

## Natural Metabolites: An Eco-Friendly Approach In Plant Diseases Management

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### Introduction

Agriculture is the primary source of livelihood for about 58% of India's population. With the advent of new techniques in agriculture crop production and cultivation has become more and more efficient but still the demand is very high because of large population. In the recent past globalisation has revolutionised food production and consumption throughout the world. One of the greatest challenges in food consumption and transportation has been seen in current COVID-19 pandemic, as global food supply chains are disrupted. The goal of sustainable and organic agriculture is to optimize the health and productivity of interdependent communities of soil life, plants, animals, and people. Plants are constantly challenged by various pathogenic microorganisms (fungi, bacteria, phytoplasma, viruses, viroids and nematodes) that decrease the quantity and quality of food, thereby pose serious threat to food security. Plant pests and pathogens cause significant reductions in crop production, with estimated global losses of 20%–40% per year. In the present scenario, current pest management relies heavily on the application of pesticides. In spite of many advantages, pesticides have harmful side effects towards non-target organisms, the resurgence of the pest population and the development of resistance. Furthermore, it is estimated that 90% of applied pesticides are lost during or after application. As a result, there is an increased motivation to develop cost-efficient, high-performing pesticides that are less harmful to the environment. The availability of innovative applications and molecular techniques opens up new possibilities in the approach to plant protection for sustainable and organic agriculture. New strategies not only directly protect plants against pathogens but can also induce enhanced immunity that permanently protects against pathogenic strains.

## Natural compounds against plant diseases

Natural bioactive compounds and bio-control agents are becoming more popular now days because of their environment friendly nature. Bioactive compounds are isolated from plant sources, algal sources, microbial sources and marine sources (Fig 1). They act as elicitors for plant defence and thereby activating resistance in plants. Majority of them are salicylic acid (SA), benzoic acid, chitosan, benzothiadiazole, alkaloids, flavonoids, terpenes, proteins, peptides, blasticidin, mildiomyacin, polyoxins, phenolic compounds, etc., which act against various phytopathogens.

Microorganisms and plants have proven to be good source of natural products such as anti insecticidal, antimicrobial agents, and antineoplastic agents. Bioactive natural products derived from these sources are also reported to have various biological activities related to human health including biofilm inhibitory, anti inflammatory, immunosuppressive, anticancer, antifungal, and antibiotic activities. Different plant extracts from leaves, seeds, stems, and even roots are reported worldwide as medicines but also as biopesticides. Diverse genera belonging to different plant families such as Apocynaceae, Flacourtiaceae, Fabaceae, Lamiaceae, and Asteraceae, are reported as potent sources of biopesticides and bioactive natural products. Resins and essential oils of different plants are used as anti microbial compounds. These essential oils are major component for making formulation of biopesticides which include *Allium sativum* (Garlic, family *Amaryllidaceae*), *Syzygium aromaticum* (clove, family Myrtaceae), *Cinnamomum cassia* and *Cinnamomum zeylanicum* (cinnamon of family Lauraceae), *Mentha piperita*, and *Thymus vulgaris* (peppermint and thyme of family Lamiaceae). Oil of tea plants is enriched in terpenes and terpinene which were having antimicrobial activities and also used as biopesticides against viruses and plant fungal infections by infecting membrane integrity. Members of family polygonaceae i.e., *Reynoutria sachalinensis* is known to produce salicylic acid and also reported to show resistance to phytopathogens and play an important role in acquiring systemic resistance. Similarly, phenolic compounds contribute to host plant resistance against pathogens, insects and herbivores. Plants are rich source of flavonoids and more than 5000 flavonoids have been reported. They play an important role in imparting resistance in plants. Several flavones such as flavonols, flavones, proanthocyanidins, flavan-3-ols, flavonones, flavans, and isoflavonoids etc function against many insect pests and pathogens.

Biological control is one of the most interesting alternatives to chemical control. It involves the use of antagonistic microorganisms to suppress pathogens and pests. The growth of pathogens and pests is restricted by beneficial microbes that involve several mechanisms such as production of antimicrobial compounds, production of hydrolytic enzymes; competition and/or immobilization of micronutrients such as Fe by siderophore production; competition for space; inactivation of germination factors; degradation of pathogenic factors; or parasitism of the pathogen and insecticides, or nematicides. Bio prospecting for microbial bioactive compounds (MBCs) produced by biocontrol agents is very important to drive plant health. A number of commercial products have been registered both at national and international levels based on different fungal and bacterial antagonists. These commercial products include, Biocon, Biogaurd, Ecofit, F-Stop, Soilgaurd etc with *Trichoderma* sp. as active ingredient, and Mycostop utilizing various *Bacillus* species as active ingredient. Genus *Streptomyces* of the family Actinobacteria has been reported for the majority of naturally producing antibiotic agents. Species of the genus *Streptomyces* are also reported to produce proteins and peptides (blastocidin, mildiomycin, and polyoxins) which are used as a defence against pathogen. Phenazines produced by different bacteria such as *Pseudomonas*, *Streptomyces*, *Burkholderia*, *Brevibacterium* and *Xanthomonas*, are known for antimicrobial activity. Similarly various other natural bioactive compounds are obtained from many marine sources and algae.

### Conclusion

In the present crop production scenario, the bio-control is of utmost importance, but its potential is yet to be exploited fully mainly because the research in this area is still confined to the laboratory and very little attention has been paid to produce the commercial formulations of bio agents. Moreover, whatever has been commercially produced has not been used efficiently by the farmers owing to the lack of information regarding its use. So to popularise the concept of biological control extension at university level in this direction needs to be improved. The application of the research to real-world producers will be of great benefit to understand any changes in behaviour of these natural extracts under environmental conditions, while further identifying the modes of action will increase the extension of applications of these extracts into fields. Recent research has shown that the molecular structures of these bioactive natural compounds can be modified and new stable molecules



can be created. Thus, these natural compounds can be used as elicitors of plant resistance against diseases.

