International Research Journal of Plant Science (ISSN: 2141-5447)
Vol. 14(6) pp. 01-2, December, 2023
DOI: http:/dx.doi.org/10.14303/irjps.2023.51
Available online @ https://www.interesjournals.org/plant-science.html

Opinion

Ethylene signaling in plant growth and senescence: A molecular orchestra

Nidhi Khatun*

Department of Botany, Aligarh Muslim University, India

Email: nkhatun.amu@gmail.com

INTRODUCTION

Ethylene, a simple gaseous plant hormone, holds a dual role in the orchestration of plant life. While ethylene is instrumental in promoting growth and development, it also plays a crucial role in triggering senescence and programmed cell death. This article delves into the intricate world of ethylene signaling, exploring how this molecular messenger conducts a symphony that regulates diverse aspects of plant life (Dubois et al., 2020).

Ethylene is produced in various plant tissues, primarily in response to developmental cues and environmental stimuli. The key biosynthetic pathway involves the conversion of methionine to ethylene through a series of enzymatic reactions. Once produced, ethylene is perceived by a family of receptors known as ethylene receptors or ethylene response sensors. These receptors, localized on the endoplasmic reticulum, initiate the ethylene signaling cascade upon binding to the hormone (Binder et al., 2020).

Ethylene acts as a growth-promoting hormone in certain contexts, influencing processes such as seed germination, root development, and overall plant architecture. During seed germination, ethylene production is often induced, breaking seed dormancy and initiating the growth of the seedling. In roots, ethylene modulates cell elongation and differentiation, contributing to root growth and morphology (Guo et al., 2004).

Additionally, ethylene influences shoot development by regulating processes like stem elongation, leaf expansion, and the formation of lateral branches. The hormone acts in concert with other phytohormones, such as auxins and gibberellins, to coordinate various aspects of plant growth and architecture (Ouaked et al., 2003).

Ethylene also plays a pivotal role in leaf and fruit abscission, contributing to the shedding of older leaves and ripe fruits. The hormone induces the activation of cell wall-degrading enzymes, leading to the weakening of tissues at the abscission zone. This programmed process facilitates the efficient shedding of organs and supports resource allocation to other parts of the plant (Alonso et al., 2004).

Ethylene serves as a signaling hub in the plant's responses to various environmental stresses. In conditions such as flooding, drought, and pathogen attack, ethylene levels often increase, triggering adaptive responses. Ethylene is involved in the regulation of stomatal closure, activation of defense genes, and the synthesis of secondary metabolites that enhance the plant's resistance to stressors (Pré et al.,2008).

The intricate symphony conducted by ethylene involves extensive cross-talk with other phytohormones. Notably, ethylene interacts with auxins, gibberellins, abscisic acid, and jasmonic acid, forming an intricate network of signaling pathways. This cross-talk allows plants to integrate various signals and tailor their responses based on the specific environmental and developmental cues they encounter (Czarny et al., 2006).

One of the classic responses to ethylene is the "triple response" observed in etiolated seedlings. In this scenario, ethylene inhibits the elongation of the hypocotyl, promotes the radial swelling of the hypocotyl, and enhances the curvature of the apical hook. The triple response is a protective mechanism that allows seedlings to navigate obstacles in the soil and emerge successfully into the light (Kendrick et al., 2008).

As plants progress through their life cycle, ethylene signals a shift from growth to senescence—a process vital for

Received: 01-Dec-2023, Manuscript No. IRJPS-23-122647; **Editor assigned:** 02-Dec-2023, PreQC No. IRJPS-23-122647 (PQ); **Reviewed:** 16-Dec-2023, QCNo. IRJPS-23-122647; **Revised:** 22-Dec-2023, Manuscript No. IRJPS-23-122647 (R); **Published:** 29-Dec-2023

Citation: Nidhi Khatun (2023). Ethylene signaling in plant growth and senescence: A molecular orchestra. IRJPS. 14:51.

nutrient recycling and the completion of the plant life cycle. Ethylene promotes senescence by activating the expression of genes associated with the breakdown of cellular components, chlorophyll degradation, and the remobilization of nutrients (Merchante et al., 2013).

Understanding ethylene signaling pathways has significant implications for agriculture and biotechnology. Researchers explore ways to modulate ethylene responses to enhance crop performance, optimize growth under stress conditions, and extend the shelf life of fruits and vegetables. By manipulating ethylene signaling, it becomes possible to engineer crops with improved stress tolerance, reduced post-harvest losses, and enhanced overall productivity (Yoo et al., 2009).

CONCLUSION

Ethylene signaling stands as a captivating molecular orchestra orchestrating diverse aspects of plant growth, development, and response to environmental cues. From promoting growth in seedlings to triggering senescence and abscission, ethylene's versatility underscores its importance in the intricate dance of plant life. As research continues to unravel the nuances of ethylene signaling, the potential for harnessing this knowledge to optimize crop traits and improve agricultural sustainability becomes increasingly promising. Ethylene, with its dual role as a growth promoter and senescence trigger, remains a central player in the complex regulatory networks that govern plant physiology and adaptation.

REFERENCES

Dubois M, Van den Broeck L, Inzé D. (2020). The pivotal role of ethylene in plant growth. Trends Plant Sci. 2018;23(4):311-23.

Binder BM. (2020). Ethylene signaling in plants. J Biol Chem. 295(22):7710-25.

Guo H, Ecker JR.(2004). The ethylene signaling pathway: new insights. Curr Opin Plant Biol.7(1):40-9.

Ouaked F, Rozhon W, Lecourieux D, Hirt H.(2003) A MAPK pathway mediates ethylene signaling in plants. EMBO J.22(6):1282-8.

Alonso JM, Stepanova AN.(2004) The ethylene signaling pathway. Sci. 306(5701):1513-5.

Pré M, Atallah M, Champion A, De Vos M, Pieterse CM, et al.,(2008) The AP2/ERF domain transcription factor ORA59 integrates jasmonic acid and ethylene signals in plant defense. Plant Physiol. 147(3):1347-57.

Czarny JC, Grichko VP, Glick BR.(2006). Genetic modulation of ethylene biosynthesis and signaling in plants. Biotechnol Adv.24(4):410-9.

Kendrick MD, Chang C. (2008). Ethylene signaling: new levels of complexity and regulation. Curr Opin Plant Biol.11(5):479-85.

Merchante C, Alonso JM, Stepanova AN.(2013). Ethylene signaling: simple ligand, complex regulation. Curr Opin Plant Biol.16(5):554-60.

Yoo SD, Cho Y, Sheen J. (2009). Emerging connections in the ethylene signaling network. Trends Plant Sci. 14(5):270-9.