OPINION

Pseudomonas species RU47's field-scale rhizosphere competence and biocontrol impact are independent of plant species and soil type

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Roy N. Pseudomonas sp. RU47's field-scale rhizosphere competence and biocontrol impact are independent of plant species and soil type. J. Environ. Microbiol. 2022;4(3):1-2.

ABSTRACT

At the field level, biocontrol inoculants frequently exhibit inconsistent efficacy, and the cause of this is frequently unknown. Given that the biocontrol strain must compete with the local microbial community in the rhizosphere, inoculant strains with a high level of rhizosphere competence are thought to be a critical component for effective biocontrol effects. It is well recognised that a variety of factors, including plant species and soil type, affect the composition of the microbial communities in the rhizosphere. However, the existence of a pathogen can also affect the composition of the microbial population in the rhizosphere. We proposed that the rhizosphere competence of a biocontrol strain and its biocontrol impact against a soil-borne pathogen are influenced by plant species, soil type, and the pathogen. The three soil types (diluvial sand, alluvial loam, and loess loam) were kept under similar agricultural management at the same field site for 12 years as part of an experimental plot system to test the theory. We examine Pseudomonas sp. RU47's rhizosphere competence in two plant species (potato and lettuce) as well as its biocontrol activity against Rhizoctonia diseases. Plate counts were used to assess the colonisation density of an RU47 mutant that was rifampicin-resistant in the rhizosphere of both crops. Bacterial community compositions were investigated using Denaturing Gradient Gel Electrophoresis (DGGE) and 16s rRNA gene fragments amplified from entire community DNA. According to DGGE, RU47 had a more significant impact on the makeup of the bacterial population in the lettuce rhizosphere than in the potato rhizosphere. In contrast, the pathogen Rhizoctonia solani had a far greater impact on the bacterial community in the potato rhizosphere than in the lettuce rhizosphere. Only lettuce grown in alluvial soil showed a substantial influence of RU47 on the Pseudomonas-specific GacA signatures of the rhizosphere. The biocontrol properties of RU47, which are independent of soil type and plant species, as well as its negligible impact on the makeup of the local bacterial community, may be crucial considerations in the registration and use of RU47 as a biocontrol strain.

Key Words: *Rhizosphere; Rhizoctonia; Pseudomonas-specific; Rhizoctonia Diseases; Rhizosphere*

INTRODUCTION

It is challenging to control diseases brought on by soil-borne pathogens like Rhizoctonia solani (Kuhn); however, using bacterial inoculants to reduce disease provides an environmentally benign control strategy. However, at the field scale, biocontrol inoculants frequently displayed a lack of consistency in their biocontrol activity.

Over many years, work has been done to identify the variables that determine the effectiveness of bacterial inoculants as biocontrol agents. Inconsistency in disease suppression was considered to be caused by variations in bacterial inoculants' capacity to colonise the rhizosphere and survive at sufficiently high cell densities. As a result, it was determined that a high level of rhizosphere competence was necessary for the expression of positive impacts on plants.

The complicated interaction between plants and their microbiome, including any used bacterial inoculants, is only now being fully understood by research. A growing body of research using 16S rRNA gene-based fingerprints has shown that the bacterial community composition in the rhizosphere is influenced by both biotic (such as plant species and genotypes, developmental stage, and plant pathogens) and abiotic (such as weather conditions and agricultural management) factors.

Numerous studies have conclusively demonstrated that the rhizosphere microbiome is influenced by both plant type and soil type. A subset of these populations was enriched in the rhizosphere of the plant due to root exudates, resulting in an enhanced relative abundance in the rhizosphere compared to the comparable bulk soil from different soil types with various physicochemical qualities. The influence of various soil types and plant species on the rhizosphere competence and biocontrol activity of bacterial

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inoculants at the field scale was poorly understood until recently. Despite the soil types harbouring a specific bacterial population, the inoculant strains Serratia plymuthica 3Re4-18 and Pseudomonas sp. RU47 were able to colonise the rhizosphere of lettuce at an appropriate density at the field scale in a previous study.

Since the strain RU47's genome sequence is phylogenetically related to strains from the P. koreensis group, it has recently been reclassified. Based on the 16S rRNA gene sequence, it was initially identified as Pseudomonas jessenii.

We make the assumption that plant traits are more likely to be the cause of the frequently reported inconsistent biocontrol effects in the field based on the findings of this study. The plant influences the rhizosphere microbiome through root exudates by promoting bacteria that have characteristics that are good for plant growth and health. The root system in the rhizosphere releases about 30% to 50% of the carbon that was fixed during photosynthetic activity. Therefore, root exudates are crucial in triggering substrate-driven competition among rhizosphere microorganisms, including the colonisation of roots by a biocontrol inoculant. The genetic makeup of the plant controls the pattern of root exudation as well as the quantity of different exudate chemicals produced and secreted by the roots.