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Paper title:

The contribution of soil biodiversity to diesel degradation

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ABSTRACT

Interest in the relationship between biodiversity and ecosystem functioning has grown. Various theses have been proposed. For example, the 'insurance hypothesis' states that diverse ecosystems can tolerate perturbations because they have a species buffering capacity. However, others suggest that diverse ecosystems are less stable than simple ones because of a trade-off between production and stability. Most of the studies carried out to date have concentrated on plant assemblages and productivity, with particular emphasis on grasslands, although there is rapidly growing interest in the relationship between soil functioning and soil biodiversity. Soil microbial diversity is greater than that above-ground and as a result there is likely to be considerable species redundancy, in which case any variation in biodiversity will not necessarily adversely affect functioning. However, biodiversity is likely to be most important, not when conditions are stable, but when changes or perturbations occur.

Soil microbial species richness was amended *constructively* by inoculating sterile soil with microbial communities differing in diversity to give high, intermediate and low levels of species richness. Half the soil samples were amended with 2% diesel and these, together with diesel-free soils were maintained at constant moisture for 3 months, during which time soils were regularly sampled and analysed for: (1) microbial diversity (T-RFLP; fungal populations were monitored using primers based upon amplification of the ITS2 ribosomal DNA, whilst analysis of bacterial populations were based on the 23S ribosomal DNA), (2) microbial activity (using Biolog technology), (3) diesel degradation (measured using a Varian 1200 Quadropole GM/MS) and (4) microbial biomass-C (C_{mic}) and biomass-N (N_{mic}) (measures of total biomass were used to verify status of soil incubations prior to experimental use and also as a measure of biomass during experimentation. The fumigation-extraction technique with k_{EC} = 2.22 and k_{EN} = 0.54 was used).

Each dilution treatment contained a similar biomass, confirming that differences in diesel degradation and activity were due to changes in species richness and not a result of altered biomass. The dilution technique for amending diversity was particularly effective with regard to the fungal component of the community. A total of 71 different species were detected. Diesel amendment reduced diversity (in all dilution treatments) and several bacterial species were only detected in diesel-contaminated soil.

Community level catabolic potential (Biolog) was generally unaffected by diesel contamination when all 95 substrates were considered. Oxidation of the simple carbon substrates (e.g. carbohydrates)

was unaffected by diesel, but utilisation of more complex substrates (e.g. aromatic compounds) was increased when communities were subjected to diesel contamination. This suggests redundancy with regard to easily degraded substrates and a diesel-mediated selection mechanism leading to more complex degradation capabilities in communities associated with diesel-contaminated soils. Diesel degradation was more rapid in soils with the greatest species-richness than in those with the lower levels of diversity. This was the case for every hydrocarbon fraction measured (C_{12} to C_{25}).

KEY words: soil biodiversity, diesel biodegradation, Biolog GN2 plates, T-RFLP

Biography

Name: Miss Galina Ivanova, PhD student
Ms Galina Ivanova has graduated from the University of Sofia, Sofia, Bulgaria with a Master degree in Biotechnology. She has been enrolled as a full-time PhD student at the Department of Biotechnology, University of Szeged, Hungary. Her PhD studies are in the field of Environmental Biotechnology and Toxicology. In 2004 she was awarded a 1 year - fellowship from the University of Nottingham, UK where she has conducted a research on biodiversity of soils contaminated with diesel fuel. In her laboratory in Hungary she has been working on gene expression of diesel- and petroleum – degrading microorganisms as well as on bioremediation strategies for cleaning – up soils and water.

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Area of discussion: Environmental effects of biotechnologies: biodiversity