NEW ITEMS IN THE NBMA RESOURCE LIBRARY

Soil HEI June 2016

TITLE: Parallel shifts in plant and soil microbial communities in response to biosolids in a semi-arid grassland

Author: Sullivan, T.S., M.E. Stromberger, M.W. Paschke
Source: Soil Biol Biochem 2006 38:449-459
Abstract: Approximately 70,150 dry Mg of biosolids from over 450 wastewater treatment facilities are applied to the semi-arid rangelands of Colorado every year. Research on semi-arid grassland responses to biosolids has become vital to better understand ecosystem dynamics and develop effective biosolids management strategies. The objectives of this study were to determine the long-term (w12 years) effects of a single biosolids application, and the short-term (w2 years) effects of a repeated application, on plant and microbial community structure in a semi-arid grassland soil. Specific attention was paid to arbuscular mycorrhizal fungi (AMF) and linkages between shifts in plant and soil microbial community structures. Biosolids were surface applied to experimental plots once in 1991 (long-term plots) and again to short-term plots in 2002 at rates of 0, 2.5, 5, 10, 21, or 30 Mg haK1. Vegetation (species richness and above-ground biomass), soil chemistry (pH, EC, total C, total N, and extractable P, NO3–N, and NH4–N), and soil microbial community structure [ester-linked fatty acid methyl esters (EL-FAMEs)], were characterized to assess impacts of biosolids on the ecosystem. Soil chemistry was significantly affected and shifts in both soil microbial and plant community structure were observed with treatment. In both years, the EL-FAME biomarker for AMF decreased with increasing application rate of biosolids; principal components analysis of EL-FAME data yielded shifts in the structure of the microbial communities with treatment primarily related to the relative abundance of the AMF specific biomarker. Significant (p%0.05) correlations existed among biomarkers for Gram-negative and Gram-positive bacteria, AMF and specific soil chemical parameters and individual plant species' biomass. The AMF biomarker was positively correlated with biomass of the dominant native grass species blue grama (Bouteloua gracilis [Willd. ex Kunth] Lagasca ex Griffiths) and was negatively correlated with western wheatgrass (Agropyron smithii Rydb.) biomass. This study demonstrated that applications of biosolids at relatively low rates can have significant long-term effects on soil chemistry, soil microbial community structure, and plant community species richness and structure in the semi-arid grasslands of northern Colorado. Reduced AMF and parallel shifts in the soil microbial community structure and the plant community structure require further investigation to determine precisely the sequence of influence and resulting ecosystem dynamics.
Document#: BIN.EF.MI.5.1

TITLE: Temporal variation outweighs effects of biosolids applications in shaping arbuscular mycorrhizal fungi communities on plants grown in pasture and arable soils

Author: Hazard, C., B. Boots, A.M. Keith, D. T. Mitchell, O. Schmidt, F.M. Doohan, G.D. Bending
Source: Applied Soil Ecol. 2014 82: 52-60.
Abstract: Landspreading of biosolids (treated sewage sludge) in agroecosystems is a common waste management practice worldwide. Evidence suggests biosolids may be detrimental to arbuscular mycorrhizal fungi (AMF); however, previous studies focused on arable systems and often unrealistically high biosolids application levels. We investigated the effects of biosolids on AMF communities in grassland and arable agroecosystems, in the context of the natural seasonal dynamics of AMF community composition and diversity. A pasture and arable system under commercial farming management were amended annually with two different types of biosolids, applied at levels meeting current European Union regulations, in a factorial, replicated field-scale plot experiment. AMF root colonisation and community composition were measured in Lolium perenne roots from the pasture and Trifolium repens roots growing in arable soil across the seasons of two years. AMF community compositions were assessed by terminal-restriction fragment length polymorphism analyses. Biosolids had no significant effect on AMF root colonisation or community composition in either agroecosystem. Soil chemical analyses indicated several changes in the top 0–5 cm layer of the pasture soil, including small increases in heavy metal concentrations in biosolids relative to control plots. Temporal AMF dynamics were detected in soils from both agroecosystem indicating that the effect of seasonality outweighed that of biosolids application
Document#: BIN.EF.MI.5.2

