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Exogenous Application of Silicon through the Rooting Medium Modulate Growth, Ion uptake and Antioxidant Activity of Barley (Hordeum vulgare L.) Under Salt Stress

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Abstract : Salt stress is an abiotic stress that causes a heavy toll on growth and development and also reduces the productivity of arable and horticultural crops. Globally, a quarter of total arable land has fallen prey to this menace, and more is being encroached because of the usage of brackish water for irrigation purposes. Though barley is categorized as salt-tolerant crop, but cultivars show a wide genetic variability in response to it. In addressing salt stress, silicon nutrition would be a facile tool for enhancing salt tolerant to sustain crop production. A greenhouse study was conducted to evaluate the response of barley (Hordeum vulgare L.) cultivars to silicon nutrition under salt stress. The treatments included [(a) four barley cultivars (Jou-87, B-14002, B-14011, B-10008); (b) two salt levels (0, 200 mM, NaCl); and (c) two silicon levels (0, 200ppm, K2SiO3. nH2O), arranged in a factorial experiment in a completely randomized design with 16 treatments and repeated 4 times. Plants were harvested at 15 days after exposure to different experimental salinity and silicon foliar conditions. Results revealed that various physiological and biochemical attributes differed significantly ($p<0.05$) in response to different treatments and their interactive effects. Cultivar “B-10008” excelled in biological yield, chlorophyll constituents, antioxidant enzymes, and grain yield compared to other cultivars. The biological yield of shoot and root organs was reduced by 27.3 and 26.5 percent under salt stress, while it was increased by 14.5 and 18.5 percent by exogenous application of silicon over untreated check, respectively. The imposition of salt stress at 200 mM caused a reduction in total chlorophyll content, chl ‘a’ , ‘b’ and ratio a/b by 10.6,16.8,17.1 and 7.1, while spray of 200 ppm silicon improved the quantum of the constituents by 10.4,12.1,10.2,10.3 over untreated check, respectively. The quantum of free amino acids and protein content was enhanced in response to salt stress and the spray of silicon nutrients. The amounts of superoxide dismutase, catalases, peroxidases, hydrogen peroxide, and malondialdehyde contents rose to 18.1, 25.7, 28.1, 29.5, and 17.6 percent over non-saline conditions under salt stress. However, the values of these antioxidants were reduced in proportion to salt stress by 200 ppm silicon applied as rooting medium on barley crops. The salt stress caused a reduction in the number of tillers, number of grains per spike, and 100-grain weight to the amount of 29.4, 8.6, and 15.8 percent; however, these parameters were improved by 7.1, 10.3, and 9.6 percent by foliar spray of silicon over untreated crop, respectively. It is concluded that the barley cultivar “B-10008” showed greater tolerance and adaptability to saline conditions. The yield of barley crops could be potentiated by a foliar spray of 200 ppm silicon at the vegetative growth stage under salt stress.

Keywords : salt stress, silicon nutrition, chlorophyll constituents, antioxidant enzymes, barley crop
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