

## Antagonism in Rhizobacteria: Application for Biocontrol of Soil-borne Plant Pathogens

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### EDITORIAL

Rhizobacteria play an important role in plant defense and could be promising sources of biocontrol agents. Antagonism between soil microorganisms is a common phenomenon. A number of investigators' have documented antagonism of fungi, actinomycetes and true bacteria to root rot pathogens (Ortiz-Castro *et al.*, 2009). Soil bacteria, particularly rhizospheric ones with antagonistic properties, reveal biological control effectiveness to some plant diseases, and are the most likely for development of biological control agents (BCAs) (Essghaier *et al.*, 2009).

The rhizosphere of plant is a zone of intense microbial activity, and some bacteria from this zone, termed rhizobacteria, exhibit active root colonization in the presence of the existing native microflora. Various species of rhizospheric bacteria like *Pseudomonas*, *Azospirillum*, *Azotobacter*, *Klebsiella*, *Enterobacter*, *Arthrobacter*, *Bacillus* and *Serratia* and endophytic bacteria like *Pseudomonas*, *Bacillus*, *Xanthomonas* and *Erwinia* have been reported to be associated with soil crops. Bacteria are estimated to occupy between 7% and 15% of the total root surface area (Gray and Smith, 2005). Rhizo-bacteria that exert beneficial effects on plant development are referred to as plant growth-promoting rhizo-bacteria (PGPR) (Kloepper and Schroth, 1978) because their application is often associated with stimulation of plant growth. It was found that bacteria that produced more compounds associated to phytopathogen biocontrol and/or plant growth had a higher efficacy for biocontrol (Mota *et al.*, 2017).

Biological control, a bioeffector method with other living organisms to control pests (insects, mites, weeds, and plant diseases) (Flint *et al.*, 1998), has been considered as effective approaches. The use of biological control

measure is one of the best strategies available to combat the pests and diseases in an ecofriendly manner and much experimental work is being carried out all over world to assess its commercial acceptability and applicability.

Interest in biological control of plant pathogens has increased considerably over the past years, partly as a response to public concern about the use of hazardous chemical pesticides (Raaijmahers *et al.*, 2002). Most approaches for biocontrol of plant diseases have used single biocontrol agents as antagonists to a single pathogen (Siddiqui *et al.*, 2000). It is likely that most cases of naturally occurring biological control result from mixtures of antagonists for example, mixture of antagonists are considered to account for protection in disease-suppressive soils (Lemanceau and Alabouvette, 1991).

Biological control offers an important alternative to synthetic chemicals. The use of bacteria like *Pseudomonas sp.*, *Bacillus sp.*, and various other bacteria has been investigated because of their properties to produce antifungal metabolites and protect plants from fungal infection (Gupta and Kaushal, 2017). *Bacillus sp.* is considered safe biological agent and their potential as biocontrol agent is considered to be high (Kim *et al.*, 2004; Etesami and Alikhani, 2017). Bacteria are also used for biocontrol of other bacterial or fungal pathogen, viruses and nematodes (Shalaby and Sedik, 2008; Alshiby *et al.*, 2016; Murphy ET AL., 2000; Saman, 2009). The mechanisms of biocontrol adopted by rhizobacteria include the production of antibiotics, bacteriocins, siderophores, hydrolytic enzymes and other metabolites, phytoalexins production, interference in quorum sensing, reduction in ethylene production, and induction of systemic resistance.

A comparative study was conducted and *Bacillus thuringiensis* isolates were identified from different localities

of city Gujranwala which could be used as biocontrol agents (Yunus *et al.*, 2016a). Similarly from other investigations *B. subtilis* isolates were found to produce protease enzyme (Yunus *et al.*, 2017a) and Esterase enzyme (Yunus *et al.*, 2017b). A total of 56 isolates, belonging to four different strains of antibiotic producing bacteria; *B. subtilis* (30), *B. licheniformis* (9), *Streptomyces* (12) and *Actinomycetes* (5) were found from soil samples. These results suggest that soil isolates, having antibiotic producing capability can be used commercially after proper standardization (Yunus *et al.*, 2016b).

To improve efficacy of biological control, however, understanding of the mechanisms of action, nutrition, and ecology of biocontrol agents is needed. Such knowledge will lead to substantial progress in selection of superior strains, mass production, and appropriate formation of biocontrol organisms (Fravel, 1988). In vivo biocontrol agent selection is not a simple task owing to the diversity of agents and interactions with the host plant. Thus, it is required to develop efficient selection approaches to diminish costs and increase the possibility of choosing organisms that can be produced in a large scale at low cost and that retain their viability and efficiency for long periods.

## CONFLICT OF INTEREST

There is no conflict of interests regarding the publication of this paper.

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