TITLE: Agricultural land usage transforms nitrifier population ecology

Author: Bertagnolli, A.D., D. McCalmont, K.A. Meinhardt, S.C. Fransen, S. Strand, S. Brown and D.A. Stahl
Source: Environ. Micro. 2016 doi:10.1111/1462-2920.13114.
Abstract: Application of nitrogen fertilizer has altered terrestrial ecosystems. Ammonia is nitrified by ammonia and nitrite-oxidizing microorganisms, converting ammonia to highly mobile nitrate, contributing to the loss of nitrogen, soil nutrients and production of

detrimental nitrogen oxides. Mitigating these costs is of critical importance to a growing bioenergy industry. To resolve the impact of management on nitrifying populations, amplicon sequencing of markers associated with ammonia and nitrite-oxidizing taxa (ammonia monooxygenase-amoA, nitrite oxidoreductase-nxrB, respectively) was conducted from long-term managed and nearby native soils in Eastern Washington, USA. Native nitrifier population structure was altered profoundly by management. The native ammonia-oxidizing archaeal community (comprised primarily by Nitrososphaera sister subclusters 1.1 and 2) was displaced by populations of Nitrosopumilus, Nitrosotalea and different assem- blages of Nitrososphaera (subcluster 1.1, and unassociated lineages of Nitrososphaera). A displacement of ammonia-oxidizing bacterial taxa was associated with management, with native groups of Nitrosospira (cluster 2 related, cluster 3A.2) displaced by Nitrosospira clusters 8B and 3A.1. A shift in nitrite-oxidizing bacteria (NOB) was correlated with management, but distribution patterns could not be linked exclusively to management. Dominant nxrB sequences displayed only distant relationships to other NOB isolates and environmental clones.
Document#: BIN.EF.MI.5.3

TITLE: Distinct responses in ammonia-oxidizing archaea and bacteria after addition of biosolids to an agricultural soil

Author: Kelly, J.J., K. Policht, T. Grancharova, and L. Hundal
Source: Applied Environ. Micro. 2011 77-18:6551-6558
Abstract: The recently discovered ammonia-oxidizing archaea (AOA) have been suggested as contributors to the first step of nitrification in terrestrial ecosystems, a role that was previously assigned exclusively to ammonia- oxidizing bacteria (AOB). The current study assessed the effects of agricultural management, specifically amendment of soil with biosolids or synthetic fertilizer, on nitrification rates and copy numbers of archaeal and bacterial ammonia monooxygenase (amoA) genes. Anaerobically digested biosolids or synthetic fertilizer was applied annually for three consecutive years to field plots used for corn production. Biosolids were applied at two loading rates, a typical agronomic rate (27 Mg hectare1 year1) and double the agronomic rate (54 Mg hectare1 year1), while synthetic fertilizer was applied at an agronomic rate typical for the region (291 kg N hectare1 year1). Both biosolids amendments and synthetic fertilizer increased soil N and corn yield, but only the biosolids amendments resulted in significant increases in nitrification rates and increases in the copy numbers of archaeal and bacterial amoA genes. In addition, only archaeal amoA gene copy numbers increased in response to biosolids applied at the typical agronomic rate and showed a significant correlation with nitrification rates. Finally, copy numbers of archaeal amoA genes were significantly higher than copy numbers of bacterial amoA genes for all treatments. These results implicate AOA as being primarily responsible for the increased nitrification observed in an agricultural soil amended with biosolids. These results also support the hypothesis that physiological differences between AOA and AOB may enable them to occupy distinct ecological niches..
Document#: BIN.EF.MI.5.4

TITLE: Effect of amendment C:N ratio on plant richness, cover and metal content for acidic Pb and Zn mine tailings in Leadville, Colorado

Author: Brown, S., P. DeVolder, H. Compton, and C. Henry
Source: Environ. Pollut. 2007 149:165-172
Abstract: Biosolids and woody debris were applied with target C:N ratios of 8:1 to 50:1 to phytotoxic, acidic, high metal mine tailings to test the effect of amendment C:N ratio on native plant restoration. Total soil C decreased over time indicating an active microbial community. The 8:1 treatment initially had no growth, the highest plant cover for the final sampling (86.8 13.8%) and the lowest number of species (3.33 0.4). The greatest number of species was in the 30:1 treatment (5.44 0.45). Plant cover increased over time for all treatments from 44.7% in 2001 to 71% in 2005. This response was consistent across all except for the 30:1 treatment, which showed a slight decrease in the final year (65 11%). Volunteer species and evidence of animal grazing were observed in all amended plots. Results indicate that a C:N ratio 20:1 increased species diversity.
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