AgriCos e-Newsletter
ISSN: 2582-7049
Volume: 02 Issue: 08 August 2021 Article No: 11

Metagenomics and its Role in Plant Pathology

Bhagyashree Bhatt and B.K.Namriboi
Ph.D Scholar, Department of Plant Pathology, College of Agriculture, GBPUAT, Pantnagar, U. S. Nagar, Uttarakhand

SUMMARY

Plants produce some secondary metabolites which plays an eminent role in plant defense against plant pathogens. Phytoanticipins, are important constitutive compounds present in plants which have antimicrobial activity against plant pathogens. These secondary metabolites are produced through several metabolic pathways in plants and belong to different chemical classes such as fatty acids, polyketides, isoprenoids, terpenoids, shikimates, and phenylpropanoids. These compounds are known to have antimicrobial properties and thus prevent the occurrence of disease in host plants.

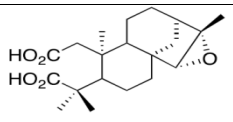
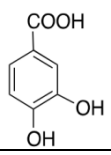
INTRODUCTION

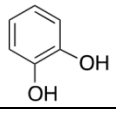
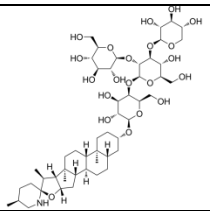
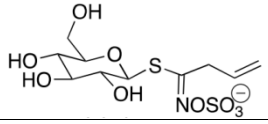
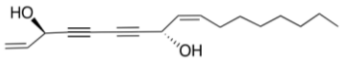
Plants, to protect themselves from the attack of pathogens, naturally synthesize some chemical compounds. These chemical compounds are the secondary metabolites which can be divided into two on the basis of their time of occurrence in plants that is compound which are produced before the attack of the pathogen are called 'Phytoanticipins 'and the compounds which are produced in response to or after the attack of the pathogen are called 'Phytoalexins'. For many decades different terms were used to describe preformed plant metabolites with roles in fighting microbial infections. The term 'phytoanticipin' was coined by Mansfield and defined in 1994 as "low molecular weight antimicrobial compound present in plants before challenge by microorganisms or produced after infection solely from preexisting constituents". The chemical structures of phytoanticipins include a huge number of scaffolds and they are derived from several plant metabolic biosynthetic pathways: fatty acids and polyketides, isoprenoids or terpenoids, shikimates, and phenylpropanoids. The plant metabolites 6-hydroxymellein from carrot, *chrysophanol* from alder buckthorn are polyketides, artemisinin from sweet wormwood, gossypol from cotton and stigmasterol from numerous species are terpenoids, and shikimic and gallic acids and pinoresinol are shikimates from various species. In addition, nicotine from tobacco, caffeine from coffee and morphine from poppy are examples of plant alkaloids biosynthesized via diverse pathways.

Detection of Phytoanticipins

Detection and isolation of constitutive metabolites that are potential phytoanticipins can be a difficult task. Antimicrobial assays need to be used to test fractions of plant extracts that may contain the potential phytoanticipin, that is bioassay-directed isolation has to be carried out. Although preliminary assays using a single fungal species may suffice, it may be useful to include in bioassays more than two species of plant microbial pathogens, otherwise ecologically important constituents could be missed. This is so because plant metabolites have selective antimicrobial activity, hence the microbial species to select for initial bioassays are important. Since different phytoanticipins belong to different chemical classes, having different properties their detection also requires different techniques such as High Performance Liquid Chromatography (HPLC), Gas Chromatography Mass Spectrometry (GCMS), Nuclear Magnetic Resonance (NMR) and many others.

Table 1: Examples of Phytoanticipins

Host Plant	Phytoanticipin	Pathogen	Structure
Rice	Oryzalic acid A	*Xanthomonas oryzae pv. oryzae*	
Onion	Protocatechuic acid	*Colletotrichum circinans*	

Onion	Catechol	*Colletotrichum circinans*	
Tomato	∝-Tomatine	*Cladosporium fulvum*	
Black mustard	Sinigrin	Against several pathogens and pests	
Carrot	Falcarindiol	*Alternaria dauci*	

Role of Phtoanticipins in Plant Defense

These plant antimicrobial compounds are likely to represent one of the first chemical barriers to potential pathogens. The distribution of preformed inhibitors within plants is often tissue specific and there is a tendency for these compounds to be concentrated in the outer cell layers of plant organs, suggesting that they may indeed act as deterrents to pathogens and pests. Some diffusible preformed inhibitors, such as catechol and protocatechuic acid (which are found in onion scales), may influence fungal growth at the plant surface. In general, however, phytoanticipins are commonly sequestered in vacuoles or organelles in healthy plants. Therefore, the concentrations that are encountered by an invading fungus will depend on the extent to which that fungus causes tissue damage. Biotrophs may avoid the release of preformed inhibitors by minimizing damage to the host, whereas necrotrophs are likely to cause substantial release of these compounds. The nature and level of preformed inhibitors to which a potential pathogen is exposed will also vary, depending on factors such as host genotype, age, and environmental conditions. However, whereas preformed inhibitors may be effective against a broad spectrum of potential pathogens, successful pathogens are likely to be able to circumvent the effects of these antibiotics either by avoiding them altogether or by tolerating or detoxifying them.

CONCLUSION

Plants do have the potential to overcome the attack of plant pathogenic microbes by production of certain chemical compounds. Though, many artificial compounds such as fungicides, antibiotics and pesticides are put to use to minimise the yield losses caused by pest and pathogens but the overuse of these compounds results in environmental pollution. Thus, use of naturally occurring compounds to defend against plant pathogens is a better alternative. With the advancement in technology and development of modern tools like High performance liquid chromatography (HPLC), Gas chromatography-mass spectrometry (GCMS), Nuclear Magnetic Resonance (NMR), there is a scope of identification and utilisation of several natural defense compounds produced by plants as a successful plant disease management strategy.

REFERENCES

Osbourn,A.E. 1996. Preformed Antimicrobial Compounds and Plant Defense against Fungal Attack. *The Plant Cell*, 8:1821-1831

Piasecka,A. Rey,N.J. and Bednare,P.2015.Secondary metabolites in plant innate immunity: conserved function of divergent chemicals, *New Phytologist*, 206: 948–96

Soledade,M. Pedras,C. and Yaya,E.E.2014. Plant Chemical Defenses: Are all Constitutive Antimicrobial Metabolites Phytoanticipins?. *Natural Product Communications,* 10 (1): 2015