International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; SP6: 788-790

Vivek Chandra Verma
Research Associate, Defence Institute of High Altitude Research-DRDO, Chandigarh, India

(Special Issue -6)
3rd National Conference
On
PROMOTING & REINVIGORATING AGRI-HORTI, TECHNOLOGICAL INNOVATIONS [PRAGATI-2019]
(14-15 December, 2019)

Elicitors defence response in plants against pathogen infection

Vivek Chandra Verma

Abstract
Plants can activate elicitors molecules for defence pathway depending upon the pathogen encountered. Originally the term elicitors are used for molecules capable of inducing the production of phytoalexin or the compound stimulating any type of plant defence. Elicitors can be classified on the basis of origin, nature and defence response. The primary immune response of plant defence involves the recognition of pathogen (or microbe) associated-molecular patterns (PAMPs/MAMPs). PAMPs are recognized by specialized trans membrane proteins in the plant, termed pattern recognition receptors (PPRs). PPR can be suppressed by *AVR* factor which recognized by the host encoded resistance (R) proteins confer ETI (Effector triggered immunity). ETI generally associated with HR and SAR. Nitric oxide biosynthesis in plants can be achieved by two pathways: oxidative pathway and reductive pathway. Nitric oxide plays an important role in the recognition of neurotropic pathogens as well as great impact on SA and JA biosynthesis. Salicylic acid (SA) is a small phenolic compound that regulates plant resistance against bio trophic pathogen.

Keywords: nitric oxide, salicylic acid, jasmine acid, elicitor, plant-pathogen

Introduction
Plants are challenged by a variety of biotic stresses like fungal, bacterial, or viral infections. This lead to a great loss to plant yield. There are various options available for the farmers to protect their crop from the disease. Disease control is largely based on the use of fungicides, bactericides, and insecticides-chemical compounds toxic to plant invaders, causative agents, or vectors of plant diseases. Other options include development of resistant cultivars, biological control, crop rotation, tillage. Nearly all chemical pesticides or fungicides have a direct antibiotic principle. But their use at commercial level is uneconomical, application is cumbersome, and some are proved to be carcinogenic. Therefore, considerable efforts have been accomplished to devise environmental-friendly strategies for the check of plant diseases and thus to save mankind from health hazard. Elicitors are compounds, which activate chemical defines in plants. Various biosynthetic pathways are activated in treated plants depending on the compound used. Commonly tested chemical elicitors are salicylic acid, methyl salicylate, jasmine acid, chitosan, and so forth which affect production of phenolic compounds and activation of various defense-related enzymes in plants. Their introduction into agricultural practice could minimize the scope of chemical control, thus contributing to the development of sustainable agriculture (Nadia *et al*., 2007) [10]. Plants can activate separate defense pathways depending on the type of pathogen encountered (Garcia-Brugger *et al*., 2006) [3]. Jasmonic acid (JA) and ethylene dependent responses seem to be initiated by necrotrophs, whereas salicylic acid (SA) dependent response is activated.

Corresponding Author:
Vivek Chandra Verma
Research Associate, Defence Institute of High Altitude Research-DRDO, Chandigarh, India

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 (Gomez-Vasquez *et al*., 2004) [4]. Different types of elicitors have been characterized, including carbohydrate polymers, lipids, glycopeptides, and glycoproteins.

Classification of Elicitors and their mode of action

Originally the term elicitor was used for molecules capable of inducing the production of phytoalexins, but it is now commonly used for compounds stimulating any type of plant defence (Nurnberger 1999) [11]. The induction of defense responses may lead to enhanced resistance. This broader definition of elicitors includes both substances of pathogen origin (exogenous elicitors) and compounds released from plants by the action of the pathogen (endogenous elicitors) (Boller 1995) [1]. Elicitors are classified as physical or chemical, biotic or abiotic, and complex or defined depending on their origin and molecular structure. Elicitors may be divided into two groups, "general elicitors" and "race specific elicitors". While general elicitors areable to trigger defense both in host and non-host plants, racespecific elicitors induce defense responses leading to disease resistance only in specific host cultivars. A race specific elicitor encoded by or produced by the action of an avirulence gene present in a particular race of a pathogen will elicit resistance only in a host plant variety carrying the corresponding resistance gene (Hammond-Kosack and Jones, 1996) [6]. General elicitors signal the presence of potential pathogens to both host and non-host plants (Hahn, 1996) [5]. Apart from that elicitors can be classified on the basis of origin *eg.* Exogenous elicitor from pathogen while endogenous elicitor can be derived from plant origin bythe action of pathogen. Jasmonic acid, salicylic acid and ethylene are classified as endogenous elicitors. 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 (Cohn*et al.*, 2001) [1]. Elicitor signal transduction mechanism which activates plant primary immune response. Pathogen like bacteria, viruses and fungi recognizes the plant cell surface and produces *AVR* gene which act as elicitor molecule. These elicitor molecules cognise and bind at elicitor receptor site. On binding, signal transduction pathway initiated resulting in the action of defence gene which leads to the primary defence response in plants. These responses involve Hypersensitive Response (HR) and Systemic Acquired Response (SAR). Direct physiological contact between the host and infecting parasite is obviously necessary for the activation of HR. Hypersensitivity is a rapidly developing defense reaction induced in incompatible host by a plant pathogen, which results in the death of a limited number of host cells and a concomitant localization of the pathogen. Some investigators have described the HR as resembling the process of apoptosis, the principal manifestation of programmed cell death in many animal cell types (Morel and Dangl, 1997) [9]. This definition has now expanded to include defense gene expression in addition to cell death (Heath, 2000) [7]. The HR is analogous to the innate immune response found in animals. HR provides resistance to biotrophic pathogens that obtain their energy from living cells (Kumar *et al*., 2001) [8].

