Geophysical Research Abstracts
Vol. 13, EGU2011-12187-1, 2011
EGU General Assembly 2011

The breakdown of water repellency in compost amended soils

Amii Whelan, Cedric Kechavarzi, and Ruben Sakrabani
Natural resources department, Cranfield University, Cranfield, Bedfordshire, MK43 0AL, United Kingdom

Soil water repellency is a widespread phenomenon occurring at a variety of scales, in different soils and environments across the world. Water repellency is however a time dependent phenomena and even the most repellent of soils will eventually permit water entry. This breakdown in repellency with time is the foundation for the water drop penetration time test which is said to be a measure of the persistence of water repellency. This breakdown in repellency is also reflected by transient contact angle decay and an increase in infiltration rates resulting in convex cumulative infiltration curves. As such the transition from a hydrophobic state through a period of subcritical repellency towards a more wettable state is gradual.

Whilst suggestions as to the cause of this breakdown have been proposed including reorientation of amphiphilic molecules and surface active substances upon contact with water and changes to the molecular conformation of organic matter, the implications of repellency breakdown are of concern. In particular, situations where the timescale of the breakdown exceeds the duration of hydrological events, such as rainfall, are important. Following the onset of infiltration, the transient changes in repellency will continue to affect infiltration behaviour due to subcritical repellency, which is often overlooked. Characterisation of the continuous breakdown of repellency together with its influence on infiltration will therefore be valuable in attempts to model water flow in repellent soils and quantification of the role of impeded infiltration on runoff and erosion. This could play an important role in brownfield environments, where repellency is often due to hydrophobic contaminants. In addition, remediation practices, such as compost application, have the potential to affect repellency and its breakdown through the addition of organic molecules and contaminant sequestration.

We characterised the time dependent relationship of water repellency using sessile drop contact angle measurements over time. Samples consisted of three soils, a sandy loam, a clay loam and an aged diesel spiked sandy loam, and two composts (one composed primarily of green waste and one of meat waste). Each soil was amended with the composts at a rate of 750t/ha. The sessile drop measurements were carried out by filming a drop of water on a monolayer of soil over time and the contact angle measured using image analysis software.

The sessile drop tests confirmed that the contact angle continuously decreases with time in both wettable and repellent samples. All samples showed an exponential decrease in contact angle with time with an initially rapid decline before reaching an equilibrium angle and a reduction in the rate of contact angle decay. The meat compost was the most repellent of the samples and had the highest initial contact angle (117°) and the longest duration of contact angle decay (9 minutes 36 seconds). The three soils had a very rapid decrease in contact angle to 0° (all <10 seconds) but the initial contact angle of the diesel spiked soil was 97°. The addition of green compost did not change the rate of contact angle decrease in the sandy loam or clay but meat compost increased the time taken for the contact angle to decrease in the sandy loam (from 7 seconds to 9 minutes). Both composts increased the time taken for repellency to breakdown in the diesel spiked soil (from 8 seconds to > 2 minutes).

Infiltration models, that include these relationships between apparent contact angle and time, are currently being developed for repellent soils.