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Elicitors: As Plant Defense Inducers

Bhagyashree Bhatt[1] and Sudha Mathpal[2]
[1]Ph.D Scholar, Department of Plant Pathology, [2]Ph.D Scholar, Department of Entomology
College of Agriculture, GBPUAT, Pantnagar, U. S. Nagar, Uttarakhand

SUMMARY

Plants on being attacked by plant pathogens shows some defense response to prevent the losses caused by the pathogen. These defense responses can be said to functions in plants as immune system functions in case of animals, which is through overcoming the attack by several pathogens. The induction of these defence responses is triggered by several factors to which elicitors form a part. The elicitors play a major role in triggering defense response in plants. Elicitors can be abiotic or biotic, natural or synthetic. Elicitors cause a signalling cascade in plants, activating defense responsive genes and allowing the plant to resist pathogen attack .A number of compounds have been studied as potent elicitors and have been utilised successfully.

INTRODUCTION

Like every other organism, plant also have the ability to defend themselves against the pathogen attacks, though they does not have immune system as it is there in case of animals, but they can produce certain chemical compounds to resist the losses caused by plant pathogen. There are several factors which lead to the induction of defense responses in plant and elicitors forms as important part of them. Plants can activate several defense pathways depending on the type of pathogen encountered (Brugger *et al*, 2006). Jasmonic acid (JA) and ethylene dependent responses seem to be initiated by necrotrophs, whereas salicylic acid (SA) dependent response is activated by biotrophic pathogens. The mechanisms responsible for this differential recognition and response may involve crosstalk among these three different signal transduction pathways: JA, ethylene, and SA. The better understanding of plant signalling pathways has led to the discovery of natural and synthetic compounds called elicitors that induce similar defense responses in plants as induced by the pathogen infection. Different types of elicitors have been characterized, including carbohydrate polymers, lipids, glycopeptides, and glycoproteins. Most commonly used chemical elicitors are salicylic acid, methyl salicylate, benzothiadiazole, benzoic acid and chitosan which affect production of phenolic compounds and activation of various defense-related enzymes in plants.

What are Elicitors?

An elicitor can be defined as a molecule that triggers the hypersensitivity response in the plant. The term elicitor was originally used for molecules capable of inducing the production of phytoalexins, but it is now commonly used for compounds stimulating any type of plant defense (Nürnberger, 1999). Elicitors act as signal compounds at low concentrations, providing information for the plant to trigger defense, distinguishing elicitors from toxins, which may act only at higher concentrations and/or affect the plant detrimentally without active plant metabolism. Elicitors are extremely diverse molecules with no chemical similarities other than the fact that they trigger the hypersensitivity response. In some cases these elicitors are formed when plant-derived enzymes degrade fungal cell walls. For example, a beta-linked heptaglucoside has been shown to be a highly effective elicitor of the hypersensitivity response in soybean roots infected with the root-rotting fungus *Phytophthora megasperma*.

Type of Elicitors

Elicitors are classified as following (depending on their origin and molecular structure)

- Physical or Chemical,
- Biotic or Abiotic, and
- Complex or Defined.

Elicitors may be divided into two groups (on the basis of host specificity)

- General elicitors
- Race specific elicitors.

While general elicitors are able to trigger defense both in host and non-host plants, race specific elicitors induce defense responses leading to disease resistance only in specific host cultivars.

Elicitors can be further classified into two types (on the basis of origin):

- Pathogen derived elicitors (exogenous elicitor) and
- Plant derived elicitors (endogenous elicitor).

Most of the exogenous elicitors of the plant defense responses are nonspecific and differ widely in their chemical nature including protein, oligosaccharides, glycoprotein and lipids. Inducible defense responses can be triggered, not only upon the encounter of the plant tissue by pathogen, but also upon the elicitor treatment. Therefore, elicitors are now extensively used to study the molecular mechanism of defense responses. The most commonly used biotic elicitors are fungal homogenates from genera such as *Phytophthora*, *Aspergillus*, and *Alternaria*, but abiotic elicitors, e.g., inorganic salts of cadmium, copper, and vanadyl, are also effective. The use of chitosan as an elicitor has also been studied and utilised. Chitosan is widely distributed in nature and can be extracted from sources such as crab shells.

