Topsoil Evaporation in Water Repellent Soil Affected by Tillage and Claying: Preliminary Case-study Results

GIACOMO BETTI[1], GAUS AZAM[2]

[1]Department of Primary Industries and Regional Development, 20 Gregory St Geraldton WA 6530, Australia
[2]Department of Primary Industries and Regional Development, 75 York Rd Northam WA 6401, Australia

Soil water repellence represents one of the major soil constraints to broad-acre agriculture in southern Australia. Topsoil wettability is significantly reduced by the presence of hydrophobic organic compounds, resulting in poor seed germination, early plant establishment and ultimately lower yields. Soil mechanical disturbance (tillage) in combination or not with the addition of clay-rich subsoil (e.g. clay spreading) have been successfully adopted in the Australian broad-acre agriculture for the amelioration of water repellent sandy soils. Both methods are proven to effectively change the soil physical characteristics, promoting wetting of topsoil uniformly and thus improving early plant establishment. However, the downside of ameliorating water repellent soils is the removal of the natural 'mulching effect' provided by the presence of the hydrophobic material in the topsoil. This in fact could potentially lead to increase the loss of soil water by evaporation, particularly during hot and dry summer in the low rainfall regions. To test this hypothesis, soil profiles were reconstructed in replicated large pots (290 mm diameter, 450 mm deep) representing a typical water repellent sandy soil in its original conditions (control treatment, with water repellent topsoil over non-repellent subsoil) and after four different treatments for the amelioration of soil water repellence, such as: *i)* topsoil mixed with subsoil (representing deep tillage), *ii)* combination of deep tillage and addition of clay-rich subsoil, *iii)* topsoil inversion and *iv)* clay-rich subsoil application as top dressing with no further incorporation. The soil profiles, wetted to near saturation, were kept in a controlled environment (air temperature >30°C and air humidity < 50%) simulating the typical summer hot and dry conditions expected in most part of the wheat belt of Western Australia. Using a mobile Perspex evaporation dome (similar to the one described in McLeod et al. 2004), we measured the evaporation rates (mm day $^{-1}$) from the treated soil surface at different intervals over 100 h. All treatments had similar initial evaporation rates (1.8 to 2.4 mm day $^{-1}$) but the mean evaporation rate in the control treatment significantly declined after 48 h. Treatments with the top-dressed application of clay-rich subsoil recorded the higher evaporation rates in the first 24 h (2.2 mm day^{-1}). However, as the clay-rich layer over the topsoil started to dry (and from cracks), the evaporation rate subsequently declined to the rates similar to those observed in the control treatment. In contrast, treatments representing tillage in combination or not with the clay-rich soil continued to evaporate water at similar rate until the end of study period. These preliminary results confirmed the potential for soil amelioration to increase soil evaporation in water repellent soils and further research is required to better understand this process.