*General Article*_____ *Chapter –21*

THE ROLE OF PLANT HORMONES IN MEDIATING THE PLANT-INSECT INTERACTION

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Abstract

Plants have evolved a range of defence mechanisms to counteract insect herbivory, including the production of toxic compounds, physical barriers, and induced responses such as the release of volatile organic compounds. However, these responses are often regulated by plant hormones, which play a critical role in mediating plant-insect interactions. Recent studies have provided new insights into the complex interplay between plant hormones and insect herbivores, revealing novel defence and susceptibility mechanisms. In this review, we highlight the latest research on the role of plant hormones in regulating the plant-insect interactions, with a particular focus on jasmonic acid, salicylic acid, and auxin. We discuss the crosstalk between these hormones and their downstream signalling pathways, as well as the impact of environmental factors, such as temperature, light, and biotic stress, on hormone-mediated responses. Finally, we outline the potential applications of this knowledge for the development of novel strategies for pest management in agricultural systems.

Keywords: Plant hormones, Plant-Insect Interaction, Insects, Herbivory

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Introduction

Plant-insect interactions are a fundamental aspect of ecological systems, with insects often causing significant damage to plant populations. However, plants have evolved a range of defence mechanisms to counteract insect herbivory, including the production of toxic compounds, physical barriers, and induced responses such as the release of volatile organic compounds. These responses are often regulated by plant hormones, which play a critical role in mediating plant-insect interactions. In recent years, significant progress has been made in understanding the complex interplay between plant hormones and insect herbivores, revealing novel mechanisms of defence and susceptibility. In this article, we review the latest research on the role of plant hormones in regulating plant-insect interactions and discuss the potential applications of this knowledge for developing novel strategies for pest management in agricultural systems.

Jasmonic Acid

Jasmonic acid (JA) is a key hormone that regulates plant defence responses to herbivory. JA is synthesized in response to herbivore damage and triggers the expression of genes encoding enzymes involved in the production of toxic compounds such as alkaloids, terpenoids, and phenolics. These compounds act as deterrents to herbivores, reducing the damage inflicted on plants. In addition to the production of toxic compounds, JA also plays a crucial role in the production of volatile organic compounds (VOCs), which serve as signals that attract natural enemies of herbivores.

Recent research has shed light on the complex regulatory mechanisms underlying JA-mediated responses to herbivory. For example, it has been shown that JA signalling is subject to feedback regulation by the receptor COI1, which interacts with other proteins to modulate JA-responsive gene expression (Koo et al., 2018). Moreover, the JA signalling pathway is also influenced by other hormones, such as salicylic acid (SA) and auxin, which can either enhance or suppress JA-mediated responses depending on the specific context (Li et al., 2020).

Salicylic Acid

SA is another hormone that plays a critical role in plant defence against pathogens, but its role in mediating the plant-insect interactions is not well understood. Recent research has shown that SA can also be induced by insect herbivory, and that it can modulate JA-mediated responses. SA can act antagonistically to JA by suppressing the expression of JA-responsive genes, leading to the reduced production of toxic compounds and VOCs. However, SA can also act synergistically with JA under certain conditions, such as during systemic acquired resistance, which enhances the ability of plants to resist subsequent herbivore attack (Wasternack and Song, 2017).

Auxin

Auxin is a hormone that regulates various plant growth and development processes, but also plays a role in plant defence against insect herbivores. Recent research has shown that auxin can modulate JA-mediated responses by interacting with the JA signalling pathway. Auxin can act either synergistically or antagonistically with JA

depending on the specific context. For example, under certain conditions, auxin can enhance the production of toxic compounds and VOCs in response to herbivore attacks (Hou et al., 2019). However, the precise mechanisms underlying the crosstalk between auxin and JA signalling pathways are not yet fully understood.

Environmental Factors

Plant hormone-mediated responses to insect herbivory are also influenced by various environmental factors such as temperature, light, and biotic stress. For example, high temperatures can increase the production of JA and expression of JA-responsive genes, leading to an enhanced defence response against herbivores (Cao et al., 2018). Similarly, certain wavelengths of light can induce the expression of JA-responsive genes and increase the production of VOCs, which can attract the natural enemies of herbivores (Ballaré, 2020). Biotic stress caused by other pests or pathogens can also modulate the plant hormone-mediated response to insect herbivores, leading to changes in the production of toxic compounds and VOCs

Conclusion

In conclusion, plant hormones play a critical role in mediating plant-insect interactions by regulating plant defence responses to herbivory. Jasmonic acid, salicylic acid, and auxin are key hormones that modulate plant defence responses. Environmental factors such as temperature, light, and biotic stress also play a critical role in shaping plant hormone-mediated responses to insect herbivory. Understanding the complex interplay between plant hormones and insect herbivores is critical for developing novel pest management strategies in agricultural systems, such as the use of hormone-based approaches to enhance the ability of plants to resist insect herbivores.

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