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Research Paper

Effect of foliar micronutrient elements and humic acid on yield and quality of sugar beet

Maryam Dashti jooshegham[1], Ghorban Ali Rasam[2], Ali Reza Dadkhah[3], asghar khoshnod yazdi[4]
1M. Sc Student of Faculty of Higher complexes of Shirvan
2&4 Assistant Professor of Faculty of Higher complexes of Shirvan
3 Associate Professor of Faculty of Higher complexes of Shirvan

Abstract: To the importance of micronutrients in crop improvement and environmental protection test in a randomized complete block design with three replications. Treatments were first treatment foliar fertilizer micro complete both Level 1 and 2 liters per hectare and humic acid at two levels: 2.5 and 5 liters per hectare and the second treatment stage, taking on three levels, including the 8 leaf, 16 leaf and 30 leaf and lack of fertilizer treatment (control), respectively. In this experiment, yield and quality traits such as root yield, the amount of sugar, sodium, potassium and amino nitrogen, alkalinity factor, Brix molasses, recoverable sugar content and sugar yield significant factor were evaluated. The results showed that, among the various levels of foliar micronutrients, humic acid and the control of root yield, the amount of sugar, potassium and amino nitrogen, alkalinity index, Brix molasses, recoverable sugar content and sugar yield significant factor in there is a level of 1%. Treatments (H2S3) with 44.053 tons per hectare root yield and control treatments with the lowest root yield was 36.5 tons per hectare. Maximum recoverable sugar content, ratio of recoverable sugar, molasses sugar sugar content and the lowest percentage owned treatment (H1S2) Respectively, 16.17, 91.21, 17.73 and 1.55 per cent.

Keywords: foliar micro-nutrients, humic acid, sugar beet, yield, quality traits

Introduction

Today, in addition to macronutrients, using micronutrients are as an important tool to obtain the highest performance in considered unit (Mosavi et al., 2007). Micronutrients have an important impact on the health of humans and animals as well as increasing the quality and quantity of products (Sharma et al., 1992). Lack of micronutrient elements in soils is not unique to the country and a large part of researches in other countries contains micronutrient elements (sepehr and malakouti, 1997).

The rate of application of micronutrients elements in countries with advanced nutrients is approximately 4-2 percent of the total amount of fertilizer consumption, but it is about 0.0002 % in Iran (Malakouti and Iran Tehrani, 2005). Plants need some elements in order to suitable growth. Some of these elements are such as iron, manganese, boron, molybdenum, zinc, magnesium (Fajrya, 1998), but the lack of them in the soil overshadow the performance of macronutrients elements (Malakouti, 1996). Several reports are represented on the role of micronutrients in enzymatic reactions, the metabolism of carbon and nitrogen assimilatory and different combinations of plant, sugar transport, and cell division, arranging and conducting water as the results of increase in synthesis of various plants (Marschner, 1983 and Reuter et al., 1988 and shiemshi, 1982). The extent of salty and sodium soil in Iran that increase the soil Ph reduces the absorption capability of micronutrients and leads to food shortages and quality and performance reduction (salar dini 1992; naseri et al., 1998). Spraying boron, copper, magnesium, manganese, and zinc is suitable for reducing the toxicity of these elements in the soil and preventing consolidation (Camberto, 2004). Using micronutrients elements in deficiency cases, especially through spraying, can improve the performance and components of safflower (Lewis & McFarlane et al., 1986; Movahhedy-dehnavy., 2009). Spraying zinc and sulfur in accompany with nitrogen and phosphorus fertilizers increase the performance of safflower's seed, protein and seed oil (Babhulkar et al., 2000). Mahlr and colleagues (Mahler et al., 1992) also stated that foliar application of manganese sulfate increase the atmosphere performance in comparison to other methods. Iron spraying is an economical way to treat chlorosis that caused by iron deficiency in sugar beet and will lead to increase the performance of this plant (Fernandez et al., 2004).

