DETERMINATION OF SOME MACRO AND MICRO ELEMENTS IN GRAIN OF WINTER BARLEY GENOTYPES

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INTRODUCTION

Crop plants are a major source of energy, carbohydrates (McKevith, 2004), protein (Comai et al., 2007; Shewry, 2007) and macro elements, especially magnesium and zinc (Kowieska et al., 2011). Determining the content of phosphorus, potassium, magnesium, calcium and zinc as well as essential amino acids in grains is of the goal for the choice of cereal crop in food production (Sidhu et al., 2007).

The content of macro and micro elements in barley grain is a small but necessary for the normal functioning of metabolic processes in the plant. The deficit of phosphorus, potassium, calcium, magnesium and iron can cause disruption of normal growth and development of the plant or changes in physiological and metabolic processes (Samac & Tesfaye, 2003).

The aim of this research was to determine the content of some macro and micro elements in grain of winter barley genotypes.

MATERIAL AND METHODS

Experimental material

Total 21 two row winter barley genotypes were used as a material. Five of them are Macedonian (***Hit, Izvor, Egej, Line 1*** and ***Line 2***), two varieties are Serbian (***NS 525*** and ***NS 565***), two varieties are Croatian (***Zlatko*** and ***Rex***) and the other 12 genotypes are with Bulgarian origin (***Obzor, Perun, Emon, Lardeya, Orfej, Imeon, Zagorec, Asparuh, Kuber, Sajra, Devinija*** and ***Odisej***).

Location and methods

The experiment was conducted during the period of 2012-2014 on the field of the Faculty of Agriculture, in two locations in the Republic of Macedonia: Ovche Pole and Strumica (Fig. 1). Randomized block design with three replications was applied. The standard growing measures were applied during the vegetation.

Fig. 1. Location of the study area in the R. Macedonia

Sample preparation

For digestion of seed samples, the microwave digestion system was applied (Fig. 2). The precisely measured mass (0,5 g) of each genotype was measured in Teflon digestion vessels to which 5ml concentrated nitric acid, HNO_3 and 2ml hydrogen peroxide, H_2O_2 were added.

Fig. 2. Microwave digestion system, model Mars 4, CEM Corporation

Determination of elements content

Analyses were performed with mass spectrometry with inductively coupled plasma for, Na, Mg, P, Ca, Fe, Cu and Zn (Fig. 3).

Fig. 3. Mass spectrometry with inductively coupled plasma (ICP-MS)

RESULTS AND DISCUSSION

The average values for content of macro and micro elements in genotypes studied in both localities are given in Table 1 and 2. Average values for content of macro and micro elements in examined genotypes in Ovche Pole ranging from 1,746 mg/kg of copper to 798,4 mg/kg of phosphorus (Tab. 1) and for genotypes analyzed in Strumica ranging from 2,335 mg/kg of copper to 1 053,6 mg/kg of phosphorus (Tab. 2). The highest average value for the content of sodium was determined in genotype *Izvor* (48,27 mg/kg). Genotype *line 2* had the highest content of magnesium (437,25 mg/kg) and P (912,5 mg/kg), genotype *Egej* calcium (139,0 mg/kg), while for the genotype *Hit* was received highest iron content (18,2 mg/kg). The copper content was the largest in genotype *NS 525* (2,063 mg/kg) and zinc among genotype *Odisej* (6,050 mg/kg). In Strumica locality, maximum content of sodium and calcium was established in genotype *Izvor* (95,80 mg/kg and 195,9 mg/kg). Genotype *line 2* showed the highest magnesium content (554,50 mg/kg), while the highest phosphorus content was determined in genotype *Emon* (1 268,0 mg/kg). For the genotype *Obzor* was obtained the greatest iron content (28,0 mg/kg). The content of copper (6,090 mg/kg) and zinc (6,950 mg/kg) was the greatest among genotype *NS 565.* In Table 3 is given the correlation between content of elements and grain yield for both locations.

Table 1. Average values for content of elements (mg/kg) in barley genotypes analyzed in Ovche Pole locality

	Na	Mg	P	Ca	Fe	Cu	Zn
Average	**31,51**	**395,02**	**798,4**	**106,9**	**14,9**	**1,746**	**4,996**
Min	12,75	342,90	641,5	68,5	12,3	1,361	3,789
Max	48,27	437,25	912,5	139,0	18,2	2,063	6,050
CV (%)	25,67	6,50	7,97	14,60	9,55	10,03	10,82

Table 2. Average values for content of elements (mg/kg) in barley genotypes analyzed in Strumica locality

	Na	Mg	P	Ca	Fe	Cu	Zn
Average	60,93	483,34	1 053,6	151,0	23,6	2,335	5,927
Min	29,71	378,75	796,0	114,8	17,1	1,698	4,342
Max	95,80	554,50	1 268,0	195,9	28,0	6,090	6,950
CV (%)	26,72	9,27	11,08	16,89	10,68	38,06	11,04

Table 3. Correlation between elements content and grain yield in both locations

Ovche Pole

	Na	Mg	P	Ca	Fe	Cu	Zn	Grain yield
Na	1	0,225	0,323	**0,444***	**0,465***	-0,005	0,073	-0,295
Mg	0,138	1	**0,807****	0,339	**0,566****	**0,680****	**0,655****	0,010
P	-0,070	0,208	1	**0,488***	**0,574****	**0,605****	**0,517***	-0,147
Ca	0,233	-0,100	0,137	1	0,163	0,275	0,116	-0,185
Fe	0,182	0,366	**0,765****	-0,030	1	0,208	0,398	-0,145
Cu	0,357	0,152	0,147	0,398	0,154	1	**0,684****	0,414
Zn	0,255	0,354	**0,529***	**0,466***	**0,530***	**0,507***	1	0,221
Grain yield	0,175	-0,063	0,397	0,019	0,398	-0,253	-0,082	1

Strumica

*, ** level of significance, P<0,05 и P<0,01

CONCLUSION

The content of macro and micro elements in all analyzed genotypes in both localities was low. The content of sodium, magnesium, phosphorus, calcium, iron, copper and zinc was higher in the genotypes analyzed in Strumica locality, compared with genotypes grown in Ovche Pole. For genotypes in both localities there was no significant correlation between elements content and grain yield.

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