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REVIEW
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The Role of Synthetic Microbial Communities (SynCom) in Sustainable Agriculture

Ambihai Shayanthan[1,2], *Patricia Ann C. Ordoñez*[1] *and Ivan John Oresnik*[1]*

[1] Department of Microbiology, University of Manitoba, Winnipeg, MB, Canada, [2] Department of Agricultural Chemistry, University of Jaffna, Jaffna, Sri Lanka

Modern agriculture faces several challenges due to climate change, limited resources, and land degradation. Plant-associated soil microbes harbor beneficial plant growth-promoting (PGP) traits that can be used to address some of these challenges. These microbes are often formulated as inoculants for many crops. However, inconsistent productivity can be a problem since the performance of individual inoculants/microbes vary with environmental conditions. Over the past decade, the ability to utilize Next Generation Sequencing (NGS) approaches with soil microbes has led to an explosion of information regarding plant associated microbiomes. Although this type of work has been predominantly sequence-based and often descriptive in nature, increasingly it is moving towards microbiome functionality. The synthetic microbial communities (SynCom) approach is an emerging technique that involves co-culturing multiple taxa under well-defined conditions to mimic the structure and function of a microbiome. The SynCom approach hopes to increase microbial community stability through synergistic interactions between its members. This review will focus on plant-soil-microbiome interactions and how they have the potential to improve crop production. Current approaches in the formulation of synthetic microbial communities will be discussed, and its practical application in agriculture will be considered.

Keywords: plant-associated microbes, rhizosphere, plant growth-promoting traits, synthetic communities (SynCom), plant microbe interaction

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***Correspondence:**
Ivan John Oresnik
Ivan.Oresnik@umanitoba.ca

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INTRODUCTION

Agricultural production must increase by about 70% from its current level by 2050 to meet the demand for a growing population (ELD Initiative, 2015; Singh et al., 2020). However, current studies estimate that global food production will decrease by 12% over the next 25 years due to the degradation of agricultural lands (ELD Initiative, 2015). After the second industrial revolution, traditional agricultural practices shifted towards the use of synthetic chemical fertilizers and pesticides to improve crop production (Melillo, 2012; Dixon, 2018). The intensive use of these agrochemicals has led to the deterioration of the quality of both the soil as well as the environment (Meena V. S. et al., 2017). A possible solution to mitigate some of these problems might be the development of sustainable agriculture practices that harness crop-associated microbiomes to either