Cynosa™

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Can silicon reduce the effects of abiotic stress in plants?

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Following robust research and development, Maxstim recently released its silicon based biostimulant, Cynosa. To better understand the role of silicon as a biostimulant, we've put together comprehensive technical notes demonstrating its effect on arable crops, horticulture and sports turf.

Abiotic stress can be caused by drought conditions

Is silicon an effective plant biostimulant?

Plant biostimulants have been described as any substance or microorganism applied to plants which (regardless of its nutrient content) can enhance nutrition efficiency, abiotic and biotic stress tolerance and crop quality traits. While most growers and agronomists considering the use of a biostimulant to manage abiotic and biotic stress are familiar with materials such as seaweed extracts, humic acids and protein hydrolysates, it can be a surprise to them that silicon also falls into this class of bioactive materials. Silicon has long been recognized as a non-essential element required for the growth and nutrition of plants. But numerous scientific studies have now demonstrated that silicon can also enhance the stress tolerance of a wide range of plant species encompassing arable crops, horticultural production and sports turf.

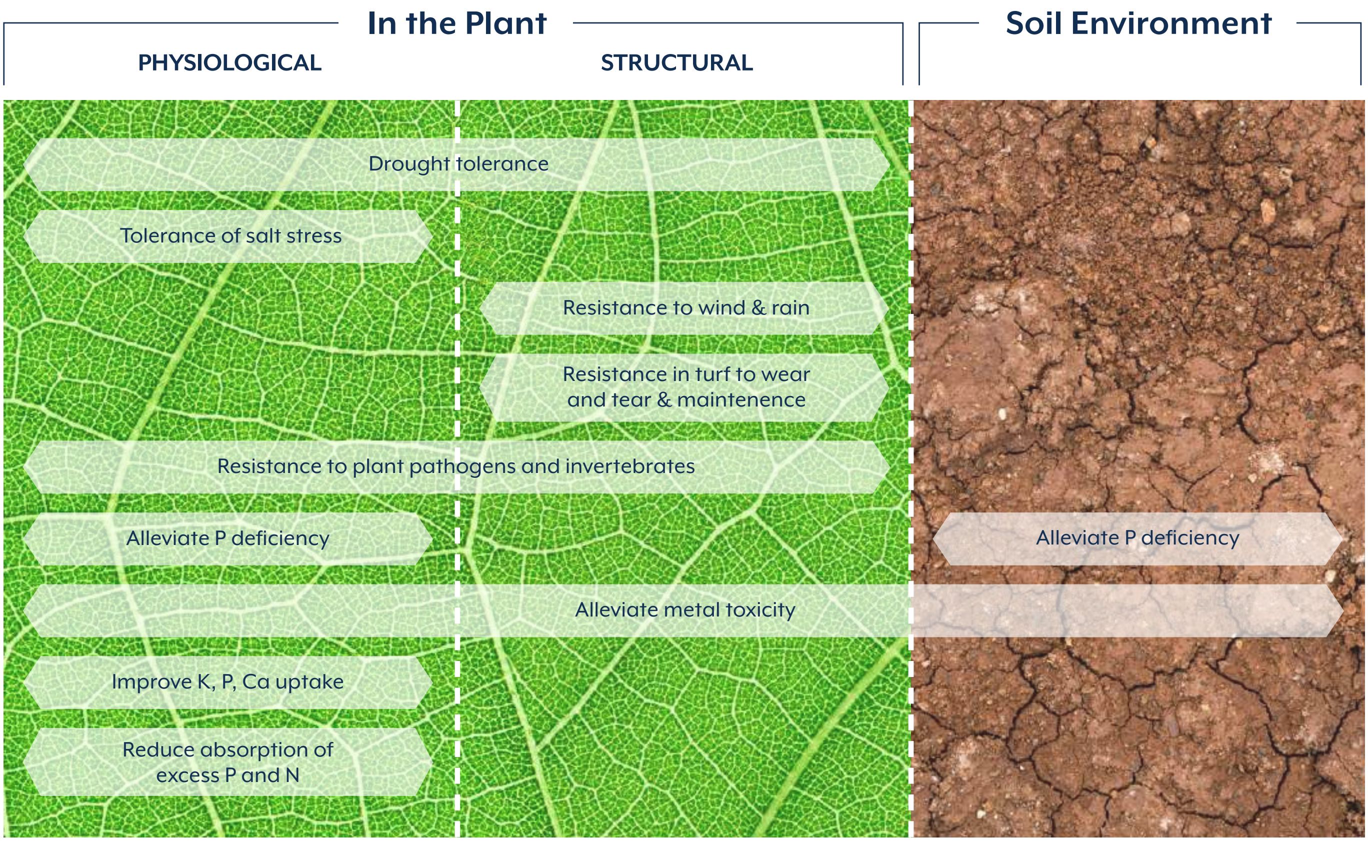
How available is silicon for plants?