Abd EI Hadi (1986) has reported 1 to 51 percent increase in performance through spraying Zinc, iron and manganese on several plants such as sugar beet. Peppermint requires many nutrients during the growth and production of active ingredients and researches show that adequate amounts of micronutrient elements significantly increase the essential oil of peppermint (Omid beigi 1997). Hiumic acid is one of the important fertilizers in plants. Hiumic acid increases the absorption of nitrogen, potassium, calcium, magnesium, and phosphorus by the plant. Application of hiumic acid enhances chlorosis because of the ability of hiumic acid to storage soil iron in a form that is readily absorbed and metabolic. This phenomenon can be effective in alkaline and calcareous soils that are usually having deficiency of organic materials and absorbable iron. Verlinden et al (2010) studied the effects of hiumic acid on several Grass. They found that hiumic acid increases herb pasture. Taher and colleagues (2011) examined the effect of different levels of hiumic acid on wheat plants. The results showed that the levels of hiumic acid have significant difference between shoot weight and plant height and the amount of nitrogen in wheat grown. Bulent et al(2009) in a study about the impact of hiumic acid on Triticum durum Salihli have found that hiumic acid increases the absorption of phosphorus, potassium, magnesium, sodium, copper, and zinc. One of the advantages of hiumic acid is its effect on various nutrients such as sodium, potassium, magnesium, zinc, calcium, iron, copper and other elements in order to overcome nutrient deficiencies, which increase the length and weight of roots and beginning of lateral roots (Aiken et al., 1985).

Thus, according to the importance of micronutrients in crop improvement and environmental protection, this study was conducted in order to examine micronutrients and hiumic acid spraying through fertilizer irrigation method on qualitative and quantitative characteristics of sugar beet.

Materials and Methods:

The experiment was performed in 1391-1392 in a research farm (located at 56 degrees and 57 minutes until 58 degrees and 7 minutes of east longitude and 36 degrees and 40 minutes until to 37 degrees, 17 minutes of north latitude, at an altitude of 1260 meters above sea level). The experiment has been done in a randomized complete block design with three replications.

The first treatment contains spraying with complete micro fertilizer in both 1 and 2 liters per hectare and hiumic acid at two levels: 2.5 and 5 liters per hectare. The second treatment that had been done in 3 stages includes 8 leaves, 16 leaves and 30 leaves and no fertilizer (control) treatment. Each plot consists of six lines with a length of 4 meters. The distance between rows and the distance of plant on the line was considered 50 cm and 16 cm respectively. Deep plowing action was taken in the fall in order to prepare the seedbed. Light plowing, disc, leveling and marking was performed in spring. Nitrogen fertilizer was used in two parts. One part was coincides with the planting and the next part was after thinning and weeding and full deployment of plants (6 leaves stage) in the farm. SPSI004 was cultivator number and seeding was taken in third of June. Harvest was in late of November 1392 from the four midfield in three-square meters.

Roots harvested from each plot were washed and then has been weighted, then, pulp roots of each sample was taken in laboratory of research and sugar beet agriculture services company of Khorasan. The sugar percentage in pulp sample was measured using Polari metric method and impurity concentrations of sodium, potassium was measured by flame photometry method, and harmful nitrogen concentration was estimated using blue number with the use of Botalayzer. Molasses sugar was estimated using the Branshevik formula and other qualitative parameters were calculated according to standard formulas (Abdollahian noghabi et al., 2005).

According to the concentration of impurities of recoverable sugar, molasses sugar percentage and sugar yield and turbidity coefficients were calculated based on the following relationships:

Percentage of recoverable sugar= percentage of molasses sugar - sugar percentage

molasses sugar percentage = 0/12 (sodium + potassium) + 0/24 (harmful nitrogen) + 0/36

Sugar extraction coefficient =

Percentage of recoverable sugar / sugar content * 100

Alkalinity ratio = sodium + potassium / harmful nitrogen

The collected data have been analyzed based on complete randomized block design with the help of SAS software and the average comparison has been done using LSD method at the level of 1%.

