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Bacterial Bioagents: An Effective Tool for Plant Disease Management

Sneha R. Patil* and C. Senthilraja

[1]Dept. of Plant Pathology, [2]Dept. of Plant Protection, Horticulture College and Research Institute, TNAU, Periyakulam, Tamil Nadu (625 604), India

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Corresponding Author

Sneha R. Patil

e-mail: snhpatil70@gmail.com

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E-mail: *bioticapublications@gmail.com*

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Abstract

Crop yield is greatly hampered by the infection created by pests and pathogens. Various pathogens cause severe disease and greatly reduce the yield thus making it essential for managing these pathogens. Chemical management has been widely exploited for managing these diseases. The use of chemicals has created various issues such as residual toxicity, chemical residue in soil and final produce, soil degradation, reduction in soil fertility. To overcome these issues various new strategies have been recognized among which use of bacterial biocontrol agents is an effective tool for plant disease management. Bacterial biocontrol agents help in management of disease without creating any negative effects on the environment.

Introduction

The indiscriminate and extensive use of pesticides in recent years has posed a serious problem of pollution in the eco-system and development of resistance in the pathogens. In this context, biological control strategy of the pest management has been found eco-friendly, less expensive and offer marketable products free of hazardous chemicals. Many genera belonging to fungi, bacteria, actinomycetes and viruses are used as a biocontrol agent to combat several important plant diseases.

Biological Control

The reduction of inoculum density or disease producing activities of a pathogen or parasite in its active or dormant state, by one or more organisms, accomplished naturally or through manipulation of the environment, host or antagonist or by mass introduction of one or more antagonist.

Characteristics of Ideal Biocontrol Agents

It should grow fast. It has un-damaging nutrient and environment requirement. It should be good at primary resource capture to colonize organic, new plants and seedling. Isolation and culturing them should be easy. It should be non-pathogenic to plants, humans and domestic animals. It should be stress tolerant. It should have capacity to parasitize more than one pathogen.

Significance

- Enhanced seed germination.
- Better seedling emergence.
- Improved root system.
- Increase plant growth and development.

• Increase plant yield.

• Reduce plant diseases.

• Inexpensive.

• Environmentally safe.

Mode of Action

• **Antagonism** is the ability of one bacterium to produce adverse or negative effect on other or target bacteria is antagonism.

• **Antibiosis** is a biological interaction between two or more organisms that is detrimental to at least one of them.

• **Antibiotic production:** Antibiotic produced plays a vital role in antagonist and pathogen interaction leading to disease suppression. Certain strain of bacterial antagonist produces diffusible secondary metabolite that inhibits other bacteria and fungi.

• **Siderophore production:** Bacterial bioagents produces water soluble fluorescent siderophore, which act as high-affinity iron chelators that inhibit the growth of fungi and bacteria through iron deprivation under iron limited condition. As siderophore sequester the limited supply of iron in the rhizosphere, they limit its availability to pathogens and ultimately suppress their growth.

Limitation of Biological Control

• It is slow process as complex interaction involved in control.

• Lack of funds.

• Lack of knowledge of factors which determine survival and colonization of the pathogen and antagonist are some of the limitation for quick adoption of the technology.

Table 1: Secondary metabolites produced by bacterial biocontrol agents

Sl. No.	Bacteria	Secondary Metabolite
1	*Pseudomonas fluorescens*	2,4-Diacetylphloroglucinol, Sorbisitin Al & B, Pyrrolnitrin, Pyoluteorin, Oomycin A, Ferribactin, Ferrichrome, Ferroxamine B, Pseudobactin, Pyochelin
2	*Pseudomonas aeruginosa*	Pyoverdine
3	*Bacillus* sp.	Surfactin

Table 2: Bacterial biocontrol products in the market

Sl. No.	Biocontrol agent	Target pathogen	Product
1	*Bacillus subtilis*	*Corticium invisum, C. theae*	Biotok
2	*Pseudomonas fluorescens*	Numerous fungal diseases	Biocure-B, Bioshield, Plant biocontrol, Agent-2
3	*A. radiobacter* strain K84	*A. tumefaciens*	Diegall, Galltrol, Norbac 84c
4	*Bacillus subtilis* Strain GB 03	*Pythium ultimum, Rhizoctonia solani*	Kodaik, Companion
5	*Streptomyces griseovirdis* strain K61	*Sclerotinia sclerotiorum, S. minor, Pythium* spp.	Mycostop

Conclusion

Bacterial bioagents are potential bioagents which act against various fungal, bacterial and nemic diseases. The bacterial bioagents used alone and in combination with fungicides, amendments, fungal bioagents have given better disease control and resulted into better yield. The bacterial bioagents have helped in better germination and plant growth, besides disease suppression. Therefore, bacterial bioagents have been found as primary component in integrated crop management of soil borne and certain.

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