

THE EFFECT OF FOLIAR FERTILIZATION ON THE YIELD AND QUALITY OF SUGAR BEET (*BETA VULGARIS* L.)

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Introduction

Sugar beet has an outstanding place among the plants; rentability of sugar manufacture is determined by the stability of yield and the quality (saccharose content) of sugar beet. The most important constituent of beet is certainly sucrose, while the various non-sucrose substances impair the sugar yield to different degrees. The molassigenic substances such as potassium, sodium, raffinose and N compounds such as amino-N and betaine increase the molasses loss, whereas invert sugar and glutamine lead to color formation during evaporation and crystallization as a consequence of the Maillard reaction. This is regarded as a major quality impairing factor for white sugar (VAN DER POEL et al., 1998). In common with most crops, climate and soils are the two main determinants of yield per unit area. Both are outside the growers' control but next most important is the plant's nutrition, which can be manipulated to the advantage of producer and processor (DRAYCOTT and CHRISTENSON, 2003). Fertilization of sugar beet requires special knowledge. An adequate nutrient supply is one of the important factors for both yield and quality of sugar beet (KULCSÁR and JÁSZBERÉNYI, 1999). The effect of unfavorable soil conditions on yield and quality can be decreased by foliar fertilization and plant nutrition. This way, the yield stability of sugar beet producing on Hungarian Plains can be improved (RUZSÁNYI et al., 2001).

Sulphur deficiency has been recognized as a constraint to agricultural production, since it has been shown not only to influence yield, but also the quality of many crops, such as oil seed rape (FISMES et al., 2000; MCGRATH and ZHAO, 1996) and cereals (HANEKLAUS et al., 1995; SYERS and CURTIN, 1987) as well as grassland (SCOTT et al., 1983; SYERS and CURTIN, 1987). Sulphur is one of the major nutrients and is required to synthesize key amino acids, which in turn are needed to produce functional and structural proteins (WILLENBRINK, 1967). In future, fertilizer sulphur may well be needed. An alternative, being used on other crops, is also elemental sulphur. New experiments are needed now to establish the need for sulphur (DRAYCOTT and CHRISTENSON, 2003).

In addition to the major nutrient elements, sugar beet, in common with other crops, needs very small amounts of other elements. Localized areas may show sporadic symptoms and some crops may be short of copper but this deficiency appears, at present, to be of little economic significance. However, as yields continue to increase and farming practices change, application of this micronutrient may become more important (COOKE and SCOTT, 1993). The sugar beet is moderately responsive to copper. Occasionally copper deficiency may be found, but this micronutrient deficiency is generally corrected with fertilizer materials applied either to soil or to plant foliage (DRAYCOTT and CHRISTENSON, 2003).

In our experiment we examined the effect of sulphur, copper and two foliar fertilizers with organic and inorganic active agents.

Methods

Our plot experiment in randomised blocks in four replications was set up in Hajdúböszörmény (N 47°41' E 21°30'; elev above 368 ft) in 2005 at two sites (Béke Agricultural Cooperative – 1st site and Hajdúböszörményi Agricultural Plc. – 2nd site) on chernozem soil. Plot size was 24 m × 300 m.

The yield and the quality of the sugar beet are mainly determined by the plant production system, so we studied the effect of different foliar treatments.

We examined the response of sugar beet to sulphur (Cosavet DF, 5 kg ha⁻¹), copper (Kelcare Cu, 0,5 kg ha⁻¹) and two foliar nutrients with high active agent (these were Biomit plussz, 4 l ha⁻¹; and Fitohorm Euro Öko Gyökérgumós, 4 l ha⁻¹) sprayed with 200 l ha⁻¹ water at both of the sites.

The treatments and dates are in *Table 1*.

Table 1. Treatments and application dates

Treatments	1st application	2nd application	3rd application
	2005.05.31. 2005.06.03.	2005.06.21. 2005.06.27.	2005.08.01. 2005.08.31.
1. Control	-	-	-
2. Biomit Plussz	+	+	+
3. Fitohorm Euro Gyökérgumós	-	+	+
4. Cosavet DF	-	+	-
5. Kelcare Cu	-	+	-
6. Cosavet Df + Kelcare Cu	-	+	-

Produced by: Biomit Ltd. Hungary(2); Fitohorm Ltd. Hungary (3); Sulphur Mills (4); Kemira GrowHow Hungary (5).