In nature, silicon (Si) usually exists as silica (SiO_2) or binds with metals to form silicates. Over 50% of earth's crust and the soil mass is SiO_2. In most soil solutions and natural waters, where pH is less than 9.5, Si is present mainly as uncharged monomeric orthosilicic acid, H_4SiO_4 and is taken up by plants in this form. After uptake, SiO_2 forms and accumulates in the cells of various tissues including outer epidermis of leaves and the plant vascular system. All terrestrial plants contain Si in their tissues although the content of Si varies considerably among species, ranging from 0.1 to 10% Si on a dry weight basis. Despite the high incidence of Si in most mineral soils, there is often low availability to plants. In some cases Si deficiency can occur due to Si depletion from continuous planting of crops that demand high amounts of this element. For example, rice can remove 230 to 470 kg of Si per ha and intensive cropping results in the removal of Si from the soil solution at a rate faster than it can be replenished naturally. Silicon deficiency occurs more often in highly weathered low pH soils and heavy rainfall can cause high levels of weathering, leaching, and desilication. Due to their low mineral content organic soils can also be deficient in plant-available Si. Surprisingly, soils having a high content of quartz sand (SiO_2) are often low in plant-available Si. This is frequently the case in sand-based sports rootzones (e.g. USGA-based quartz sand greens and tees). Soil-less hydroponic cultivation is also at risk from Si deficiency and nutrient solutions may require an addition of Si to provide adequate levels of this important element.

Can silicon improve the tolerance of plants to stress?

Silicon can enhance the response of plants to stresses by:

- Modifying soil chemistry
- Enhancing plant structures to increase mechanical strength
- Modifying plant metabolic and physiological processes



Impact of silicon on abiotic and biotic stresses in plants

Can silicon reduce the effects of abiotic stress in plants?

Can silicon help manage nutrient availability?

Addition of Si to soil can have a significant impact on the nutrient availability of growing plants. In the case of phosphorus, silicon amendments can improve uptake when phosphorus levels are low and can moderate uptake when the soil has excess phosphorus. There is good evidence that addition of Si to soil and hydroponic solutions will improve absorption of Potassium, Nitrogen and Calcium.

Can silicon reduce the damage from soil pollution?

Soil contamination with trace elements (especially metals) resulting from industrial or natural contamination is widespread. Contamination results in major physiological disruptions including reduced biomass production, photosynthesis inhibition and disturbance in nutrient uptake. The value of silicon in mediating these problems is clear and will increasingly be part of the solution for such contaminated soils.

Can silicon protect plants from extreme weather?

The precipitation and deposition of amorphous silica in plants results in an increase in structural strength. Consequently, crop plants can have an enhanced resistance to mechanical stresses associated with climate change (e.g. wind, rainfall), to frost damage and there may be a greater tolerance of wear and tear in sports turfgrasses. For example, this means that cereal crops may be protected from lodging and may maintain an erect growth form, maintaining photosynthetic levels and yields. In turfgrasses, leaves and stems of plants grown in the presence of Si may also show a more upright growth, helping improve the distribution of light into the turf canopy.

Amorphous silica in plants results in an increase in structural strength

Leaves on silicon treated plants were also larger and thicker

Can silicon enhance tolerance to drought stress?

A range of experiments have shown that plants subjected to drought and treated with Si maintained higher stomatal conductance, relative water content, and water potential than non-treated plants. Leaves on silicon treated plants were also larger and thicker, thereby limiting the loss of water through transpiration and reducing water consumption. Additionally, silicon fertilization seems to modify the development of secondary and tertiary cells of the plant endodermis, thus allowing better root resistance in dry soils and promoting a faster growth of roots, all of which enhance plant tolerance of drought conditions.

Silicon induced changes in water stressed plant physiology and metabolism exposed to drought have also been observed and include stimulation of antioxidant defences which help maintain key processes such as photosynthesis.

Can silicon improve the tolerance of plants to salinity stress?

In many regions, poor quality irrigation water or elevated salt levels in rootzones can constrain plant production. Si has been shown to counteract the effects of high Na by:

- increasing the activity of antioxidant enzymes
- decreasing cell membrane permeability,
- increasing root activity allowing better absorption of nutrients
- decreasing excess sodium absorption inhibiting transport of Na to the leaves
- specific accumulation of Na in the roots

Cynosa: a new silicon based biostimulant for arable crops, horticulture and sports turf.

Our understanding of silicon as an effective biostimulant led us to develop our new product Cynosa. It has been designed to specifically strengthen plants and protect them against fungal diseases. Rich in bioflavonoids, Cynosa is a perfect companion product to use alongside Maxstim's other biostimulants and will support crop development and growth throughout a plant's lifecycle.

If you would like to understand more please get in touch to request our technical report which demonstrates product efficacy following field testing.

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