Role of Nitric oxide in disease resistance

Nitric oxide is potent gaseous molecules produced by oxidative pathway as well as reductive pathway by the action of enzymes. In oxidative pathway polyamines, salicylhydroxmate and L-Arginine are converted into nitric oxide by the action of polyamine oxidase and nitric oxide synthase like enzyme. The reductive pathway involves nitrate and nitrite for the production of nitric oxide (Prochazkova *et al.*, 2014) [12].

Impact of NO on SA and Jasmonic acid signalling

Nitric oxide induces ICS1 gene and induces SA pathway. When SA produces it binds to the SA receptors induced SA genes. Similarly NO induces LOX3 gene to convert α-linolenic acid into jasmonic acid shown in Fig1

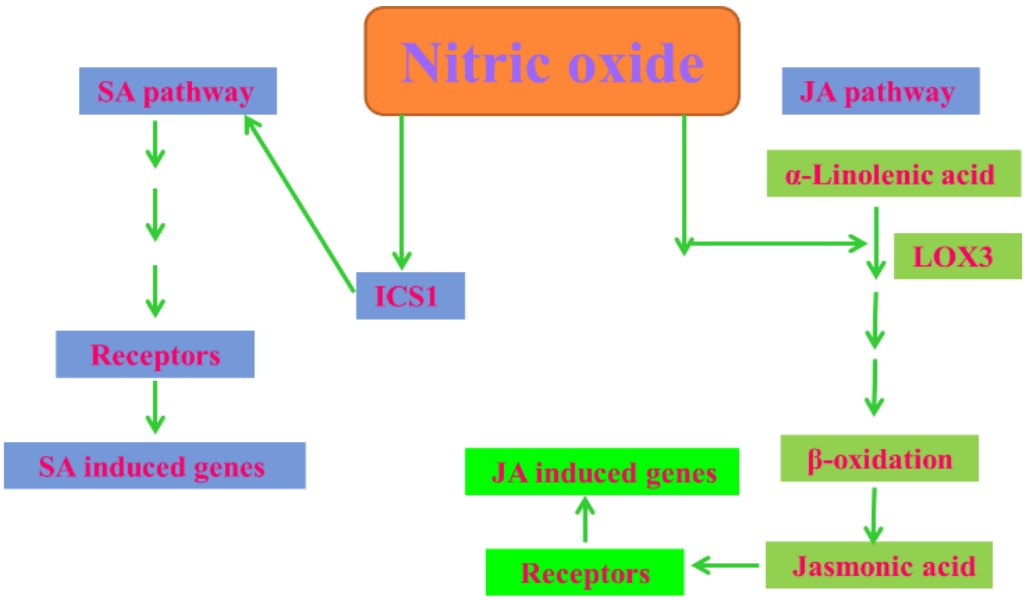

Fig1: Impact of NO in production of endogenous elicitors

Conclusion

The use of elicitors in crop protection and pest management is still in the very early stages of use as a new control method, and thus the current experiences come from experimental trials, and not yet from large scale agricultural use. Elicitor's uses can be expected to reduce damage from insects, fungi, pests and herbicides. It can minimize environmental hazards as elicitors affect directly to the plant and their acute toxicity to other organism is lower than pesticides.

Elicitor treatments could be an alternative to genetically modified (GM) plants for better attraction of natural enemies of pest organisms on cultivated plants.

References

1. Boller T. Chemoperception of microbial signals in plant cells. Annual review of plant biology. 1995; 46(1):189-214.
2. Cohn J, Sessa G, Martin GB. Innate immunity in plants. Current opinion in immunology. 2001; 13(1):55-62.
3. Garcia-Brugger A, LaMotte O, Vandelle E, Bourque S, Lecourieux D, Poinssot B. Early signalling events induced by elicitors of plant defenses. Molecular plant-microbe interactions. 2006; 19(7):711-724.
4. Gómez-Vasquez, Day R, Buschmann H, Randles S, Beeching, JR, Cooper RM. Phenylpropanoids, phenylalanine ammonia lyase and peroxidases in elicitor-challenged cassava (Manihotesculenta) suspension cells and leaves. Annals of botany. 2004; 94(1):87-97.
5. Hahn MG. Microbial elicitors and their receptors in plants. Annual review of phytopathology. 1996; 34(1):387-412.
6. Hammond-Kosack KE, Jones JD. Resistance gene-dependent plant defense responses. The Plant Cell. 1996; 8(10):1773.
7. Heath MC. Hypersensitive response-related death. In Programmed cell death in higher plants. Springer, Dordrecht, 2000, 77-90.
8. Kumar J, Hückelhoven R, Beckhove U, Nagarajan S, Kogel KH. A compromised Mlo pathway affects the response of barley to the neurotropic fungus Bipolarise sorokiniana (Teleomorph: *Cochliobolussativus*) and its toxins. Phytopathology. 2001; 91(2):127-133.
9. Morel JB, Dangl JL. The hypersensitive response and the induction of cell death in plants. Cell death and differentiation. 1997; 4(8):671.
10. Nadia G, El-Gamal G, Abd-El-Kareem F, Fotouh Y, El-Mougy, N. Induction of systemic resistance in potato plants against late and early blight diseases using chemical inducers under greenhouse and field conditions. Res. J Agric. Biol. Sci. 2007; 3:73-81.
11. Nurnberger T. Signal perception in plant pathogen defense. Cellular and Molecular Life Sciences CMLS. 1999; 55(2):167-182.
12. Prochazkova D, Haisel D, Pavlikova D. Nitric oxide biosynthesis in plants. Plant soil Environ. 2014; (60):129-34.