OPEN ACCESS Freely available online

Journal of Bacteriology & Parasitology

Commentary

Use of Rhizosphere Carbon Sources to Discriminate Soil Microbial Community

Toshiyuki Tony*

Department of Microbiology, Kyoto University, Kyoto, Japan

DESCRIPTION

Sole carbon source tests (Biolog™), designed to identify microbial isolates can be used to metabolically fingerprint soil microbial communities, although the carbon source profiles were not selected for this purpose. This paper reports on the use of alternative carbon sources not available in the Biolog™ GN plates to characterize soil microbial communities. The carbon sources used are compounds commonly found in plant root exudates and are, therefore, ecologically more relevant and representative of the types of substrates available to microorganisms in rhizosphere soil. The additional carbon sources tested included various phenolic acids, amino acids, carboxylic acids, long chain aliphatic and carbohydrates. In total, 125 different carbon sources were used to discriminate between soil samples from nine different sites each with three types of grassland vegetation. The growth curves for different groups of carbon sources were all sigmoidal, but the maximum rate of utilization was faster for carbohydrates, amino acids and carboxylic acids than for amides, phenolic and long chain aliphatic acids. Significant discrimination of soil microbial communities between sites, but not grassland types, was shown and was more distinct using the exudate carbon sources than those in the Biolog GN plate. The use of fewer carbon sources which are more ecologically meaningful constitutes a more efficient and economical technique.

SOLE CARBON SOURCE TESTS

The requirement to place biodiversity within the context of the sustainability of agricultural and natural ecosystems has increased interest in methods of measuring soil microbial diversity since soil functionality depends so much on the activity of micro-organisms. There are several techniques which can be used to study microbial communities and quantify diversity in genetic, taxonomic or functional terms. The use of sole carbon source tests is one way to measure functional diversity and has been applied to a wide range of soil habitats, undergoing changes in land use or disturbance due to pollution. Sole carbon source tests have been used in a variety of ways to classify or characterize both single species isolated from soil and mixed populations, either extracted from the environment or in model systems. The method first described by Garland and Mills uses a commercially available micro titre plate which can be used to simultaneously test the utilization of 95 different substrates as sole carbon sources. Carbon source utilization is indicated by color development of a redox indicator dye and changes in the overall patterns of carbon source utilization rates indicate differences in community composition. The technique has become popular because it is simple, uses automated measuring apparatus and yields a great deal of information about an important functional attribute of microbial communities, although the analysis and interpretation of such data is often more complicated. It was noted that there was significant redundancy in the Biolog GN plate carbon sources, in that many of the carbon sources were highly correlated and contributed little to the discrimination of microbial populations. In studies using Biolog plates, 95 carbon sources have been used and when both GN and GP type plates are combined 138 carbon sources can be tested. However, there is no reason why fewer carbon sources might not be able to discriminate adequately between populations. In studies characterizing isolates, as few as 20 or even 9 carbon sources were enough to determine shifts in carbon source utilization profiles.

This reports on the use of a wider range of carbon sources and is currently available in the GN type of Biolog plate. The additional carbon sources were chosen to represent compounds reported in the literature as plant root exudates to make the tests ecologically more relevant for testing soil microbial communities and rhizosphere isolates. By selecting only relevant carbon sources this might also allow the use of fewer tests, allowing greater replication and more economical use of micro titre plates. In order to test such ideas statistically, a large sample set is required. Data from soil samples collected from a range of upland grasslands in the United Kingdom were used to test these rhizosphere carbon sources. The soil samples had been collected as part of a UK coordinated project, called `Micronet'. The aim of this project is to develop and apply different molecular, taxonomic and physiological techniques to assess the biodiversity of soil microbial populations and their relationship to plant community structure. Data from `Micronet' sites were used here to allow a comparison of the widest range of carbon sources. The full findings of this study, and the relationship between carbon source utilization and soil, plant or climate

Correspondence to: Toshiyuki Tony, Department of Microbiology, Kyoto University, Kyoto, Japan, Tel: +81-91-1656-5994; E-mail: tonynuro@swd.ac.jp

Received: December 10, 2020; **Accepted:** December 24, 2020; **Published:** December 31, 2020

Citation: Tonty T (2020) Use of Rhizosphere Carbon Sources to Discriminate Soil Microbial Community. J Bacteriol Parasitol. S7:004.

interactions, will be published elsewhere and discussion herein is limited to the comparison of the carbon sources tested.

CHARACTERISTICS OF UTILIZATION OF DIFFERENT TYPES OF EXOGENOUS CARBON SOURCES

The metabolic capacity of soil microorganisms to the types of exogenous carbon sources (carboxylic acids, amino acid, carbohydrate, complex compounds) in non-rhizosphere soils were higher ($p<0.05$) than that of rhizosphere soils with different fertilizer treatments. The metabolic capacity of soil microorganisms to exogenous carbon sources in rhizosphere soils were increased with application of organic manure managements. In rhizosphere and non-rhizosphere soils, there was no significant difference ($p>0.05$) in microbial utilization of complex compounds among different fertilizer treatments. In different types of exogenous carbon sources, the average utilization rate of carboxylic acids was higher ($p<0.05$) than that of complex compounds with different fertilizer treatments.