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Elicitors in Fruit Crops: Role in Enhancing Fruit Quality Traits

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Plants are constantly exposed to a range of stress factors, both biotic (such as bacteria, fungi, insects, and viruses) and abiotic (like salinity, drought, extreme temperatures, nutrient excess or deficiency, and heavy metals). These factors result in widespread damage to plants, leading to substantial economic losses in cultivated areas. Fruit quality is significantly affected by practices prior to harvest that can affect both postharvest quality and storage life. Recently, efforts are made to preserve the shelf life of fruits by replacing synthetic preservatives with natural alternatives, and several environment friendly methods to maintain fruit quality, which includes the use of Elicitors (Defence modulators). The elicitors are the substances, which induces physiological changes in the plant cells, activating array of mechanisms that enhances the level of plant secondary metabolites, thus, improves qualitative characters of fruit. These molecules may be in the form of growth regulators, nutrient elements or any compounds that stimulate defense responses in plants. The important elicitors are Salicylic acid, Chitosan, Eugenol, Seaweed extract and micronutrient complex. (Thakur & Sohal, 2013)

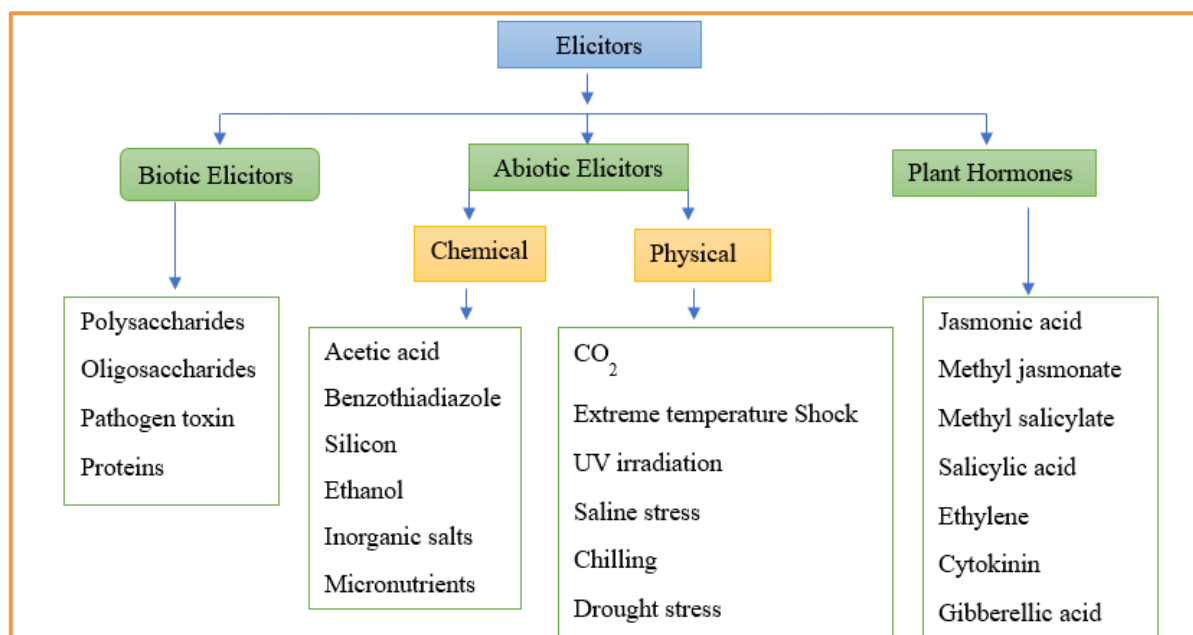
Why to focus on Elicitors?

Focusing on elicitors in fruit crop management is increasingly important, as they provide a sustainable and environmentally friendly alternative to conventional agrochemicals. Elicitors help safeguard crops from a wide range of biotic and abiotic stresses without causing ecological harm or contributing to the development of resistant pathogen strains. By activating the plant's innate defense mechanisms, they stimulate the synthesis of secondary metabolites such as phenolic compounds, which play a vital role in enhancing fruit quality, nutritional value, and antioxidant capacity. Additionally, the application of elicitors as pre-harvest sprays has been shown to significantly reduce postharvest losses, making them an effective tool to boost both crop resilience and commercial value.

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Classification of elicitors



Mechanism of Elicitors

The perception of elicitors by plants initiates a rapid sequence of defense signalling events (Fig. 1). These include accelerated ion exchange, activation of protein kinases through phosphorylation, calcium ion release and NADPH oxidase activation triggered by cytoplasmic acidification. This signalling cascade leads to the production of reactive oxygen species (ROS) and the onset of the hypersensitive response (HR), characterized by localized cell death at infection sites. HR, in turn, activates systemic acquired resistance (SAR) throughout the plant. Many elicitors also stimulate the enzyme phenylalanine ammonia-lyase (PAL), which plays a crucial role in the biosynthesis of defense-related secondary metabolites. Notably, methyl jasmonate has been reported to enhance PAL activity in crops such as sweet cherry, guava, and carrot. (Moreno *et al.*, 2018).

