Journal of Advances in Microbiology Research

E-ISSN: 2709-944X
P-ISSN: 2709-9431
JRM 2020; 1(1): 28-30

www.microbiojournal.com
Received: 16-11-2019
Accepted: 22-12-2019

Dr. Firdos Katiar
Associate Professor, Department of Botany, Christ Church College, Kanpur, Uttar Pradesh, India

Correspondence Author;
Dr. Firdos Katiar
Associate Professor, Department of Botany, Christ Church College, Kanpur, Uttar Pradesh, India

An inclusive report of Biocontrol of Soil-Borne Plant Diseases

Dr. Firdos Katiar

Abstract
Soil-borne plant diseases are caused by pathogenic microorganisms, such as fungi, bacteria, and viruses, that live in the soil and attack the roots or other parts of the plant. These diseases can cause significant damage to crops, leading to reduced yields and economic losses. Biocontrol is a method of managing plant diseases by using beneficial microorganisms or natural products to suppress or control the pathogenic ones. Biocontrol of soil-borne plant diseases is a management strategy that involves the use of beneficial microorganisms to suppress or control plant pathogens in the soil. Soil-borne plant pathogens such as fungi, bacteria, and nematodes are responsible for causing various diseases in plants, including damping-off, root rot, and wilt. Biocontrol agents (BCAs) are naturally occurring microorganisms that can be used to reduce the impact of soil-borne plant pathogens on crops. BCAs can be bacteria, fungi, or other microorganisms that colonize the roots of plants and protect them from pathogens by several mechanisms. The most commonly used BCAs for the control of soil-borne plant diseases include Trichoderma spp., *Bacillus spp*., and *Pseudomonas spp*. These BCAs have been widely studied and have shown promising results in the control of various soil-borne plant pathogens.

Keywords: Biocontrol agents, Soil-borne plant diseases, Antagonism

Introduction
Biocontrol of soil-borne plant diseases refers to the use of living organisms, such as bacteria, fungi, or other microorganisms, to control plant diseases caused by soil-borne pathogens. These microorganisms can be naturally occurring or deliberately introduced into the soil to suppress the growth and activity of soil-borne plant pathogens. The biocontrol agents used for soil-borne plant diseases can work in various ways. Some produce enzymes or other compounds that can inhibit or kill plant pathogens. Others colonize the plant roots and produce chemicals that stimulate plant growth and enhance the plant's natural defenses against pathogens.

Several biocontrol agents have been successfully used to manage soil-borne plant diseases, including Bacillus subtilis, Trichoderma spp., and Pseudomonas fluorescens. These biocontrol agents are commercially available and can be applied to the soil in various ways, including seed treatment, soil drench, or foliar spray. The effectiveness of biocontrol agents can vary depending on several factors, including the type of pathogen, the soil type, and environmental conditions. Therefore, it is important to select the appropriate biocontrol agent for a specific plant pathogen and to use them in combination with other management practices, such as crop rotation and sanitation, to achieve the best results.

Biocontrol of soil-borne plant diseases offers a sustainable and environmentally friendly approach to disease management, as it reduces the use of synthetic pesticides and chemicals, which can have adverse effects on the environment and human health. Biocontrol of soil-borne plant diseases is the use of naturally occurring microorganisms or their products to suppress or control plant pathogens in soil. The goal of biocontrol is to reduce the use of chemical pesticides and promote sustainable agriculture. There are several strategies for biocontrol of soil-borne plant diseases, including:

1. **Introduction of beneficial microorganisms:** This involves the introduction of beneficial microorganisms, such as bacteria, fungi, and nematodes that can outcompete or suppress plant pathogens in the soil. For example, certain bacteria and fungi have been shown to produce enzymes that break down cell walls of plant pathogens, thereby reducing their ability to infect plants.
2. **Enhancing natural populations of beneficial microorganisms:** This strategy involves the promotion of natural populations of beneficial microorganisms already present

in the soil. This can be achieved by adding organic matter to the soil, which provides nutrients and habitat for beneficial microorganisms, or by reducing tillage, which preserves the natural structure and diversity of the soil.

3. **Use of plant extracts or bioactive compounds:** Certain plant extracts or bioactive compounds have been shown to have antimicrobial properties and can be used as natural alternatives to chemical pesticides. For example, extracts from neem tree leaves have been shown to have antifungal properties and can be used to control soil-borne plant diseases.
4. **Crop rotation:** Crop rotation is a cultural practice that involves alternating different crops in a field to prevent the buildup of plant pathogens in the soil. For example, planting legumes such as beans or peas in a field can increase the nitrogen content of the soil and reduce the population of certain soil-borne plant pathogens.

