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Opinion Article

Exploring the Role of Plant Steroids in Growth and Development

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DESCRIPTION

Plant sterols and steroid hormones, the brassinosteroids are compounds that exert a wide range of biological activities. They are essential for plant growth, reproduction, and responses to various abiotic and biotic stresses. Steroids also function as hormones in plants, regulating growth, development, and responses to environmental stimuli. These plant hormones, known as brassinosteroids, are crucial for various processes, including seed germination, cell elongation, and stress tolerance. Brassinosteroids promote cell expansion by stimulating the elongation of plant cells, resulting in increased stem and root growth. Furthermore, they contribute to plant defense mechanisms by regulating the expression of genes involved in stress response pathways. Their role in enhancing stress tolerance has garnered interest in agriculture, as it could potentially lead to the development of crops better equipped to withstand adverse environmental conditions. Beyond brassinosteroids, other plant steroids, such as gibberellins and auxins, also regulate plant growth and development. Gibberellins promote seed germination, stem elongation, and fruit development, while auxins influence tropisms (growth towards or away from stimuli) and root development. Plant steroids contribute to the fluidity and stability of cell membranes. By influencing membrane permeability and integrity, they regulate the transport of molecules into and out of cells. This is crucial for various physiological processes, such as nutrient uptake, waste removal, and cellular communication. Certain plant steroids, such as brassinosteroids, function as growth regulators. They control plant growth, flowering, and seed development. Brassinosteroids stimulate cell elongation, increase leaf expansion, promote root growth, and influence vascular development, helping plants adapt to environmental cues. Plant steroids also play a crucial role in the response to environmental stresses. They help plants withstand harsh conditions such as temperature extremes, drought, and salinity. Phytosterols stabilize cell membranes and protect against oxidative damage caused by free radicals generated during stress. Plants can also produce other sterols such as campesterol and brassicasterol. These phytosterols differ slightly in their chemical structures, allowing for specific functions within plant physiology.

Some plant steroids function as signaling molecules, transmitting signals within the plant. They can activate specific receptors and initiate a cascade of intracellular events leading to various physiological responses. These responses can include changes in gene expression, enzyme activity, or metabolic pathways. Certain plant steroids, particularly gibberellins, promote seed germination by breaking seed dormancy and initiating the germination process. They help in the synthesis of hydrolytic enzymes that break down stored nutrients in the seed, providing energy for growth. Ethylene is a plant steroid that acts as a ripening hormone. It promotes fruit ripening by triggering various physiological and biochemical changes, such as softening, color development, and flavor changes. Additionally, ethylene also influences leaf senescence, leading to the yellowing and shedding of older leaves. Plant steroids are typically produced endogenously by plants themselves, and their exogenous application is used in agricultural practices to manipulate plant growth and development for desired outcomes, such as increased crop yields, enhanced stress tolerance, and improved fruit quality. Campesterol is another prevalent plant sterol. It is often found alongside beta-sitosterol in plant sources. Like other phytosterols, it has been studied for its potential cholesterol-lowering effects. In addition steroids can have direct effects on cellular processes termed non-genomic signaling. In plants no obvious homologs of nuclear steroid receptors are known and components of BR signaling may have equivalent counterparts in mammalian non-genomic signaling. To identify components of the BR signaling pathway a genetic approach was adopted by identifying mutants that are insensitive to exogenously applied BRs.

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