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HIGHER RATES OF POTASSIUM FERTILIZER IMPROVE ECONOMIC EFFICIENCY OF SWEET MAIZE (*ZEA MAYS SACCHARATA*)

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ABSTRACT

Six hybrids of sweet maize (OS 250su, OS 254su, Bc 274su, Bc 378su, Spirit, Bonus) were planted in field trials in 2009 and 2010 on location Zupanja at three different fertilization levels (130, 150 and 180 kg K_2O/ha). We determined significant improvement of economical conditions of sweet maize with increased potassium fertilization (180 kg K_2O/ha) compared to control (130 kg K_2O/ha): earlier tasseling and silking for 3 to 7 days, 10% higher mass of ears, greater diameter of ears and 3% lower husk proportion.

Key words: sweet maize, fertilization, economical characteristics.

INTRODUCTION

Maize was recognized as a food source 9000 years ago when American Indians (Maya, Aztec and Inka) breed genera Teosinte into first eight-rowed ear maize. They used it for food, shelter, decoration and energy. With further selection they continued to create maize types adjusted to their needs. Grain of sweet maize has wrinkled surface and half hyaline endosperm with small portion of starch. From dent maize it differs in only one recessive gene (*su*) which prevents part of sugars to be transformed into starch. In the endosperm of sweet maize there are different forms of starch and water soluble dextrins, which give sweet taste to the grain.

Sweet maize is used for human consumption and it can be fried, cooked or conserved. It has been estimated that only 10% of all territories in the world used for production of cultivated plants can be placed in the category where plants are not under influence of natural stresses. In the group of territories which are under influence of external stress, approx. 20% are under mineral stress, 26% under drought stress and 15% under low temperature stress (Mengel and Kirkby, 2001; Cakmak, 2002). Soils of eastern Croatia are of different physical, chemical, pedological and biological characteristics and as such are more or less suitable for maize crop (Šimić et al., 2003).

Maize is a plant which has high needs for potassium, because optimal supply with potassium gives higher tolerance towards abiotic and biotic stress, especially towards drought, diseases and pests, including dumping off tolerance (Varallyay, 2006). Genotype has an important influence on dynamics of potassium intake (Nagy, 2007). Mineral nutrition of maize has great importance. Maize hybrids have different requirements for mineral nutrition and show different reactions when fertilized with higher amounts of phosphor and potassium (Lončarić et al., 2005).

Lack of phosphor and potassium is usually found separately and rarely found at the same time on the same ground. Weaker potassium intake is mostly determined on hydromorphic soils, with neutral to alkaline pH reaction and higher percentage of clay (Šimić et al., 2003).

It has been estimated that on the territory of eastern Croatia over 30% of soils show lower potassium availability. Better potassium intake gives plants better conditional characteristics and higher yield. The aim of our research was to determine the influence of increased potassium fertilization on

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economical characteristics of different genotypes of sweet maize.

MATERIAL AND METHODS

On Zupanja location (OPG Ivan) in 2009 and 2010 we planted six hybrids of sweet maize (OS 250su, OS 254su, Bc 274su, Bc 378su, Spirit and Bonus). Chemical analysis of the experimental soil is presented in Table 1. Trial was set in split-plot method with four repetitions and three fertilization levels: T1 – control (150 kg N, 80 kg P_2O_5, 130 kg K_2O), T2 – (150 kg N, 80 kg P_2O_5, 150 kg K_2O) and T3 – (150 kg N, 80 kg P_2O_5, 180 kg K_2O). Planting was done on April 21, 2009 and April 27, 2010 with pneumatic planter and 66027 plants per m^2. The area of trial plots was 300 m^2 (15 x 20 m).

Samples for ear analysis (number of rows, number of grains in a row, grain mass) and plant analysis (height to the ear and to the tassel) were taken 21 day after pollination. Measurement of economical characteristics was performed in the lab of Agricultural Institute Osijek with laboratory scale and by counting. Processing of obtained data was done with analysis of variance with F test, and significance of obtained values was determined on the basis of the least significant differences with LSD test (SAS Institute Inc, 2002-2003).

Table 1. Chemical analysis of the experimental soil

Soil type	Previous crop	pH KCL	pH(H_2O)	Humus	P_2O_5	K_2O
Semiglay	Wheat	4.8	6.5	2.6	19.2	18.6

RESULTS AND DISCUSSION

Our results show that there are obvious differences in values of economical characteristics of sweet maize, depending on the fertilization, hybrid (genotype) and experimental year (Table 2).

The lowest variation was determined for proportion of grains in ear mass in both experimental years and the highest variation was determined for ear mass (20%).

