



Silicon Priming Created an Enhanced Tolerance in Alfalfa (*Medicago sativa* L.) Seedlings in Response to High Alkaline Stress

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Alkaline stress as a result of higher pH usually triggers more severe physiological damage to plants than that of saline stress with a neutral pH. In the present study, we demonstrated that silicon (Si) priming of alfalfa (*Medicago sativa* L.) seedlings increased their tolerance to high alkaline stress situations. Gongnong No. 1 seedlings were subjected to alkaline stress simulated by 25 mM Na₂CO₃ (pH 11.2). Alkaline stress greatly decreased the biomass and caused severe lodging or wilting of alfalfa seedlings. In contrast, the application of Si to alfalfa seedlings 36 h prior to the alkaline treatment significantly alleviated the damage symptoms and greatly increased the biomass and chlorophyll content. Because of being concomitant with increasing photosynthesis and water use efficiency, decreasing membrane injury and malondialdehyde content, and increasing peroxidase and catalase ascorbate activities in alfalfa leaves, thereby alleviating the triggered oxidative damage by alkaline stress to the plant. Furthermore, Si priming significantly decreased the accumulation of protein and proline content in alfalfa, thus reducing photosynthetic feedback repression. Si priming significantly accumulated more Na in the roots, but led to a decrease of Na accumulation and an increase of K accumulation in the leaves under alkaline stress. Meanwhile, Si priming decreased the accumulation of metal ions such as Mg, Fe, Mn, and Zn in the roots of alfalfa seedlings under alkaline stress. Collectively, these results suggested that Si is involved in the metabolic or physiological changes and has a potent priming effect on the alkaline tolerance of alfalfa seedlings. The present study indicated that Si priming is a new approach to improve the alkaline tolerance in alfalfa and provides increasing information for further exploration of the alkaline stress response at the molecular level in alfalfa.

Keywords: alfalfa, alkaline stress, silicon priming, tolerance, osmolytes

INTRODUCTION

Salinity-alkalinity stress is an adverse obstacle in the production of agricultural crops and severely affects the growth of plants. Globally, it has been estimated that approximately 3.97×10^8 ha of land is affected by salt and 4.34×10^8 ha is alkaline (Martinez-Beltran and Manzur, 2005). However, alkaline soils (high pH from 8.5 to 11) endanger crop production more than soils containing excess