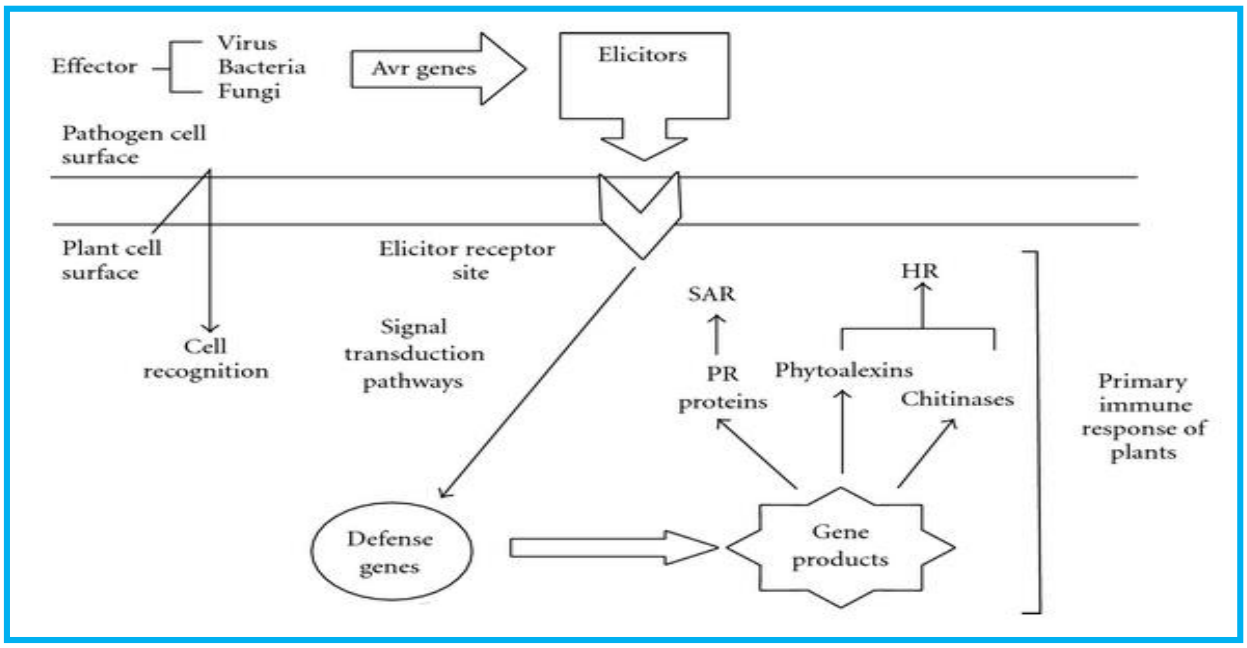

Figure 1: Role of elicitor in inducing defense response in plants (Thakur and Sohal, 2013)

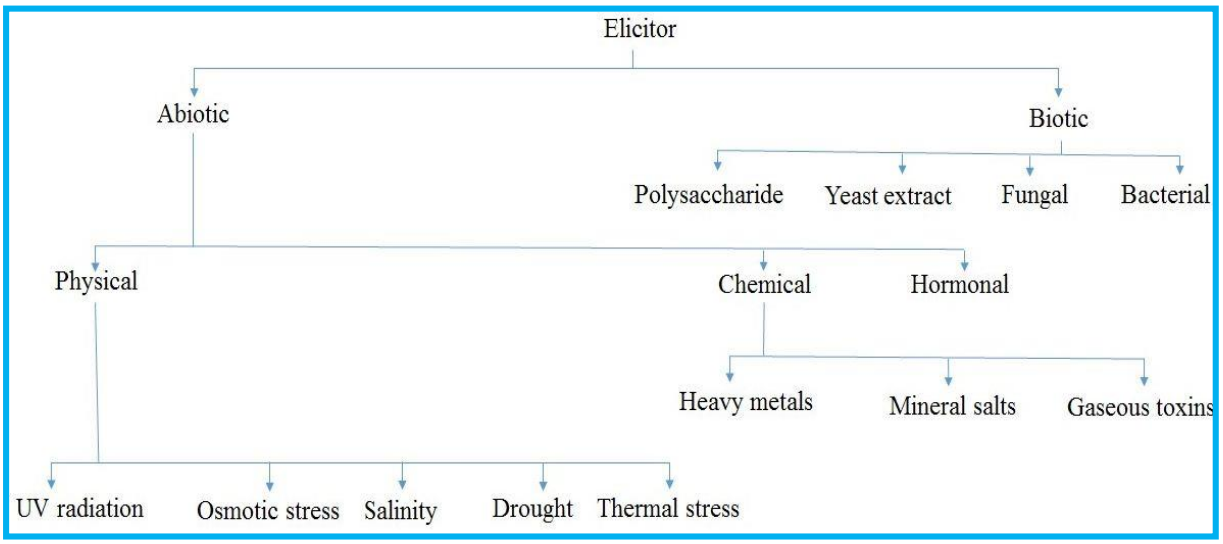

Figure2: Types of Elicitors

Advantages with use of Elicitors

- It reduces the damage caused by insects, fungi, pests, and herbivores.
- As elicitors directly affect the crop plant, and their acute toxicity to other organisms is lower than that of pesticides, thus reduces environmental hazards.
- Elicitors can be applied with the current spraying technology, as other agrochemicals.
- Elicitors can be used instead of genetically modified plants to attract natural enemies and thus reduce pest populations.
- Plants treated with elicitors bear lower ecological risks than GM plants.

Commercialised Products

Though the use of elicitors is in the initial phase, several products have been used at a commercial scale in some countries. They can also be utilised in combination with the chemical fungicides depending on their efficacy and compatibility. Elicitor as plant health promoter of annual crops under the name Bion or Actigard is available in market. Chemical inducers such as benzo (1,2,3)-thiadiazole-7- carbothioic acid-S-methyl ester (acibenzolar-S-methyl, ASM or BTH, Bion) have been developed as a potent SAR activators in several plant species. BTH is a chemical analogue of SA and has been used successfully to induce resistance to a wide range of diseases on field crops. The non-protein amino acid $\beta\beta$-aminobutyric acid (BABA) protects numerous plants against various pathogens. Several products have also been used as inducers of resistance in plants against pathogens, including chitosan, salicylic acid analogues, living or processed fungal products, and seaweed extracts. Certain synthetic compounds such as 2,6- dichloroisonicotinic acid (INA) and potassium salts has been reported to induce SAR in plants.

CONCLUSION

Management of plants disease mainly involve the use of fungicides, which give us with quick and effective results but it also has certain drawbacks such as excessive dosage may lead to phytotoxicity, residual effect of fungicides on crop produce is harmful for human health, pathogens have started developing resistance against certain fungicides, also the increasing chemical load in the environment causes environmental pollution. To overcome all these issues related to use of chemical pesticides, there is a need to look for other alternatives and use of elicitors is the most enticing alternative to be employed for the management of plant diseases.

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