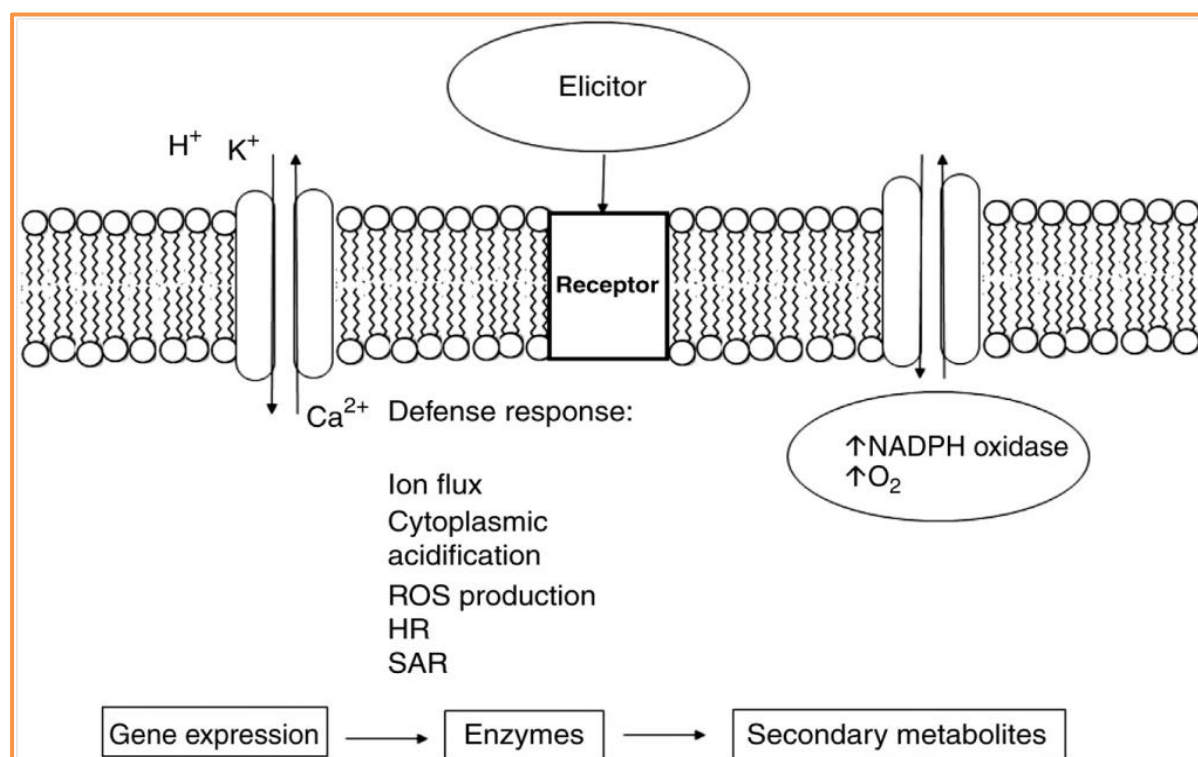


Fig.1-Responses triggered by the interaction of a plant with an elicitor
(Baenas et al., 2014).

Main functions of elicitors

Elicitors induce a range of physiological changes in plant cells, including stress responses triggered by water loss, environmental fluctuations and the activation of various defense-related enzymes. They also activate a broad array of defense mechanisms, strengthening the plant's natural resistance against biotic and abiotic stressors. Elicitors influence metabolic activity, enhancing the synthesis of secondary metabolites, which in turn improve the qualitative traits of fruits. For instance, salicylic acid (SA) has been shown to significantly induce glucose metabolism. These secondary metabolites including terpenes, steroids, phenolics, and alkaloids play a vital role in plant defense and adaptation to stress conditions. (Moreno et al., 2018).

Conclusion

The extensive use of agrochemicals in crop production has led to serious challenges such as pest resistance, pest resurgence, chemical residues, destruction of beneficial organisms, and environmental pollution. Pesticides and fungicides also pose significant health risks to farmers, consumers, and ecosystems due to their inherent toxicity. Defense modulators, such as elicitors, have emerged as promising alternatives with the potential to improve plant productivity and quality by modulating various metabolic and physiological processes. These compounds play a crucial role in activating plant defense mechanisms, thereby strengthening resistance while enhancing overall crop performance. One of the key advantages of elicitors is their low toxicity and minimal environmental impact compared to conventional agrochemicals. Their application has been shown to improve fruit quality parameters including colour, firmness, shelf life, appearance and resistance to spotting offering significant benefits to farmers aiming for higher quality and more marketable produce. Despite their potential, the use of elicitors in crop protection and pest management is still in its early stages, and there is a pressing need for large-scale agricultural and horticultural trials to validate their effectiveness and practical applicability in diverse cropping systems.

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