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Role of silicon in controlling the sodium (Na^{2+}) distribution in barley plants

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DESCRIPTION

Salinization is a global issue that gets worse due to the present climate changes. Salinity is a significant abiotic stressor today that negatively affects crop quality and output. Twenty percent of agricultural land and fifty percent of farmland worldwide, according to the United Nations Environment Program, are salt-stressed. A significant global challenge is reducing the detrimental effects of salt on plant growth. After oxygen, silicon is the second most common element in soil, and it is primarily found in the form of minerals. Si content in plants varies from 0.1% to 10%, although little is known about how it affects plant physiology. Si was shown to increase plant's resistance to a variety of conditions even though it is not classified as one of the required elements for higher plants.

There have been several hypothesized mechanisms for Si-induced plant defense;

- Mechanical defense against fungus and insects by aggregation in epidermal tissue and the development of a thick epidermal layer.
- Physiological defense due to increased plant viability brought on by improved photosynthesis and root development.
- Chemical defense *via* a reaction between pollutants in plant tissue and monosilicic acid.
- Less hazardous components are transported from the root to the leaf. High levels of mono- and polysilicic acids have been found in the plant sap, which indirectly promote these systems.

Additionally, the manufacturing of particular and generic stress hormones as well as antioxidants can be catalyzed by soluble forms of silicon.

Globally, salt stress poses a serious hazard to plant growth. Numerous studies have used physiological, molecular genetics, and genomic techniques to examine the regulatory mechanisms of silicon in reducing salt stress. The understanding of silicon's calming effects in salt-induced osmotic stress, Na toxicity, and oxidative stress has recently advanced. We highlight new research on the effects of silicon application on responses to salt stress in this article.

The following aspects will receive special attention;

- Silicon transporters have been experimentally discovered in a variety of plant species, and a structural characteristic of these transporters may serve as a significant molecular foundation for silicon permeability.
- By controlling polyamine levels and Na+ absorption, transport, and distribution, silicon may mediate salt-induced ion imbalance.
- Si-mediated activation of the aquaporin gene and osmotic adjustment are crucial in reducing the osmotic stress brought on by salinity.
- Silicon application controls antioxidant defense and polyamine metabolism to directly or indirectly reduce oxidative stress.

- Research suggests that silicon may control how plants react to salt stress by regulating the expression of several genes, including transcription factors and genes involved in hormone production. To provide a fuller understanding of the role of silicon in plants, research topics that still need to be explored are underlined.

CONCLUSION

Although Si is mostly found in soil as silica and silicates, the majority of which cannot be absorbed by plants, plants primarily absorb and use orthosilicic acid. Inadequate fertilizer application and ongoing monoculture of crops have significantly decreased the amount of silicon that plants can absorb, leading to a shortage of orthosilicic acid in soils. Silicon dissolves slowly from soil minerals. Theoretically, a reasonable use of Si fertilizers can be supported by a better understanding of the mechanisms of Si absorption and transport in plants.

Si is abundant in the Earth's crust and has favorable effects on plant growth, which have increased its significance in the agriculture sector. Our understanding of the molecular and biochemical processes of Si-regulated salt stress response is still quite restricted, despite the fact that the calming effects of Si on salinity stress have been extensively explored in laboratory and field conditions. The regulation of ion balance, hydration status, reactive oxygen species, photosynthesis, and research are the five categories into which this work gathers and analyses these systems.