Biocontrol of soil-borne plant diseases involves the use of beneficial microorganisms or natural products to control or suppress plant pathogens in the soil. The microorganisms used for biocontrol include bacteria, fungi, and viruses that colonize plant roots and inhibit the growth or activity of harmful pathogens. Natural products include plant extracts, essential oils, and other organic compounds that have antimicrobial properties. The main mechanisms by which biocontrol agents (BCAs) suppress soil-borne plant diseases include:

1. **Antagonism:** BCAs compete with plant pathogens for resources, such as nutrients and space, and produce antimicrobial compounds that inhibit pathogen growth.
2. **Induced systemic resistance:** BCAs induce the plant's own defense mechanisms, making it more resistant to pathogen attack.
3. **Biofumigation:** Some BCAs produce volatile organic compounds that have fumigant properties, which can kill soil-borne pathogens.
4. **Parasitism:** Some BCAs parasitize the pathogen, either by infecting it with a virus or by colonizing its host tissue.
5. **Competition:** BCAs can compete with pathogenic microorganisms for nutrients and space, thereby reducing the population of the pathogen in the soil.
6. **Antibiosis:** BCAs produce metabolites that inhibit the growth and development of pathogenic microorganisms.
7. **Mycoparasitism:** Some fungi BCAs can parasitize and kill the pathogenic fungi.

Several BCAs have been commercialized for the control of soil-borne plant diseases, including Trichoderma spp., *Bacillus spp*., *Pseudomonas spp*., and *Streptomyces spp*. Other natural products, such as garlic, neem, and chitosan, have also shown promise as biocontrol agents. Biocontrol of soil-borne plant diseases offers several advantages over chemical control methods, including reduced environmental impact and reduced risk of developing pathogen resistance. However, the efficacy of biocontrol agents can be affected by factors such as soil type, temperature, and moisture, as well as the presence of other microorganisms in the soil.

Biocontrol of soil-borne plant diseases involves the use of beneficial microorganisms to suppress or manage the diseases. Soil-borne plant diseases are caused by various pathogens that live in the soil, including fungi, bacteria, nematodes, and viruses. These pathogens can infect plant roots, leading to reduced plant growth, yield, and quality. Biocontrol agents can be naturally occurring soil microorganisms or introduced microorganisms that are selected for their ability to suppress plant pathogens. They work by either directly antagonizing the pathogen or by inducing plant defense responses against the pathogen.

Some examples of biocontrol agents used for soil-borne plant diseases include:

1. ***Trichoderma spp*.:** A group of fungi that are commonly found in soil and have the ability to produce enzymes that can degrade plant pathogen cell walls.
2. ***Bacillus spp*.:** A group of bacteria that can produce antimicrobial compounds that can inhibit plant pathogens.
3. ***Pseudomonas fluorescens*:** A bacterium that produces compounds that can induce plant defenses against pathogen attack.
4. **Arbuscular mycorrhizal fungi:** Fungi that form mutualistic associations with plant roots and can enhance plant resistance to soil-borne pathogens.
5. ***Streptomyces spp*.:** A group of bacteria that produce antibiotics that can inhibit plant pathogens.
6. **Plant extracts and essential oils:** Some plant extracts and essential oils have been shown to have antimicrobial properties and can be used as biocontrol agents against soil-borne plant pathogens. Examples include garlic, ginger, neem, and cinnamon.
7. **Bio fumigation:** Certain plants, such as Brassica species, produce natural compounds that are toxic to soil-borne pathogens. Incorporating these plants into the soil as green manure can help to reduce pathogen populations.
8. **Biological soil amendments:** Certain soil amendments, such as compost and vermicompost, can increase soil microbial diversity and activity, which can help to suppress soil-borne pathogens.

Biocontrol of soil-borne plant diseases has several advantages over chemical control methods. Biocontrol agents are environmentally friendly, safe for humans and animals, and do not leave residues on the crops. Additionally, they can be used in integrated pest management (IPM) programs to reduce reliance on chemical pesticides.

Conclusion

Biocontrol of soil-borne plant diseases is an environmentally friendly and sustainable approach to disease management that can be integrated with other management strategies such as cultural practices and chemical control methods. However, it is essential to select the appropriate BCA for a particular pathogen and crop, and also ensure that the BCA is applied at the right time and in the right manner for maximum efficacy. Biocontrol strategies can be effective in controlling soil-borne plant diseases, but they require careful selection and management of the beneficial microorganisms involved. It is important to understand the ecology of the pathogen and the biocontrol agent, and to choose the right biocontrol agent for the specific situation.

