

Bacteria beats water repellency

CSIRO Plant Industry



Water repellent sandy soils are a major problem across the western and southern grain growing regions of Australia. CSIRO Plant Industry research has shown that if the number of beneficial bacteria can be increased in these soils, water repellency can be reduced. And the easiest way to start this process is by a simple application of lime.

Water repellency

Sandy soils are typical across large tracts of land where wheat and other grains are grown in Western Australia and South Australia. A common problem with these soils is water repellency which occurs in approximately 5 million hectares causing estimated losses of crop and pasture production of more than \$100M. In these soils, when water is poured onto the soil it will simply pool on the top without soaking in or it will move down 'preferred pathways' leaving large volumes of soil dry.

This is almost hopeless for plants as they need the water to infiltrate the soil surface and then for it to be held in the soil profile for them to use when they need it.

Water repellency is caused when hydrophobic 'skins', made from plant waxes and other products from the natural process of plant biodegradation, form around individual sand grains. These waxy skins effectively repel the water from the soil and limit water availability to the crop.

Water cannot infiltrate sandy soils when they develop a waxy hydrophobic skin around individual sand grains (below), resulting in poor plant growth due to limited water (right).



The bacteria

Dr Margaret Roper, a soil microbiologist at CSIRO Plant Industry in Perth, has identified different types of bacteria belonging to the actinomycetes group that help break down these wax barriers.

Actinomycetes are a common form of soil bacteria that decompose organic matter returning important nutrients back to the soil. The types involved in breaking down wax barriers are from the *Rhodococcus* species and *Mycobacterium* species.

These actinomycetes have been found in all soils tested but they need a moist environment to be effective.

Boosting actinomycete levels

To activate the actinomycetes Dr Roper investigated two options – inoculation and management.

Inoculation was successful, especially with the *Rhodococcus* species, however the improvements in wettability, although statistically relevant were small. It is also expected that the costs of production and application of the inoculant would probably outweigh the benefits.

Dr Roper also tried adding lime. Some farmers had noticed that lime improved water infiltration into their soils. Her results in field trials in south western Australia show that following a lime application the numbers of actinomycetes increased up to ten times. This resulted in a significant and substantial reduction in water repellency for at least four years.

Wetting agents and certain clays can also be used effectively to increase water infiltration but are expensive and less likely to be readily available and suitable for farmers to use.

Applying lime

In her experiments, Dr Roper used a range of concentrations of lime up to 15 tonnes per hectare, however smaller amounts of less than 5 tonnes per hectare, can significantly increase populations of wax-degrading bacteria and reduce water repellency.

Lime is cheap and easy to apply and has the added benefit of raising soil pH to levels that favour other soil micro-organisms also important in soil health.

Several farmers in Western Australia and South Australia have reported improved water infiltration after the application of lime.

References

Roper MM. 2005. Managing soils to enhance bioremediation of water repellency by natural populations of wax-degrading bacteria. *Australian Journal of Soil Research*. 43: 803-810.

Roper MM. 2006. Potential for remediation of water repellent soils by inoculation with wax-degrading bacteria in south-western Australia. *Biologia, Bratislava*, 19:S358-S362.

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