OPEN ACCESS Freely available online

ISSN: 2155-9597
Journal of Bacteriology & Parasitology

Short Communication

Plant-Microbe Ecology-Symbiotic Relationship of Plants and Microbial Communities

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ABSTRACT

Plant community dynamics are driven by the microbial mediation of soil resource partitioning and sharing the inhibition of other host symbionts or extensively sharing the broadly specific symbiotic fungi. The plant phenotype and ecology can be affected by the impact of the symbiotic microbes on the environment and competition for soil resources.

Keywords: Plant; Symbionts; Phenotype; Soil resources

INTRODUCTION

Plants have recently been recognized as the metaorganisms that possess a distinct microbiome and close symbiotic relationships with associated microorganisms. Plant ecology is affected by complex interactions with plant-associated microbes. The roles of both plant-associated microbes and the host in ecosystem function have been recognized, but the detailed mechanisms are unclear [1]. Since plants are immobile, they have coevolved with microbes and acquired a number of mechanisms that modulate the outcome of their interactions. Roots can continuously synthesize, accumulate and secrete a wide range of compounds into the soil, which are known as the root exudates. Root exudates contain enzymes, water, H+ ions, mucilage and carbon-containing primary and secondary compounds. Scientists have observed that the density of microbes in the rhizosphere was 100 times greater than that in the bulk soil. Recent studies have showed that plant root exudates shape the soil bacterial community. According to a study, a plant species selects a specific rhizosphere bacterial community [2].

DESCRIPTION

The change in the microbial composition generates feedback on the plant relative performance that defines the long-term effects of the soil microbes on their coexistence with that plant species. The feedback can be of two types; positive plant-soil microbial feedback reinforces the spatial separation of the microbial communities, while negative feedback results in plant replacement, which necessitates recolonization of locally specific roots [3]. Systematic methods such as genome-wide association studies have enabled us to explore the relationships of plant loci and symbiotic communities in detail. How does the microbiome diversity and function potentially affect host plant performance? The presence of microbial hubs in plant microbiome networks plays an important role between a plant and its microbial community. Plant Growth-Promoting Rhizobacteria (PGPR) can produce a complex blend of volatile substances, which are distinct between bacterial species and other closely related species. Some of these bacterial volatiles can stimulate plant growth, suppress disease stimulating ISR or antagonize phytopathogens, nematodes or insects [4,5].

Worldwide crop production is affected by biotic and abiotic stress factors, which cause millions of dollars in losses. The beginning of the industrial revolution in 1750 and the human activities such as burning fossil fuels and deforestation have altered the global climate. An increase in carbon dioxide and temperature is speeding up the life cycle of grain and oilseed crops. Accordingly, extreme heat waves and droughts have reduced global harvests of cereals such as maize, wheat and rice by 10% in a span of 50 years, which has become a grave concern of various governments. The impact of a warming climate on spring plant phenology is evident. A longer growing season may increase carbon uptake and potentially mitigate climate change, leaf emergence, fruiting and germination. Abiotic stress factors

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Received: 11-Dec-2020, Manuscript No. JBP-24-7484; **Editor assigned:** 16-Dec-2020, PreQC No. JBP-24-7484 (PQ); **Reviewed:** 30-Dec-2020, QC No. JBP-24-7484; **Revised:** 16-Aug-2024, Manuscript No. JBP-24-7484 (R); **Published:** 13-Sep-2024, DOI: 10.35248/2155-9597.24.15.517

Citation: Fry RC (2024) Plant-Microbe Ecology-Symbiotic Relationship of Plants and Microbial Communities. J Bacteriol Parasitol. 15:517.

include extreme temperature, drought, water logging, light and salinity as major parameters that affect plant growth [6]. Plant-associated microbes were found to benefit plants by enhancing nutrient uptake, stimulating root and shoot growth by producing indole acetic acid, 1-Aminocyclopropane-1-Carboxylate (ACC) deaminases, solubilizing phosphate and enhancing the uptake of nutrients from the environment. They also assist and enhance plant resistance to adverse environmental stresses such as drought, heavy metals, salts and nutrient deficiency. Biotic stress factors include interaction with other organisms and infection by pathogens or damage by insect pests and some plant growth-promoting bacteria have been used as biocontrol agents against plant pathogens. This study explores the relationships between plant hosts and their symbiotic microbial communities. We discuss and review current reports of how the plant-associated microbial community might be shaped by the host and how the plant microbiome affects plant growth, productivity and host survival in various symbiotic associations. This knowledge will guide efforts to improve agricultural practices and predict how environmental factors will affect the microbial community and plant diversity [7].

Plant ecology can be affected by global climate change in terms of above and below ground ecological diversity in a terrestrial ecosystem. The terrestrial plant community drives dynamic changes in the soil microbial ecology that may result in alterations in ecosystem function. The ecologists postulated that stabilizing mechanisms are essential for maintenance of species diversity and coexistence. Scientists have found evidence that microbially mediated positive and negative feedback might play a crucial role in the entire plant ecosystem and contribute to these mechanisms of plant-plant interactions. Traditionally, competing plant species have been thought to have strong negative intraspecific interactions for the high overlap in resource usage [8].

CONCLUSION

Soil resources can govern the coexistence of plant species by resource partitioning and sharing. Studies have found root symbionts that increase the efficiency of nutrient uptake and allow the host to persist in a low nutrient environment, thereby directly contributing to the competitive exclusion of other plants. Rhizosphere microbes can alter the availability of different forms of nitrogen or phosphorus in the soil and affect plant-plant interactions *via* the mediation of resource partitioning. Soil resources can also be transferred by shared symbiotic fungi called Common Mycorrhizal Networks (CMNs). In nature, different plant species commonly share the broadly specific mycorrhizal fungi. Some scientists demonstrated the direct transfer of resources from one plant to another *via* CMNs with labelled carbon, nitrogen and phosphorus.

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