The results of research on influence of increased potassium fertilization on economical characteristics of sweet maize are shown in Table 3.

Table 2. The results of analysis of variance

Variation source	Date of silking			Height to the tassel			Ear mass		
	F-test	LSD		F-test	LSD		F-test	LSD	
		0.05	0.01		0.05	0.01		0.05	0.01
Hybrid A	11.52**	1.54	2.18	9.63**	11.52	6.15	11.56*	9.78	15.18
Year B	6.57*	11.87	3.26	118.56*	11.62	21.57	368.25**	11.64	17.63
Treatment C	297.85*	6.72	7.13	478.56**	15.26	19.34	642.15**	17.78	18.56
*(AxC)	27.57*	2.32	4.18	19.56*	3.87	6.15	42.12**	7.12	8.68
*(BxC)	98.76**	3.05	4.26	127.07**	7.51	9.63	172.77**	5.12	7.07
*(ABC)	7.14*	9.17	11.51	358.58**	10.56	14.87	356.47*	12.56	14.17

*Interaction

Obtained results show that increased potassium fertilization by 20 to 40% in sweet maize results in earlier tasseling and silking (3-7 days), increased plant height to the ear and tassel (10 to 20 cm), ear diameter (11%), ear mass (20%) and in reduced portion of husk (by 3%). With analysis of variance we determined significant differences of investigated characteristics for interaction of hybrid and fertilization. Significance on the level ($P<0.01$) was determined for grain mass and on the level ($P<0.05$) for silking and tasseling. This analysis emphasizes the importance of specific mineral nutrition of sugar corn hybrids.

Table 3. Average economical characteristics of sweet maize for 2009 and 2010

Economical characteristics	Hybrid						Average value
	Os 250su	Os 254su	Bc 274su	Bc 376su	Spirit	Bonus	
T1 – Control (150 kg N, 80 kg P_2O_5, 130 kg K_2O)							
Date of tasseling	30.06.	30.06.	5.07.	8.07.	1.07.	1.07.	2.07.
Date of silking	2.07.	2.07.	9.07.	11.07.	3.07.	4.07.	4.07.
Height to the ear (cm)	45	52	55	60	54	57	53
Height to tassel (cm)	140	152	155	158	149	150	150
Ear mass (g)	192	182	180	185	176	191	184
Ear diameter (cm)	4.8	4.5	4.8	4.7	5.1	5.2	4.8
Husk (%)	30	31	31	33	32	32	31
T2 – (150 kg N, 80 kg P_2O_5, 150 kg K_2O)							
Date of silking	28.06.	28.06.	2.07.	3.07.	29.06.	29.06.	29.06.
Date of tasseling	1.07.	1.07.	4.07.	6.07.	2.07.	1.07.	2.07.
Height to the ear (cm)	57	62	65	70	65	70	64
Height to the tassel (cm)	150	165	165	168	160	165	162
Ear mass (g)	218	211	210	215	216	211	213
Ear diameter (cm)	5.8	5.5	5.8	5.7	5.9	5.7	5.7
Husk (%)	28	29	30	31	30	30	29
T3 – (150 kg N, 80 kg P_2O_5, 180 kg K_2O)							
Date of silking	28.06.	28.06.	29.06.	30.06.	29.06.	28.6.	28.06.
Date of tasseling	30.06.	1.07.	2.07.	3.07.	1.07.	30.06.	1.07.
Height to the ear (cm)	65	70	75	78	66	69	70
Height to the tassel (cm)	170	172	175	180	165	165	171
Ear mass (g)	229	282	218	215	221	219	230
Ear diameter (cm)	6.0	5.9	5.8	5.7	5.8	5.6	5.8
Husk (%)	27	29	30	29	30	29	29

We also determined significant differences between variances of potassium fertilisation and the year ($P \leq 0.01$) with all investigated characteristics. The most significant difference was determined for grain mass.

That proves that potassium fertilisation i.e. potassium intake is weather dependant. Potassium is an important constitutional element of the grain and with better intake grain mass is higher.

Based on the results we concluded that in production of sweet maize potassium fertilization has an important role, since it positively influences qualitative and quantitative characteristics. Analysis of variance showed significant statistical differences in economical characteristics, with the highest influence of potassium fertilization.

CONCLUSIONS

Based on our research we can conclude that increased potassium fertilization in sweet maize production influences the following:

- Earlier tasseling and silking, from 3 to 7 days;
- Increases plant height with up to 30 cm;
- Increases ear diameter by 18% and ear mass by up to 20%;
- Reduces husk percentage by up to 3%.

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