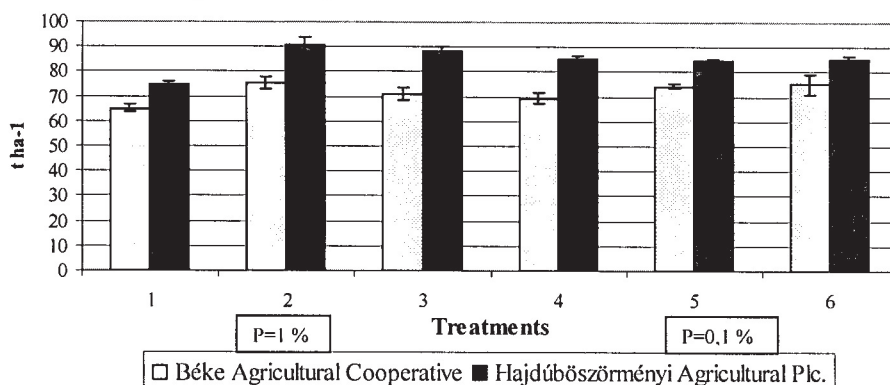
We have taken root- and leaf samples (these are under analysis) at 4 week intervals, starting at the beginning of August. The harvest of sugar beet was on November. We determined the weight of root in the field. The quality parameters (sucrose, potassium, sodium and alpha-amino N content) of the root samples was determined from filtrated beet brei, by an automatic beet laboratory system, called VENEMA in the Kabai Eastern Sugar Plc. Hungary. Sucrose was analysed polarimetrically, potassium and sodium were determined by flame-photometry and alpha-amino nitrogen was analysed by the fluorometric method. The white sugar yield was calculated from beet yield, sucrose concentration and standard molasses loss.

The results of the experiment were processed SPSS 12.0 for Windows.

Results and discussion

We measured the highest yield in the second treatment (75,15 and 90,74 t ha⁻¹), and the lowest on the control plots (65,12 and 74,65 t ha⁻¹) at both of the sites (*Figure 1*). There were significant differences between the foliar treatments.

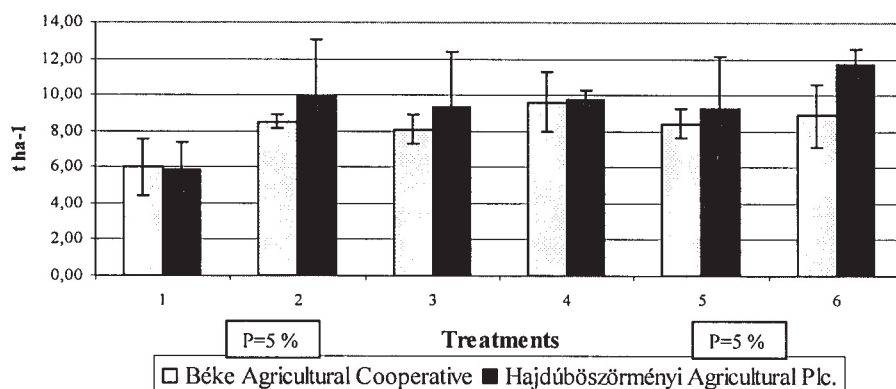
Figure 1: Root yield in the different treatments in 2005



In the average of 6 treatments the sugar content was 14,66 % on the 1st and 14,23 % on the 2nd site, however there were no significant differences between the results of treatments. Similar result was observed in the case of sodium, potassium and alpha amino-content. There were not found significant difference between the treatments.

The highest sugar yield was obtained on plots treated with Cosavet DF (Figure 2.). On the 1st site we measured the highest net sugar yield on plots treated with Cosavet DF (9,62 t ha⁻¹), and on the 2nd site Cosavet DF, combined with Kelcare Cu (11,70 t ha⁻¹).

Figure 2: Net sugar yield in the different treatments in 2005



Conclusions

We have found that the crop- and the sugar yield were significantly influenced by the foliar treatments. It can be stated that fertilization increased the crop yield, while the quality parameters (as above) have not changed. This way the sugar yield significantly increased on the effect of different foliar fertilizers.

Acknowledgement

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