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Commentary

Importance of Ethylene and Cytokinin in Plant Growth Development

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DESCRIPTION

One of the major plant adaptations that were essential for the colonization of the land was the presence of roots or structures that resemble roots. Numerous biotic and abiotic interactions are mediated by the roots, and root design is a crucial factor in influencing yield under both normal and stress circumstances, notably drought. Building a thorough picture of plant developmental and adaptation responses that directly affect crop output depends on an understanding of the variables governing root growth. The balance of three key processes i) cell proliferative activity in the Root Apical Meristem (RAM), ii) cell differentiation, and iii) elongation of cells exiting the RAM-determines the root's total growth rate. Cytokinins and ethylene are only two examples of the Phytohormones that are known to regulate all of these activities. Cytokinins have both good and negative effects on how much RAM may proliferate. Auxin and gibberellic acid interact with cytokinins to shorten the RAM by driving cell differentiation in the root transition zone. Cytokinins increase RAM size by promoting stem cell proliferation. The control of root cell elongation has been linked to cytokinin-regulated auxin transport in both ethylene-dependent and -independent ways, potentially through causing cell wall stiffness [1].

Endogenous hormonal signals and a variety of external variables both influence leaf growth and development. Phytohormones, transcriptional regulators, and mechanical characteristics of the tissue control these activities. The physiological importance of ethylene in leaf growth and development has been demonstrated using ethylene inhibitors, and its genetic significance has been demonstrated using ethylene-insensitive mutants or transgenic plants lacking the essential ethylene production enzymes. In Arabidopsis, Ethylene Response Factor 5 (ERF5) and Ethylene Response Factor 6 (ERF6) have been found to enhance leaf development in response to environmental stresses. The species used in the study and the ethylene concentration affect how leaves grow and develop. *Poa alpina* and *Poa compressa*, which grow more slowly than other Poa species, showed increased ethylene sensitivity and leaf elongation inhibition. However, the slower growing species showed a positive influence on leaf elongation rate at low ethylene concentrations, but the two fast-growing species only showed a modest inhibition at the same concentration [2-3].

At greater doses, this reaction was reversed, demonstrating an inhibitory effect. A connection exists between ethylene and plant development once mature leaves are removed. Furthermore, as compared to typical ethylene-sensitive control plants, ethylene-insensitive genotypes of the plants Arabidopsis (*Arabidopsis thaliana*), tobacco (*Nicotiana tabacum*), and petunia (Petunia x hybrid) did not exhibit an increase in the total leaf area. The rate of ethylene evolution had no relationship to the leaf elongation rate variability in maize, but treatment with ethephon, a substance that releases ethylene, increased both ethylene production and leaf area expansion (*Zea mays*). When *rhizobacteria* with increased ACC (1-aminocyclopropane-1-carboxylic acid) deaminize activity were applied to the soil surrounding pea (*Pisum sativum*) plants, ethanol has been shown to reduce the development of the leaves. Intriguingly, lettuce (*Lactuca sativa*) cultivated in enclosed spaces, where ethylene production from the plants reached stressful levels, showed the smaller leaf area. Comparatively speaking, the plants' relative leaf growth rates were lower than those of plants grown in containers where the ethylene had been removed. This decreased leaf area was a result of ethylene's indirect effects on the leaf epinasty, which had a decreased ability to absorb light and/or CO_2, and which was shown to be more sensitive to the rise in ethylene than the decline in growth. Nitric oxide (NO), which ethylene may up-regulate, as well as Reactive Oxygen Species (ROS) have both been linked to leaf growth [4].

It may be said that ethylene is essential for the growth and development of plants. There may be more than one way that ethylene influences growth and development. It activates the network of signaling pathways and affects the control of several processes through interactions with other Phytohormones. Understanding how ethylene and other Phytohormones interact to control growth and senescence may help scientists devise a potential approach for changing the molecular makeup of these hormones to induce certain responses in plants. When a plant is

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alive, ethylene and its interactions with other plant hormones have a significant impact on the transition from the vegetative to reproductive phases and senescence. This networking affects the tissues' sensitivity as well as the concentration of ethylene. There aren't many studies examining the molecular alterations in plant tissues following ethylene and other plant hormone treatments. To fully comprehend the complex network impacting important agronomic properties like yield, lifespan, and appearance, this study should be expanded to include more organs and developmental stages. The identification of novel synergistic or antagonistic interactions between ethylene and other hormones has the potential to significantly improve agricultural productivity by preventing flower ageing, extending the shelf life of flowers, and preserving the quality of climacteric fruits[5].

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