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# Strategies to Improve Biological Control of Soilborne Plant Diseases

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## Abstract

Biological control of plant soilborne diseases has appeared as an attractive alternative to other control methods. For the biological control of plant soilborne diseases, microorganisms mainly bacteria and fungi are used, which suppress growth and virulence traits or even kill pathogens and induce plant systemic acquired resistance. In recent years, the demand for organic food increased the use of biological control agents; however, complete control of plant diseases has not been achieved yet. The beneficial microbes used for biological control of plant diseases perform admirably under controlled greenhouse conditions but are not always successful under field conditions, which highly discourages the biological control methods. Hence, complete removal of chemicals from agricultural systems may not be impossible but a logical reduction in their application is feasible. Therefore, systematic integrated methods including both chemical and biological control and other control methods like cultural practices, resistant varieties and crop rotation are highly recommended.

SCAN ME

Dear Editor,

Plant soil-borne diseases are a great threat to meet food requirements. The use of chemicals (*i.e.*, fumigation of fungicides) to control soil-borne plant diseases is creating serious environmental and health problems worldwide [1]. Hence, there is a clear need and demand for the development of non-chemical alternative strategies to protect plants against diseases. The search for alternatives leads to the emergence of numerous research projects on the biological control of plant diseases. The biological control includes the use of bacteria, fungi, phages, etc. to suppress or even kill pathogens [2]. The biocontrol agents use hyperparasitism, predation, antibiosis, cross-protection, competition for site and nutrients and induced systemic resistance as the main mechanisms of action in controlling plant diseases. Although a complete control of soil-borne plant diseases has not been achieved, the demand for the use of biological control methods is on boom both for conventional and organic farmers. The biological control strategies have shown success mainly in the greenhouses and the success rate is increasing, which suggests that the market potential of biocontrol products will increase in the future [3]. Besides, the home gardening activities are increasing with the increase in the demand for organic products that will also increase the use of biocontrol products. In the 21$^{st}$ century, more and more innovative biocontrol strategies will be developed to contribute substantially to the field of plant growth and health.

Like all other fields, if a method is not fully understood, it cannot be developed further. Similarly, there are a variety of research questions about the nature of biological control that needs to be answered. More and more advanced molecular, biochemical and bioinformatics techniques are being used by scientists, but still, some questions remain unanswered regarding the molecular ecology of plant pathogens and their antagonists in different agricultural systems [4]. This lack of knowledge leads to unreliable results of biocontrol of plant diseases, especially under field conditions. Thus, there is a great need to put more emphasis on the practical features of biocontrol formulations and their mass production to make new stable, effective, safer and cost-effective biocontrol products. There are many biocontrol products composed of microorganisms, mainly including bacteria and fungi, are being sold in the market. However, such products need to be registered considering that those are not harmful to humans and non-humans like water animals and the environment [5]. The uses and applications of commercial biological control products are slow because the performance of these products is variable under different environmental conditions, especially under field conditions [6]. This urges the need to develop new formulations of biological control agents with higher stability and consistency in efficiency. Additionally, there are some aspects of biological control, which are not given importance and needs to be included in future research strategies. These aspects include, but are not limited to, environmental impact on biocontrol agents, novel biocontrol formations, mass production of biocontrol agents and use of modern nanotechnology and biotechnology techniques to improve the success and sustainability of biocontrol methods. Besides, the genetic manipulation of biocontrol agents or even pathogens is another strategy [7]. In which, the genes responsible for biological control are identified, characterized and manipulated to improve biocontrol performance.

In modern agriculture, it is almost impossible to eliminate the use of chemicals for controlling plant pests and diseases; however, their application can be reduced to a minimum level [8]. To reduce the risks to the environment and to maintain a sustainable agricultural system with minimum contamination, integrated agriculture management should be adopted. Integrated agriculture management includes both chemical and biological control and other methods like cultural practices, resistant varieties and crop rotation to manage diseases and pest problems [9]. The use of integrated agriculture management is the safest solution to overcome pest and pathogen problems in every cropping system with minimum use of chemicals and risks to the environment. Biological control is one of the most important components of integrated agriculture management and without any doubt that can help us to obtain a sustainable agriculture system in the future. The success of integrated agriculture management depends on the use of new techniques and interests of commercial companies. In the past years, the commercial interests and prospects of integrated agriculture management are booming positively. The formation of the biopesticide industry alliance and their activities are promoting the value and efficiency of biopesticides. Undoubtedly, the future accomplishments of the biological control

industry will depend on advanced business management, product marketing, extension education and research [10].

Similarly, the use of new techniques is very important to maintain the industry value of biological control products. For example, synthetic fungicides such as benzimidazoles offer a solution to plant diseases before infection; however, such therapeutic measures are used much less in plant pathology. Systemic chemicals after application are absorbed and translocated to different parts of plant and restrict the spread and development of pathogen by direct and indirect toxic effects or by increasing the systemic resistance against pathogen [11]. For example, streptomycin, cycloheximides and tetracycline can be used to control bacterial pathogens, fungal pathogens and mycoplasmas, respectively. There is a continuous increase in the demand for biocontrol products among the farmers, which shows that the future of biological control is bright and hopeful. The use of biocontrol products can not only help in controlling plant diseases, but those also improve crop yield, protect the environment and bio-resources and keep the agriculture systems sustainable.

### Conflict of interest

The authors declare no conflict of interest.

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