Using synthetic microbial communities and prebiotics to promote plant health in a synergistic way

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ABSTRACT

In agriculture, soil-borne illnesses generate significant economic losses. Using microbial preparations to manage infections is a good way to avoid soil-borne disease. However, microbial preparations are frequently unstable, restricting their use on a broad scale. The link between carbon sources and the microbial population, as well as the application of human microbial preparation principles to plant microbial preparations, are all discussed in this paper. In addition, we suggest a novel synthetic microbial community assembly technique that includes synergistic prebiotics to promote healthy plant development and disease resistance. A novel strategy is offered in this study to enhance existing microbial preparations, get a better knowledge of the interactions between carbon sources, beneficial bacteria, and plants, and create a theoretical framework for designing new microbial preparations.

Key Words: *Prebiotics; Microorganism; Plants*

INTRODUCTION

Plant diseases are determined by the interplay between pathogens, hosts, and the environment. The source of microorganisms recruited by plant roots is determined by the environment, particularly soil properties, which has a major impact on disease outbreaks. Soil-borne plant diseases are illnesses that spread via soil and have a negative impact on crop output across the world, although some other forms of organic matter may have favorable impacts by reducing the prevalence of pathogens including Fusarium, Phytophthora, Pythium, and Rhizoctonia. If this organic matter is made up of resistant carbon resources, the soil's capacity to inhibit soil pathogens is improved, whereas the addition of labile carbon resources stimulates microbial activity in the soil due to priming effects. Studies into a strategy for manipulating microbial communities to improve the environment of plant root growth, which eventually boosts plant resistance and yields, are significant due to the breakdown of microbial communities, which promotes plant production. The consistency, composition, and abundance of the core microbial population are essential for disease-suppressive soils. As a result, in disease-suppressive soils, increased competition between microbial populations and plant pathogens may constitute a disadvantage in niche allocation. These microbial communities have the potential to adapt to a variety of environmental situations in order to ensure long-term crop production. As a result, a better knowledge of soil microorganisms and their focused alteration might lead to novel agricultural system management techniques.

Many essential elements of ecosystem function are influenced to some extent by the diversity and richness of soil bacteria and fungus. However, plant health may be harmed by nutritional imbalances and the presence of a significant number of plant pathogens in the soil. Farming, crop rotation, and burning methods have an impact on the quantity and quality of organic matter in the soil, which has an impact on soil health. Microbiome engineering technique for core microorganism inoculation improves soil health by directly adjusting the connection between microorganisms, inhibiting dangerous bacteria, and recruiting beneficial microorganisms. Although the effects of chemical control are durable, this strategy frequently pollutes the environment and encourages plant disease resistance. Researchers have made significant progress in biological agent research and development in recent years. Growth-promoting microorganisms in the rhizosphere are also essential biological control agents. As a result, research and development of environmentally friendly management strategies with long-term impacts has become increasingly vital. The effects of biological control are frequently unreliable; therefore, the synthetic microbial community provides a novel method to addressing issues with conventional microbial fertilizers. At the same time, disease-suppressive soil functions as a natural biological control agent, affecting pathogen survival, infection, and reproduction. The disease-suppressive ability of disease-suppressive soils is intimately tied to the core microbial population, its structural properties, and the nutrients in the soil. Furthermore, the potential of disease-suppressive soils to suppress illness is linked to the manner of nutrient-microbiome interaction. Disease-suppressive soils, the application of human microbial preparation principles to plant microbial preparations, and the link between carbon sources and the microbial population will all be discussed in this paper. The goal of this study is to figure out how carbon sources and microbial populations interact in this process.

The microbiota of the human intestine is a complex network of bacteria that is closely related to the host's physiological activities. Furthermore, changes in the content of nutrients in the gut alter the composition of the intestinal microbial community directly or indirectly, and changes in the intestinal microbial population affect human metabolism, which in turn affects the host's health. The plant microbiome, like the gut microbiome, plays a crucial part in the development of disease resistance in plants. Clarifying the link between community interaction traits and functions is critical for directly controlling the plant microbiome and boosting plant health. We have gained a better knowledge of the link between the microbial community and the host as a result of microbiome research. Live microorganisms like probiotics, prebiotics, synbiotic, and epibiotics have been utilized as therapeutic agents or carriers in the medical profession to alter the function or makeup of the microbiota, lowering the colonization of dangerous species and promoting microbial community equilibrium. Prebiotics are not digested and used by organisms' digestive tracts, while probiotics are absorbed and used in the rectum to increase probiotic colonization, viability, and proliferation in the gastrointestinal system. Probiotics and prebiotics are combined to create synbiotics, which are micro ecological preparations. Probiotics can aid in proliferating bacteria, improving physiological activities, and improving micro ecological and enzyme balance in the body. Similarly, the composition and amount of nutrients in the soil can influence the microbial community's makeup, activity, and function. Beneficial microbes are attracted to nutrition obtained from plant sources or other sources in order to maintain plant growth.

Beneficial microorganisms and microbial source metabolites are currently the only microbial preparations utilized to preserve or stimulate plant development in agriculture. Live helpful microorganism preparations from fermentation broth that employ porous material as adsorbents to adsorb beneficial microorganism cells after the target microorganisms have been increased through industrial production are referred to as microbial

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preparations. In the animal and plant kingdoms, the intestines of vertebrates and plant roots originated separately, although they have comparable fundamental physiological roles in terms of nutrition absorption. Only a few microbial preparations now deliver the beneficial bacteria and nutrients that these microbes require. We propose a novel helpful synthetic microbial community construction approach based on the principles of prebiotics and synbiotics, as well as literature support, with the goal of researching the link between microbial communities and hosts in order to generate new microbial agents.

CONCLUSION

Plant protection is dependent on the soil microbiome. A basic microbial community may be utilized to efficiently enhance ecological services through the construction of synthetic microbial communities. The mechanism of the nutrient-plant-microbial community interaction network, as well as the impact of nutrition on microbial community regulation, are yet unknown. Understanding how soil microbial carbon sources regulate the soil microbiome can help us construct better, more permanent synthetic microbial communities. Microbial preparations now face a number of challenges, including unstable effects and low rhizosphere competitiveness. Synthetic microbial communities might be a viable solution to these issues. Although the processes of disease suppression in soils are complicated and varied, studies have revealed that disease-suppressive soils' ability to block illness is linked to the enrichment of particular beneficial microbial communities. A synthetic microbial community that prevents the spread of soil-borne illnesses was created using microbial isolation and growth techniques. Simultaneously, we can use dietary restriction or microbiome genetic alteration to change the microbiome to serve agriculture. This synthetic microbial community assembly process not only helps us better understand the interactions among microbial communities, the mechanisms of microbial community and plant interactions, and soil microbial regulation by organic matter and root exudates in microbial communities, but it also helps us better understand the interactions among microbial communities, the mechanisms of microbial community and plant interactions, and soil microbial regulation by organic matter and root exudates in microbial communities.

Synthetic microbial communities can help us better understand how disease-suppressive soils work. The microbiome in the soil is regulated in part by the makeup of carbon sources in the soil. By introducing particular carbon sources to synthetic microbial communities, researchers may better understand the causal link between root microbiota and plant phenotypes and evaluate interactions between microbiota members under natural soil circumstances.