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Foliar Application of Potassium Fertilizer to Reduce the Effects of Salinity in Potato

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Introduction

The potato of commerce (*Solanum tuberosum* L.) is an annual dicot species. It is an autotetraploid with 4x=48 chromosomes. In Iran the consumption per capita of potato is over the 35 kg. Potato production is usually done without reducing yield in the irrigation water salinity 1-2 dS m^{-1}, but 4.2 dS m^{-1} salinity reduces yield by 26 percent. 10, 25 and 50 percent yield reduction have been reported in soil electrical conductivity 2.5, 3.8 and 5.9 dS m^{-1}, respectively . Between the ability of plant species to maintain potassium levels and their tolerance to salinity is positive correlation and on this basis nutritional irregularity due to increased salinity can be compensated by increasing of potassium fertilizer. In tolerant plant species, during times of increased salinity, selective absorption of potassium increased. The ability of plants to maintain a certain level of K/Na within the cell is essential for salt tolerance and sometimes of these ratios is used as indicators of salinity tolerance. Potato yield in response to salt stress, according to a variety of uses, can be reduced from 20 to 85 percent. Harmful effects of salinity in the beginning stages of tubers and tuber growth stage are important, therefore, tuber number and tuber size are two important components of yield which may reduce in the effect of salinity. Accelerate the aging process of the shoot, unwanted earliness, are of the reasons for the reduction in tuber size.

Materials and Methods

A field experiment was conducted in the agricultural and natural resources research center (31° 32´ N, 51° 51´ E), Isfahan, Islamic Republic of Iran. According to twenty years statistics, rainfall and temperature means for experiment location were 110 mm and 25 °C, respectively. The experiment was conducted as a factorial in a completely randomized block design with four replications. The treatments were three levels of foliar K application (control, K sulphate 10 ppm, and 2.5 ppm of potassium oxide), and the number of times foliar spray were included in one (start flowering), two (full emergence of flowers), and three (two weeks after full flowering stage) times. Potato (CV. Ramus) was planted in plots 1.5 × 6 m in February 24 and harvested in 24 May in the both years. Row and plant spacing's were 75 and 20 cm, respectively. Irrigation (furrow) was applied when the soil moisture in the root zone declined to 60-65 percent of field capacity. To determine the irrigation time tensiometers placed at 15- and 30-cm depths responded to changes in soil water. To measure the tuber yield (after eliminating the edges), the whole tuber yield was measured on each plot. Tubers with size less than 35 mm were considered as non-salable tuber yield. An irrigation water productivity index based on the formula Tanner and Sinclair (1983) was calculated. Irrigation Water Productivity = Y/WC. In this formula, Y is the product of economic performance and WC is the consumed water. During the interval between the first and last spray, pressure chamber apparatus(Arimad-2 Japan) for measuring the youngest leaves water potential was used (hours 8-6 am). During the growing season, weeds were hand-weeding. The data were subjected to analysis of variance by SAS and means Fisher's Protected LSD (5%) was used for mean separation.

Result and Discussions

The results of this study showed that salable yield with three times K sulfate spraying (Ps×3S), and potassium oxide treatments sprayed with two and three times (Po×2S and Po×3S) were significantly more than to other treatments, but did not find statistically significant differences among these three treatments. Tuber weight was the most important component that significantly affected by the interaction of potassium sprayed and its frequency. Three times foliar sprays of potassium sulfate (Ps×3S) and two and three times potassium oxide foliar application (Po×2S and Po×3S), showed 19, 17 and 21% increase in compared to the control treatment, respectively. Control, and even once treated by foliar potassium (Sulphate or potassium oxide) had lower harvest

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index values than the other treatments. The negative effect of irrigation with saline water on assimilate partitioning to the tuber is cause of the reduction of harvest index. Water use efficiency with foliar application of three times potassium sulfate or potassium oxide was 27% higher than the control treatment (4.5 kg m^{-3}). The use of sufficient potassium in such a situation is not only necessary to maintain osmotic potency, the continuation of assimilates in phloem, and loading these vessels but also plays an important role in detoxification of sodium ions. In salinity stress, accelerated aging and earliness shoot unintentionally, are the reasons for the reduction in tuber size.

Conclusions

The results showed that foliar application of potassium, especially in two or three times (depending on the type of fertilizer application) can result in harmful effects of salinity and leads to an increase in tuber yield. In relation to foliar K application, some cases are necessary: First, due to the sensitivity of potato to fungal diseases, foliar application of fungicides and K fertilizers can be simultaneously tested in salt stress conditions. Second, the salinity considered for this study was 6.1 dS m^{-1}. This amount of salinity to the potatoes is too much so it may be recommendable to spray less frequently at lower salinity levels.

Keywords: Harvest index, Salinity, Water use efficiency, Yield