Article ID 240203056

Potential of Phyllosphere Microbes

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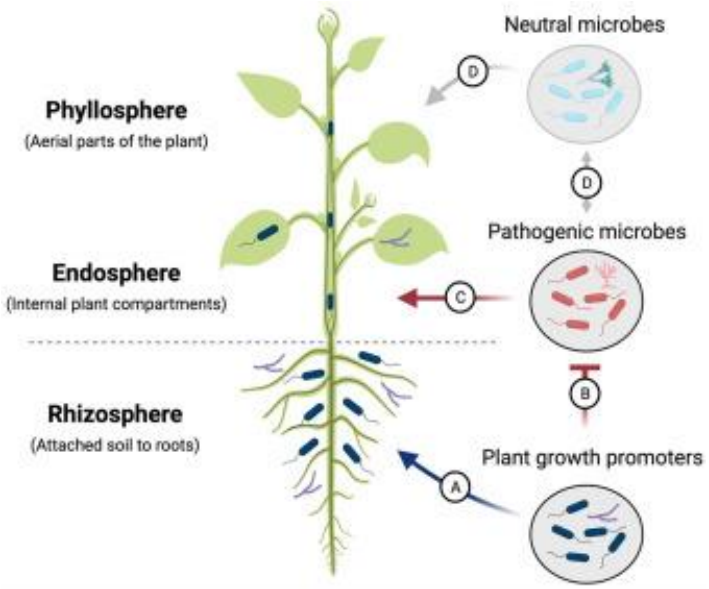
The term phyllosphere is referred to as "the aerial part of the plant or the parts of a plant above the ground usually surface of leaves, considered as a habitat for microorganisms." This is a place where normally a variety of microorganism (bacteria, yeasts, and fungi) colonizes. The global leaf area corresponds to both upper and lower surfaces, has approximately twice as great as the land surface area. The phyllosphere is the ambient region for microbes to colonize and establish its association with plants usually epiphytes. Microbial communities in the phyllosphere are highly complex and consist of many cultured and uncultured microorganisms. It has a heterogeneous group of the microbial association at the micrometer scale area due to its diverse microenvironments (habitats). The phyllospheric microbes are adapted to the insensitive environmental conditions, specifically microbial epiphytes are highly exposed to atmospheric temperature, light, UV radiation, less water, and nutrient availability. These external factors affect the composition and diversity of phyllospheric microbial communities. However, the type of plant and invading microbial populations (pathogens) are also influencing the commensals and/or mutualistic relationship with their host plant. Less number of studies are available for the microbiology of phyllosphere rather than plant root. Moreover, with increasing anthropogenic stresses, the diversity and community structure of phyllosphere microflora have been continually modified.

Mechanism of Microbial Interaction with the Phyllosphere

The leaf physiology determines the microbial diversity and abundance on the phyllosphere. It establishes the microhabitat where the microorganisms adapt to their physiology to survive in this habitat. The epiphytic microbes formed as colonial form, which gives protection to the microorganisms from this harsh microhabitat. The epidermal grooves are rich in nutrients specifically sugar and water. This region is less waxy cuticle, usually the leaf surface is fully coved with waxy cuticle which prevents the permeability and wettability of the leaf surface and regulates the colonization of the microbes on phyllosphere. The leaf surface water droplets diffuse the waxy cuticle and improve the permeability by which the compounds are diffused from the apoplast to phyllosphere surface. These leached compounds and water on the phyllosphere are making the availability of nutrients to the microorganisms. Most commonly, the flow of water from the stomata (transpiration) is increasing the permeability and wettability of guard cells and its surface cuticles. Hence, higher permeation of the cuticle layer permits the microbes to colonize densely.

Part of the phyllosphere



The part of the phyllosphere are; Leaves, Stems, Buds, Flower, and Fruit

Phyllosphere microbes are known to colonize both aerial plant parts (phylloplane) and residing within tissues of aerial plant parts (endosphere)

Factors Controlling Phyllosphere Microbiomes

Once microbes arrived at the phyllosphere, a variety of factors resolve whether microbial cells are competent to colonize the leaf and become confined. Colony establishment depends on the leaf–

atmosphere environmental interaction with the residing microorganisms in the phyllosphere. At the beginning, the microbe reaches the cuticle layer, a waxy surface that protects the leaf from the pathogens. In general, cuticle restricts the microbial association due to the functions such as barrier, reducing water and solute lass, aqueous pollution, reflectance to minimize the temperature, conferring water repellent, etc.

Biotechnological Potential of Phyllosphere Microbiota

The plant beneficial microbes are agriculturally important bioresources, and it can stimulate the plant growth and enhance plant nutrient uptake through solubilization and mobilization (of P, K, and Zn), nitrogen fixation, and siderophore production (microbes-mediated bio-fortification of Fe in different crops). Beneficial microbes can play an important role in increasing yields of the crop, remove contaminants, inhibit pathogens, and produce novel substances.

Impact of Phyllosphere Microbiome on Ecosystem

Phyllosphere microflora significantly influences the ecological relationship of the plants. The phyllosphere usually has bacteria, fungi, lichens, algae, and viruses that have actively participated in the adaptation, growth, resistance, and infection of the plant host.

Conclusion

The phyllosphere is a unique environment colonized by a wide variety of microorganisms including epiphytes and endophytes, beneficial and pathogenic, bacteria, fungus, viruses, etc. Understanding the phyllosphere community structure, networking, and physiology is a great challenge. However, extensive research on phyllosphere microbiota gives great potential for the applications in economic plant productivity, specifically agriculture and forestry, ecosystem cleaning, and health. Hitherto, both in vitro and in vivo experiments are required to improve the understanding of microbial aggregations in the phyllosphere and dynamic play in the ecosystem.

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