Application of different amounts of ZnSO$_4$ in five varieties of sugar beet

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Ehsan Neamatollahi, Mohammad Mahdi Khademosharieh, Alireza Souhani Darban, Mohammad Reza Jahansuz: Application of different amounts of ZnSO$_4$ in five varieties of sugar beet

ABSTRACT

Sugar beet is one of the twelve main crops and is becoming popular. Zinc application is recommended to increase yield quantity and quality one in sugar beet. To study the affect of different levels of zinc on yield and quality of sugar beet, an experiment was conducted at Islamic Azad University of Mashhad in 2010. The type of design was complete Randomized Block Design, with 3 replications. The levels of ZnSO$_4$ (0, 40, 80 kg/ha) were added to the soil. Applied varieties were 7112, Latitia, Florez, Rhizophort and Zarghan. Variatey had significant effect on yield and sugar content. Application of zinc had significant effect on yield and sugar content, and had significant effect on the percent of molasses. In all varieties, zinc treatments had significant effect on yield and sugar yield. Florez had the highest sugar percent and Rhizophort had the highest yield among the hybrids. The best level of zinc for sugar beet was 40 kg/ha, with the highest yield and sugar percent. In higher level of zinc (80kg/ha) yield and sugar percent decreased.

Key words: Sugar beet, Znso$_4$, Florez variety.

Introduction

Zinc deficiency appears to be the most widespread and frequent micronutrient deficiency problem inrop and pasture plants worldwide, resulting in severe losses in yield and nutritional quality. This is particularly the case in areas of cereal production. It is estimated that nearly half the soils on which cereals are grown have levels of available Zn low enough to cause Zn deficiency. Since cereal grains have inherently low Zn concentrations, growing them on these potentially Zn-deficient soils further decreases grain Zn concentration. It is, therefore, not surprising that the well-documented Zn deficiency problem in humans occurs predominantly in the countries/regions such as India, China, Pakistan, Iran and Turkey where soils are low in available Zn and cereals are the major source of calorie intake. Zinc (Zn) is an essential micronutrient and has particular physiological functions in all living systems, such as the maintenance of structural and functional integrity of biological membranes and facilitation of protein synthesis and gene expression. Among all metals, Zn is needed by the largest number of proteins. Zinc-binding proteins make up nearly 10 % of the proteomes in eukaryotic cells, and 36% of the eukaryotic Zn-proteins are involved in gene expression. Tolerance to environmental stress conditions has a high requirement for Zn to regulate and maintain the expression of genes needed to protect cells from the detrimental effects of stress [1]. Information on micronutrient requirements is lacking for sugarbeet, even though it is considered moderately sensitive to deficiencies of most micronutrients [3]. Zinc availability is limited by high pH, high free calcium carbonate, sandy texture, low organic matter, and where subsoil has been exposed by land leveling. Sugar beet (Beta vulgaris L.) is an important cash crop in Iran. Information regarding the requirements of sugar beet for primary nutrients is abundant, but research on micronutrients is less common even though sugar beet is moderately sensitive to deficiencies of most micronutrients [2].

Zinc and B availability in calcareous soil is limited due to a high pH (>7.0), high free calcium carbonate and low organic matter content, and interrelationships with other elements [6]. Excess additions of P induce Zn deficiency. Boron also may be fixed under same conditions to some extent. More B appears to be required by plants growing in soils with high pHs [5]. In addition, foliar applications are recommended sometimes to improve the efficiency of Zn and B assimilation [7]. The objective of our research was to highlight the effect of different levels of Zn and varieties Sugar beet for receive to the best Sugar percentage and yield. To expand the utility of
sorghum and corn as forage crops, breeders have focused on traits likely to affect its yield and forage quality [4].

Materials And Methods

2.1. Experimental site and treatments:

The experiment was conducted at Islamic Azad University of Mashhad research farm at Golbahar (36°30’N, 59°30’E and elevation 1010m above sea level) Chenaran, Mashhad, Iran for 180 days from May 2nd to October 30th, 2010. The soil was sandy loam, with EC of 3.5 mmhos/cm, Zn absorbability of 0.45 ppm and organic matter of 14% at the 0-60 cm soil depth. Treatments consisted of five sugar beet hybrids including Latitia, Florez, Rhizophort, Zarghan and 7112 and also three Zn-levels (0, 40 and 80 kg/ha ZnSO4). The experiment was a factorial arrangement in a completely randomized block design with three replications.

2.2. Field growth condition:

The field was plowed in autumn after corn harvested, and then was used of two cross-over disk in spring. Seeds disinfected with Benomyl before planting and were hand sown on May 2nd in 32 m² (4*8) plots with an inter row space of 50 cm.

2.3. Sampling:

Samples were collected from two non-marginal rows at randomized in harvest stage. Leaves were separated and glands were transferred to laboratory.

2.4. Statistical analysis:

The data were treated by analysis of variance using the software MSTATC and EXCEL and mean were compared by DMRT.

Results And Discussion

3.1. The ingredients

In this study, amounts of impure K+, Na+ and N in emulsion were calculated. There were significant difference between hybrids, application ZnSO4 and also the variety * zinc interaction on impure N, Na+ and K+ (Table. 1).

