Investigating the effect of silicon and potassium foliar spraying and additional soil application of potassium on quantitative and qualitative yield of sugar beet (*Betavulgaris* L.) under moisture stress conditions

M. Farazi[1], M. Goldani[2], M. Nasiri Mahallati[3], A. Nezami[4], J. Rezaei[5]

1. Ph.D. student Ferdowsi University of Mashhad.
2. Associate Professor, Faculty of Agriculture, Ferdowsi University of Mashhad, (Corresponding author)
3. Professor of Agricultural Sciences Faculty of Ferdowsi University of Mashhad
4. Professor of Agricultural Sciences Faculty of Ferdowsi University of Mashhad
5. Sugar Beet Research Department Khorasan Razavi Agricultural and Natural Resources Research and Education Center, AREEO, Mashhad, Iran

Received: April 2018 Accepted: October 2018

Extended Abstract

Farazi, M., Goldani, M., Nasiri Mahallati, M., Nezami, A., Rezaei, J., Investigating the effect of silicon and potassium foliar spraying and additional soil application of potassium on quantitative and qualitative yield of sugar beet (*Betavulgaris* L.) under moisture stress conditions
Applied Research in Field Crops Vol 31, No. 3, 2018 1-3: 1-19(in Persian)

Introduction: Deficit of water resources is one of the limitations for sugar beet cultivation in arid and semi-arid regions (Shahbazi *et al.,* 2015) and therefore the use of compounds that can improve growth and yield of sugar beet under these restricting conditions is of the most important research priorities. Potassium plays an important role in ameliorating the injurious effects of water deficit on plants. Potassium along with other anions is involved in maintaining turgor in guard cells of stomata so that increasing concentrations of potassium in guard cells causes their osmotic potential to become more negative, resulting in the absorption of water from the surrounding cells. This makes guard cells turgid and consequently leads to stomatal opening. Silicon (Si) is a non-essential nutrient for most plants. However, in field crops, it is known to affect plant growth and quality, photosynthesis, transpiration and to enhance plant tolerance to stresses such as drought. Si increases physical and chemical defense power of plants. Si plays a significant role in modulating physiological and metabolic responses in plant. This study was conducted to investigate the role of foliar spraying of silica and potassium on sugar beet (*Beta vulgaris* L.) under deficit irrigation.

Materials and Methods: In order to study the effects of foliar spraying of silicon and potassium on yield and qualitative traits of sugar beet root under water

Email address of the corresponding author: –goldani@um.ac.ir

deficit conditions, two experiments were conducted in a split plot arrangement based on a randomized complete block design with three replications in two regions of Mashhad and Fariman. The main plots were allocated to irrigation treatments including: 100 (I_1), 75 (I_2) and 50 percent (I_3) of water requirement and the sub plots were allocated to four fertilizer levels including: control (no fertilizer application) (F_1), potassium (F_2), silicon (F_3), potassium together with silicon (F_4). Promoter system (OS-1 model) and chlorophyll meter system (Minolta 502 model) were respectively used to measure chlorophyll content and stomatal conductance. Sodium and potassium concentrations were determined by the flame photometer method and amino nitrogen content was measured by water number method using betalyzer device. Data obtained from the two regions were subjected to combined analysis using MINITAB. 17 software after confirming homogeneity of variance of the two experiments.

Results and Discussion: The results showed that interaction effects of foliar spraying of fertilizers and irrigation treatments on yield, root potassium and sodium and amino nitrogen, chlorophyll index, sugar content, extraction coefficient of sugar, leaf silicon and potassium contents and white sugar yield were significant at 1% probability level. Stomatal conductance and sugar molasses were significantly affected by the treatments at 5% probability level. Under full water application (I_1), simultaneous spraying of potassium and silicon produced synergistic effects so that root yield and white sugar yield were raised by 12.9 % and 19.79 %, respectively and amino nitrogen was lowered by 33 %. Under the mild water stress (I_2), foliar application of potassium together with silicon increased chlorophyll index by 21 % and stomatal conductance by 37 %, which resulted in increased root yield (12.5 %) and white sugar yield (11%) as compared to control. Gunes *et al,* (2008) reported that silicon can increase dry matter content in sunflower grown under drought stress. Mehrandish *et al,* (2012) showed that foliar spraying of potassium enhanced chlorophyll content in sugar beet subjected to osmotic stress. Under the severe water stress (I_3), although the simultaneous use of potassium and silicon decreased sugar molasess, sodium and amino nitrogen contents by 47 %, 26 % and 21.5 %, respectively, it did not have any significant effect on the sugar beet root yield and white sugar yield. The results indicated that when the plant was fully irrigated, the correlation between leaf potassium and silicon contents and the root and white sugar yields was positive. It seems that to obtain optimal root yield (82.16) and sugar yield (19.82), potassium and silicon contents in leaf should be at the rates of 4.5 and 3.5 mg / kg, respectively.

Conclusions: In general, it can be stated that increasing amounts of silicon and potassium in leaf through foliar spraying can improve sugar beet root yield and

white sugar yield performance under mild water stress conditions.

Keywords: Drought stress, chlorophyll index, stomatal conductance, amino nitrogen

References:

Shahbazi, H. Zolfagharan, A. Ghaemi, A. Ahmadi, M. And Mohammadian, R. 2014. Effects of different amounts of water and water on quantitative and qualitative yield of sugar beet. *Sugar Beet Journal*. 30 (2): 183-192.(In Persian)

Gunes, A. Pilbeam,D.J. Inal,A.and Coban,S. 2008. Influence of silicon on sunflowcultivars under drought stress, I: growth, antioxidant mechanisms, and lipidperoxidation. Comm. Soil Sci. Plant Analysis 39:1885–1903.

Mehrandish, M. Moeini, MJ.and Armin,B. 2012. Sugar beet (*Beta vulgaris* L.) response to potassium application under full and deficit irrigation. *European Journal of Experimental Biology*. 2(6): 2113-2119.