Results and discussion

The results of analysis of variance showed that there are significant difference among different levels of spraying micronutrient, hiumic acid elements and controls on the performance of the root, the amount of sugar, the amount of potassium and amino nitrogen, alkalinity, sugar, molasses and sugar extraction coefficient in the level of 1% (table 1).

Table 1:variance analysis of quantitative and qualitative traits of sugar beet

S.O.V	DF	Yield of root	Sugar content	Potassium	Sodium	Amino nitrogen	alkalinity factor	White sugar content	Sugar content coefficient	Molasses sugar
Block	2	0.0203	0.016	0.042	0.040	0.0548	0.29	0.032	0.25	0.005
treatment	12	13.685**	1.756**	0.457*	0.322**	0.37**	1.634**	2.38**	5.361**	0.058**
Error	24	0.030	0.189	0.185	0.100	0.07	0.41	0.24	0.571	0.009
C.V. (%)	-	0.0414	2.611	7.785	17.011	14.534	14.55	3.30	0.847	5.304

* and **: Significant at 5% and 1% probability levels, respectively

Hiumic acid treatment had the highest performance with Patients with five liters per hectare and of fertilizer, watering in three stages (H2S3) with 44.053 tons per hectare and control treatment had the lowest root performance with 36.5 tons per hector. The results show that hiumic acid cause 8% performance increase in comparison with the control group. According to the study of cordeiro and colleagues (2011) hiumic acid can have positive effect on plant physiology and develop lateral roots. He and his colleagues examined the impact of hiumic acid on the root growth of maize and found hiumic acid can cause the development of maize roots with 3 milli molar in the presence of low and high dozes (no 3) and would increase the weight of fresh and dry roots. Hiumic acid increases plant performance through positive physiological effects such as the effect on the metabolism of plant cells and increasing the yield of leaf chlorophyll concentration (Nardi et al., 2002). Sugar beet root yield increase of 37% has been reported with the use of zinc (Mahmood and Hossain., 1998).

According to the results, consumption of micronutrients elements and hiumic acid in both the amount and in three different times increases the root performance in comparison with the lack of use of them. This could be due to the activities effects of all these elements on cell enzymeernandez et al, 2004).

Maximum sugar content was obtained by 73/17% of hiumic acid treatments in two-irrigation fertilizer (H1S2) steps with two and half liters per hectare. Iron bioavailability significantly increases stomatal opening that is the result of iron effects in chlorophyll synthesis. This can lead to an increase in photosynthesis ability and more asymylat allocation to sugar producing metabolism in plants such as sugar beet (Shiemshi, 2007).

Table 2:The mean effect of foliar micro-nutrients and humic acid on yield and quality of sugar beet

