Role of phytohormone's in plant response to abiotic stress.

Sam Dion*

Department of Biotechnology, Stanford University, California, United States

Introduction

Stresses from the environment are harmful to plant growth. The main abiotic variables that control plant growth to the extent that a decrease in yield is a guaranteed result include drought, salinity, heavy metal contamination, flooding, temperature (cold and high), and UV radiation. The vegetation has changed as a result of alterations in regional climate patterns, and rising salinization and water scarcity have an impact on almost 2,000 million hectares of land globally. According to estimates, 5-7% of the world's agricultural land is damaged by salt, and around 25% of it is affected by drought. By lowering water intake and changing physiological and biochemical processes, abiotic stressors hinder plant growth. Majority of dangerous heavy metals are cadmium, lead, and mercury [1].

Phytohormone's in Plant Response to Abiotic Stress

The auxin indole-3-acetic acid (IAA) has been found to enhance a number of growth and developmental processes, including cell division, elongation, and differentiation. Auxins are significant phytohormones. Tryptophan is used to make indole-3-acetic acid, which is chemically related to tryptophan. Through modifications in gene expression patterns, auxin controlled growth and developmental processes. However, a large number of research reports are available supporting the role of auxins in mediating and improving plant tolerance to abiotic stresses. Numerous reports are available depicting various modulations in the synthesis, transport, metabolism, and activity of auxins after plant exposure to stresses. After being subjected to salinity stress, rice plants showed a discernible decrease in indole-3-acetic acid [2].

Additionally, this variance in indole-3-acetic acid has the potential to modulate growth by elevating levels of other phytohormones like abscisic acid. Auxin involvement in regulating the membrane-bound transcription factor NTM2 led to the development of auxin signalling and salt stress. Uncertainty surrounds the precise process by which indole-3-acetic acid causes a reduction in salinity. Heavy metals have a detrimental impact on the production of auxins, and auxins play a significant role in the promotion of heavy metal tolerance, whether directly or indirectly. A low dose of indole-3-acetic acid was added to the sunflower plant to reduce the harmful effects of lead (Pb), which in turn spurred increases in root volume, surface area, and diameter. In addition to increasing Pb and Zn accumulation in plant tissue, indole-3-acetic acid also caused an increase in shoot biomass [3].

Abscisic Acid

Abscisic acid, like other phytohormones, is recognised to play a significant function in plants by enhancing stress responses and adaptation. It is a sesquiterpenoid, a class of important phytohormones involved in the control of growth, which occurs naturally. Numerous studies have supported the use of ABA in integrating signals under stressful situations with the modulation of the subsequent downstream reactions. Under abiotic stress, abscisic acid-induced and -mediated signalling improved the induction of tolerance responses by regulating the expression of stress-responsive genes. Additionally, under drought-stress conditions, abscisic acid has been shown to limit root development and water content. However, a sudden rise in abscisic acid levels during stressful situations might delay growth and affect the way the body reacts to it.

However, there are indications that exogenous abscisic acid may play a beneficial role in counteracting the negative effects of stressors such salinity, chilling, drought, and cold stress. Wheat was shielded against drought-induced oxidative damage by abscisic acid through exogenous application by enhancing the antioxidant system and relative water content. Application of exogenous abscisic acid has been suggested as a useful method for stress reduction and increasing stress tolerance. By significantly raising the activity of the antioxidant enzyme peroxidase in Solanum tuberosum, abscisic acid treatment reduced the formation of free radicals and increased the plant's ability to withstand stress. Tea's proteome underwent a dramatic transformation as a result of exogenous abscisic acid administration under drought-stress conditions, including modifications to proteins involved with transport, carbon metabolism, and stress tolerance. According to certain theories, abscisic acid keeps ethylene and other hormone levels stable, which keeps Zea mays shoot and root growth active. Stress enhances the synthesis and storage of abscisic acid in plant tissue. The ability of abscisic acid to operate as an anti-transpirant following the induction of stomatal closure and restriction of canopy expansion is its most crucial function, in addition to its role in signalling [4].

Salicylic Acid

Another significant phytohormone with a phenolic character is salicylic acid, which plays a significant role in modulating the activity of antioxidant enzymes to help plants tolerate stress. Water stress, salt stress, and heavy metal stress have all been claimed to be lessened by the administration of salicylic acid.

***Correspondence to:** Sam Dion, Department of Biotechnology, Stanford University, California, United States, E-mail: smdion@stanford.edu

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Through signal pathways and response mechanisms that are engaged in response to stress, salicylic acid controls a number of physiological processes essential to plant stress tolerance. There are numerous findings on salicylic acid's pain-relieving properties in plants like fava beans, maize, and wheat. In addition to reducing the detrimental effects on growth, biomass accumulation, and the antioxidant system in Vicia faba plants treated with sea water, the treatment of salicylic acid also induced an efficient accumulation of organic osmolytes, such as proline and frees [5].

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