<table>
<thead>
<tr>
<th>changes</th>
<th>df</th>
<th>Impure sugar%</th>
<th>K+</th>
<th>Na+</th>
<th>N alfalfa aminine</th>
<th>Alkaloid</th>
<th>Sugar%</th>
<th>Root yield</th>
<th>Impure sugar yield</th>
<th>Molasses%</th>
<th>Pure sugar yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replicate</td>
<td>2</td>
<td>0.617 n.s.</td>
<td>0.21 n.s.</td>
<td>0.17 n.s.</td>
<td>1.1 n.s.</td>
<td>0.37 n.s.</td>
<td>2.4 n.s.</td>
<td>0.2 n.s.</td>
<td>0.19 n.s.</td>
<td>0.02 n.s.</td>
<td>0.02 n.s.</td>
</tr>
<tr>
<td>Variety</td>
<td>4</td>
<td>0.17 n.s.</td>
<td>0.39 n.s.</td>
<td>0.41 n.s.</td>
<td>0.38 n.s.</td>
<td>0.14 n.s.</td>
<td>2.583***</td>
<td>1.712**</td>
<td>0.2 n.s.</td>
<td>0.151**</td>
<td>0.658*</td>
</tr>
<tr>
<td>Error</td>
<td>8</td>
<td>0.354 n.s.</td>
<td>0.41 n.s.</td>
<td>0.82 n.s.</td>
<td>0.63 n.s.</td>
<td>0.24 n.s.</td>
<td>0.368</td>
<td>1.337***</td>
<td>0.105 n.s.</td>
<td>0.062**</td>
<td>0.393**</td>
</tr>
<tr>
<td>Total</td>
<td>28</td>
<td>0.558</td>
<td>0.53 n.s.</td>
<td>0.55</td>
<td>0.509</td>
<td>0.197</td>
<td>0.75</td>
<td>0.535</td>
<td>0.145</td>
<td>0.031</td>
<td>0.123</td>
</tr>
</tbody>
</table>

3.2. The sugar:

Application Znso4 had significant (P<0.05) effect on the percentage of pure and impure sugar a depend also the percentage of molasses sugar whereas second level (40kg/ha Znso4) had higher percentage of pure and impure sugar and lower the percentage of molasses sugar (Fig. 1). Difference between hybrids were also significant (P<0.05) whereas 7112 had the most of the percentage of molasses sugar and the least of the percentage of pure and impure sugar and also Florez had the most of the percentage of pure and impure sugar and the least of the percentage of molasses sugar (Fig. 1).

3.3. Yield:

There were significant (P<0.05) difference between hybrids on the root yield and impure sugar yield. Florez and Rizophort had the most of impure sugar yield and the root yield, respectively, and 7112 had the least of the root yield and impure sugar yield. The root yield and pure and impure sugar yield were significantly (P<0.05) influenced by application ZnSO4 whereas second level (40kg/ha ZnSO4) was the best in this case (Figs. 2 and 3)(Table. 2).

Conclusion:

Rizophort, Florez and 7112 had the most yields, the most sugar yield and the least yield and sugar percentage, respectively. The second ZnSO4 levels (40 kg/ha) had higher root yield, percentage of molasses, pure sugar yield and impure sugar yield.

Based on this study Rizophort and Florez hybrid with used 40 kg ZnSO4/ha were recommended for planting in this station.
Table 2: Solidarity coefficients between Sugar beet different characters.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>K⁺</th>
<th>Na⁺</th>
<th>N alfa amineh</th>
<th>Alkaloid</th>
<th>Sugar %</th>
<th>Molasses %</th>
<th>Impure Sugar %</th>
<th>Root yield</th>
<th>Pure Sugar %</th>
<th>Sugar yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>K⁺</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Na⁺</td>
<td>0.47**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N alfa amineh</td>
<td>0.45**</td>
<td>0.51**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alkaloid</td>
<td>0.22</td>
<td>-0.13</td>
<td>-0.73*</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sugar %</td>
<td>-0.05</td>
<td>-0.07</td>
<td>-0.16</td>
<td>0.15</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molasses %</td>
<td>0.14</td>
<td>-0.10</td>
<td>0.03</td>
<td>0.09</td>
<td>-0.66**</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impure Sugar %</td>
<td>-0.36</td>
<td>-0.27</td>
<td>-0.64**</td>
<td>0.49**</td>
<td>0.18</td>
<td>-0.01</td>
<td>1.00</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Root yield</td>
<td>-0.32</td>
<td>-0.17</td>
<td>-0.56**</td>
<td>0.30</td>
<td>0.46*</td>
<td>-0.50</td>
<td>0.51</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure Sugar %</td>
<td>-0.27</td>
<td>-0.19</td>
<td>-0.50</td>
<td>0.31</td>
<td>0.40*</td>
<td>-0.26</td>
<td>0.72**</td>
<td>0.77*</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>Sugar yield</td>
<td>-0.11</td>
<td>-0.09</td>
<td>-0.26</td>
<td>0.20</td>
<td>0.98</td>
<td>-0.69*</td>
<td>0.27</td>
<td>0.63*</td>
<td>0.52*</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Fig. 1: Sugar beet varieties Molasses percentage

Fig. 2: Sugarbeets different varieties sugar percentage.
Fig. 3: ZnSO$_4$ effects on impure sugar yield

**Acknowledgement**

We thank the Islamic Azad University of Mashhad.

**References**