treatment	Yield of root ton per hectare)(	Sugar content	Potassium	Sodium	Amino nitrogen	Alkalinity factor	White sugar (%)content	Sugar content (%)coefficient	Molasses (%)sugar
index	36.5 i	14.93 f	5.97 ab	2.61 a	2.36 ab	3.68 c	12.85 f	86.08 e	2.07 a
M1S1	38.44 h	16.62 bcde	6.12 a	1.85 bc	1.74 c	4.57 abc	14.85 bcde	89.36 bc	1.76 cde
M1S2	39.97 f	17.1 abc	4.73 c	1.73 bc	1.73 c	4.23 bc	15.35 abc	89.72 abc	1.75 cde
M1S3	41.87 c	16.85 abcde	5.51 abc	1.86 bc	1.93 abc	3.84 c	15.06 abcd	89.4 bc	1.78 bcd
M2S1	40.46 e	17.41 ab	5.09 bc	1.48 c	1.47 dc	4.52 abc	15.79 ab	90.68 ab	1.62 de
M2S2	42.80 b	17.11 abc	5.36 abc	1.50 c	1.55 dc	4.43 bc	15.44 abc	90.18 ab	1.67 cde
M2S3	43.18 b	17.08 abcd	5.47 abc	1.59 bc	1.82 bc	3.97 c	15.32 abc	89.66 abc	1.76 cde
H1S1	39.45 g	17.16 abc	5.61 abc	1.66 bc	1.68 dc	4.36 bc	15.41 abc	89.74 abc	1.75 cde
H1S2	41.7 cd	17.73 a	5.07 bc	1.62 bc	1.14 d	5.96 a	16.17 a	91.21 a	1.55 e
H1S3	42.05 c	15.91 fe	5.61 abc	2.08 abc	2.41 a	3.23 c	13.93 fe	87.52 de	1.98 ab
H2S1	41.44 d	16.35 cde	5.63 abc	2.00 abc	1.86 abc	4.1 c	14.54 cde	88.98 bcd	1.80 bcd
H2S2	43.14 b	15.96 e	5.66 abc	2.31 ab	1.79 bc	4.48 bc	14.1 de	88.29 cd	1.86 abc
H2S3	44.053 a	16.1 de	5.94 ab	1.82bc	1.40 dc	5.65 ab	14.39 cde	89.38 bc	1.70 cde
LSD (0.01)	0.38	0.99	0.98	0.72	0.58	1.45	1.11	1.72	0.21

Mean with the same letters in each column don’t have significant differences at the 1% probability level

The lowest sugar percentage belongs to the control treatment that is equivalent to 14.93 percent compared to the other treatments.
The maximum amount of potassium has been gained with 6.12 mEq per 100 g sugar beet pulp roots from micronutrient elements spraying equal to one-liter per hectare and in one spraying step (M1S1).
The lowest amount of potassium belongs to micronutrient elements spraying about one liter per hectare and in two stages of spraying (M1S2) that is equal to 4.73 mEq per 100g sugar-beet pulp roots.
The greatest amount of sodium was obtained from the control treatments equal to 2.61 mEq in each 100 g of pulp sugar beet and the lowest amount of sodium of spraying treatments was gain in 2 liters per hectare and in one and two spraying stages (M2S2, M2S1) that are equal to 1.48 and 1.5 mEq per 100 g of sugar beet pulp respectively.
The maximum amount of harmful nitrogen belongs to control treatment that is equal to 2.63 mEq for per 100 g sugar beet pulp and its minimum amount of spraying treatments are about one liter per hectare and 1.74 and 1.73 in one and two spraying steps(M1S2, M1S1). Sugar beet quality increase has been done through increasing sugar percentage and reducing harmful non-sugar elements such as nitrogen, sodium, and potassium. Because the increase of these impurities reduces sugar recoverability through preventing sucrose, crystallization and increasing the amount of produced molasses (Alimoradi, 1998؛،Dunham et al., 1992 ؛ Winter and Smith, 1990).

The minimum and maximum of the recoverable sugar content belong to the control treatments (12.85%) and hiumic acid one liter per hectare and in in two irrigation fertilizer (H1S2) is 16.17%.
The maximum and minimum of extraction rate of sugar belong to H1S2 and control treatments are equal to 91.21 % and 86.08 % respectively.
The most percentage of molasses sugar belongs to control treatments (2.07%) and the lowest percentage of it belongs to H1S2 (1.55%).
Sugar beet quality is determined by some criteria such as the high percentage of gross sugar, low amount of harmful elements such as nitrogen, sodium, and potassium. Optimal extraction rate of sugar beet depends on the lowest amount of nitrogen, sodium, and potassium (Kochaki et al, 1993).
H1: hiumic acid in an amount of 2.5 liters per hectare
H2: hiumic acid in an amount of 5 liters per hectare
M1: micro elements in the amount of 1 liter per hectare
M2: Micro-elements in the amount of 2 liters per hectare
S1: 8 leaves stage S2: 8 and 16-leaves stage S3: Stage 8, 16 and 30 leaves

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