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Building plant microbiome vault: a future biotechnological resource

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Abstract
The plant-microbiome symbiotic association will need to be taken advantage of for feeding the burgeoning millions in the face of climatic perturbations and environmental deterioration. Since the plants select their microbiome from the soils on which they grow, soils, therefore, remain the key source of microbiome for sustainable food production. Building a reliable and reproducible plant microbiome vault of key crops growing with desirable traits such as high yielders under low input conditions, drought tolerant plots, disease suppressive soils, etc. can become an important and irreparable biotechnological resource for future agriculture. Based on the available literature, a complementary approach is discussed wherein i) rhizosphere and bulk soils are preserved with the best available protocols in such a way that their biological components remain undisturbed for long periods and the viable microbiome can be accessed; supplemented side-by-side with ii) systematic isolation, screening and preservation of the 'Minimal Effective Microbiome Set' ('MEMS') for building the plant microbiome vault.

Keywords Plant microbiome vault · Rhizosphere soil · Minimal effective microbiome set · Live soil preservation

1 Plant and it's microbiome: A co-evolved metaorganism

Plants have co-evolved symbiotically with microorganisms into a metaorganism over centuries of their evolution. The co-evolution has been found to be specific, stable and conserved among different individuals of a species and is viewed as a unit of selection (Zilber-Rosenberg and Rosenberg 2008; Rosenberg and Zilber-Rosenberg 2016). This relationship has a decisive role to play in food security for humans and animals besides sustainability of the environment. Barter in energy economy drives this vital relationship between the plants and the microbes. While the plants fix carbon dioxide by photosynthesis and release more than 20–40% of it as carbon-rich root exudates as food for the soil microbes, the latter offer a plethora of ecosystem services that is critical for the survival, growth and fitness of the plants (Vandenkoornhuyse et al. 2015). Unique niche offered by the plants around their roots (rhizosphere), within the plant roots, stem, leaves, pollen and seeds (endosphere) as well as the leaf surface (phyllosphere) for the microbes to grow, exchange nutrients and live together defines the relationship now known as the 'plant holobiont' and the contribution of their genes – the 'hologenome' (Zilber-Rosenberg and Rosenberg 2008; Rosenberg and Zilber-Rosenberg 2016). The microbial 'diversity' in this relationship is termed the 'plant microbiome' (Turner et al. 2013; Berg et al. 2016). At genome level, the microbial genomes are called 'second genome' of the plants.

2 Soil 'seeds' plant microbiome

The understanding of plant microbiome association and interaction has risen to remarkable levels (Schlaeppi and Bulgarelli 2015; van der Heijden and Hartmann 2016; Busby et al. 2017) with the i) development of quicker and more accurate nucleic acid sequencing platforms, ii) high resolution software for analysis of microbiome diversity and function from big data generated out of the sequencing platforms, and iii) linking such data with the chemical ecology of the root exudates and hormones (Badri and Vivanco 2009; Huang et al. 2014; Lebeis et al. 2015) of the plant microenvironment using sophisticated chromatography and microscopy. Backed up by these cutting edge technologies, it is becoming clear that the main source of the plant microbiome is the astonishingly diverse soil microbiome (Sanchez-Canizares et al. 2017) that serves as the primary inoculum for the rhizosphere and root

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