References

1. Ansari RA, Rizvi R, Sumbul A, *et al*. Plant-growth-promoting rhizobacteria (PGPR)-based sustainable management of phytoparasitic nematodes: Current understandings and future challenges. In Management of phytonematodes: recent advances and future challenges. Springer, Singapore. 2020b. p. 51-71.
2. Simpson M, McLenaghen RD, Chirino-Valle I, *et al*. Effects of long-term grassland management on the chemical nature and bioavailability of soil phosphorus. Biol Fertil Soils. 2012;48(5):607–611.
3. Singh N, Manshian B, Jenkins GJ, *et al*. Nano Genotoxicology: the DNA damaging potential of engineered nanomaterials. Biomaterials. 2009;30(23-24):3891-3914.
4. Tanović B, Gašić S, Hrustić J, *et al*. Effect of emulsifiable concentrate (EC) of oregano essential oil on Monilinia spp. In: Book of Abstracts, 5th CASEE Conference: Healthy Food Production and Environmental Preservation: The Role of Agriculture, Forestry and Applied Biology. University of Novi Sad, Faculty of Agriculture, Novi Sad. 2014. p. 48.
5. Ardakani AS. Toxicity of silver, titanium and silicon nanoparticles on the root-knot nematode, Meloidogyne incognita, and growth parameters of tomato. Nematology. 2013;15(6):671–677.
6. Culman S, Duxbury J, Lauren J, *et al*. Microbial community response to soil solarization in Nepal's rice wheat cropping system. Soil Biol Biochem. 2006;38:3359–3371.
7. Deepak S, Ashish K, Singh AK, *et al*. Induction of resistance in field pea against rust disease through various chemicals/micronutrients and their impact on growth and yield. Plant Pathol J (Faisalabad). 2013;12(2):36–49.
8. Dignam BE, O'Callaghan M, Condron LM, *et al*. Challenges and opportunities in harnessing soil disease suppressiveness for sustainable pasture production. Soil Biol Biochem. 2016;95:100–111.
9. Dignam BE, O'Callaghan M, Condron LM, *et al*. Effect of land use and soil organic matter quality on the structure and function of microbial communities in pastoral soils: implications for disease suppression. PLoS One. 2018;13(5):e0196581.
10. Arnault I, Fleurance C, Vey F, *et al*. Use of Alliaceae residues to control soil-borne pathogens. Ind Crop Prod. 2013;49:265–272.
11. Goudjal Y, Zamoum M, Sabaou N, *et al*. Potential of endophytic *Streptomyces spp*. for Biocontrol of Fusarium root rot disease and growth promotion of tomato seedlings. Biocontrol Sci Technol Taylor & Francis. 2016;26(12):1691–1705.
12. Azam A, Ahmed AS, Oves M, *et al*. Size-dependent antimicrobial properties of CuO nanoparticles against Gram-positive and-negative bacterial strains. Int J Nanomedicine. 2012;7:3527.
13. Bailey KL, Lazarovits G. Suppressing soilborne diseases with residue management and organic amendments. Soil Tillage Res. 2003;72(2):169-180.
14. Ball BC, Bingham I, Rees RM, *et al*. The role of crop rotations in determining soil structure and crop growth conditions. Can J Soil Sci. 2005;85(5):557–577.
15. Wang S, Lawson R, Ray PC, *et al*. Toxic effects of gold nanoparticles on Salmonella typhimurium bacteria. Toxicol Ind Health. 2011;27(6):547–554.
16. Weller DM, Raaijmakers JM, Gardener BBM, *et al*. Microbial populations responsible for specific soil suppressiveness to plant pathogens. Annu Rev Phytopathol. 2002;40(1):309–348.
17. Widmer TL, Mitkowski NA, Abawi GS. Soil organic matter and management of plant-parasitic nematodes. J Nematol. 2002;34(4):289.
18. Xu L, Liu Y, Bai R, *et al*. Applications and toxicological issues surrounding nanotechnology in the food industry. Pure Appl Chem. 2010;82(2):349–372.
19. Yan Y, Kuramae EE, Klinkhamer PG, van Veen JA. Revisiting the dilution procedure used to manipulatemicrobial biodiversity in terrestrial systems. Appl Environ Microbiol. 2015;81:4246–4252.
20. YankoVa, V, Valchev N, Markova D. Effectiveness of phytopesticide neem azal T/S ® against tomato leafminer (Tuta absoluta meyrick) in greenhouse tomato. Bulgarian J. Agricultural Science. 2014;20(5):1116–1118.
21. Basallote-Ureba MJ, Melero-Vara JM. Control of garlic white rot by soil solarization. Crop Prot. 1993;12:219–223.
22. Berendsen RL, Vismans G, Yu K, *et al*. Disease-induced assemblage of a plant-beneficial bacterial consortium. ISME J. 2018;12(6):1496–1507.
23. Berg G, Smalla K. Plant species and soil type cooperatively shape the structure and function of microbial communities in the rhizosphere. FEMS Microbiol Ecol. 2009;68:1-13.