Measuring Matric Potential

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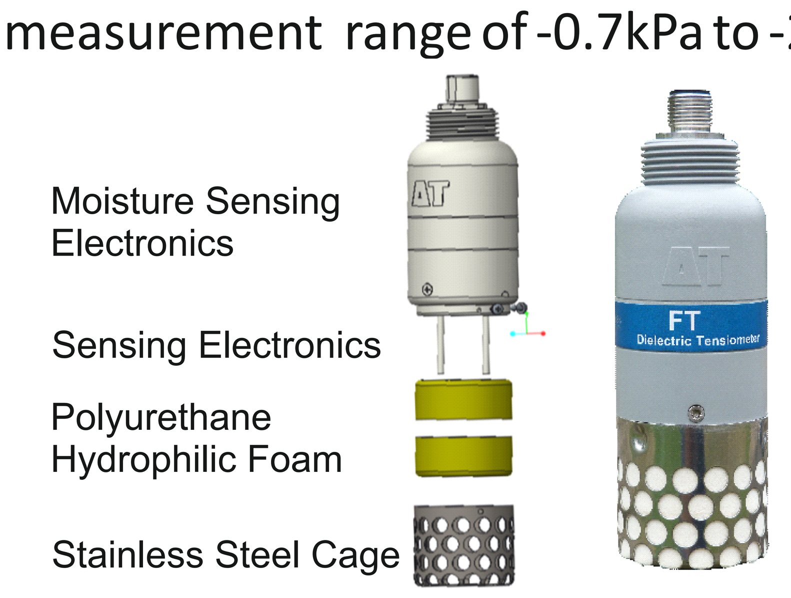
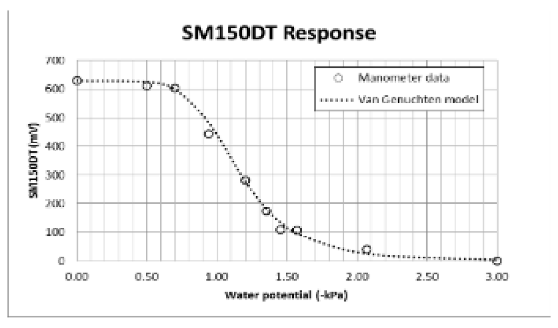
The availability of soil water, and the ability of plants to extract it, is an important variable in plant research. The matric potential has been a useful way to describe water status in a soil–plant system. In soil it is the potential that is derived from the surface tension of water menisci between soil particles. The magnitude of matric potential depends on the soil water content, the size of the soil pores, the surface properties of the soil particles, and the surface tension of the soil water. Of all the measures of soil water, matric potential is perhaps the most useful for plant scientists. In this poster, the relationship between matric potential and soil water content is explored. It is shown that for any given soil type, this relationship is not unique and therefore both soil water content and matric potential need to be measured for the soil water status to be fully described. However, in comparison with water content, approaches for measuring matric potential have received less attention until recently. In this poster, a critique of current methods to measure matric potential is presented, together with their limitations as well as underexploited opportunities. The relative merits of both direct and indirect methods to measure matric potential are discussed. The different approaches needed in wet and dry soil are outlined.

Very wet conditions

A novel dielectric tensiometer that has been designed specifically for use in soil-free substrates such as coir, peat and Rockwool with a water tension measurement range of -0.7kPa to -2.5kPa.

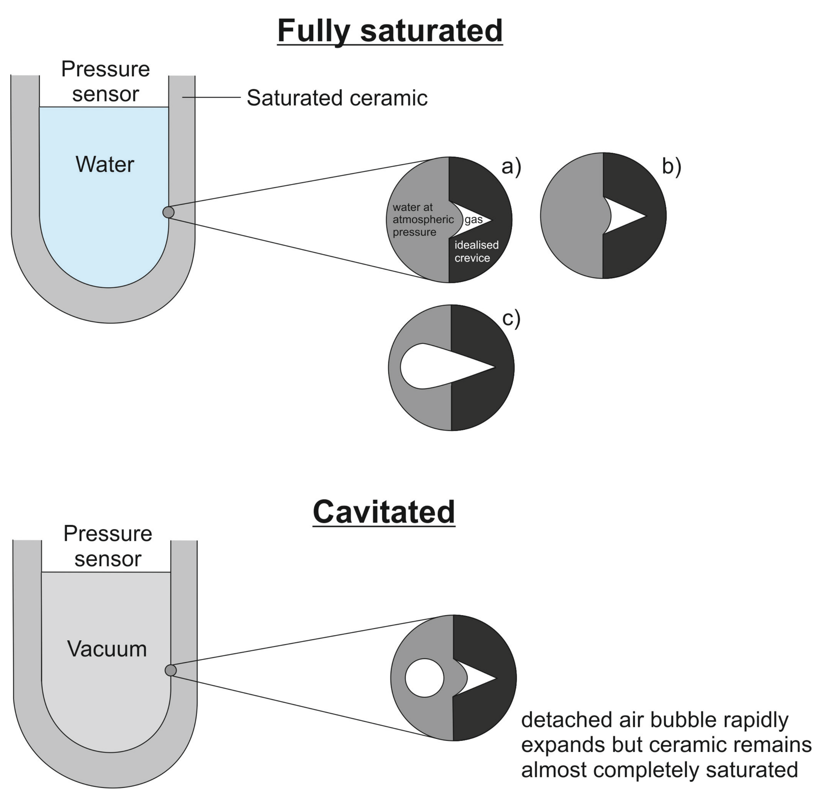




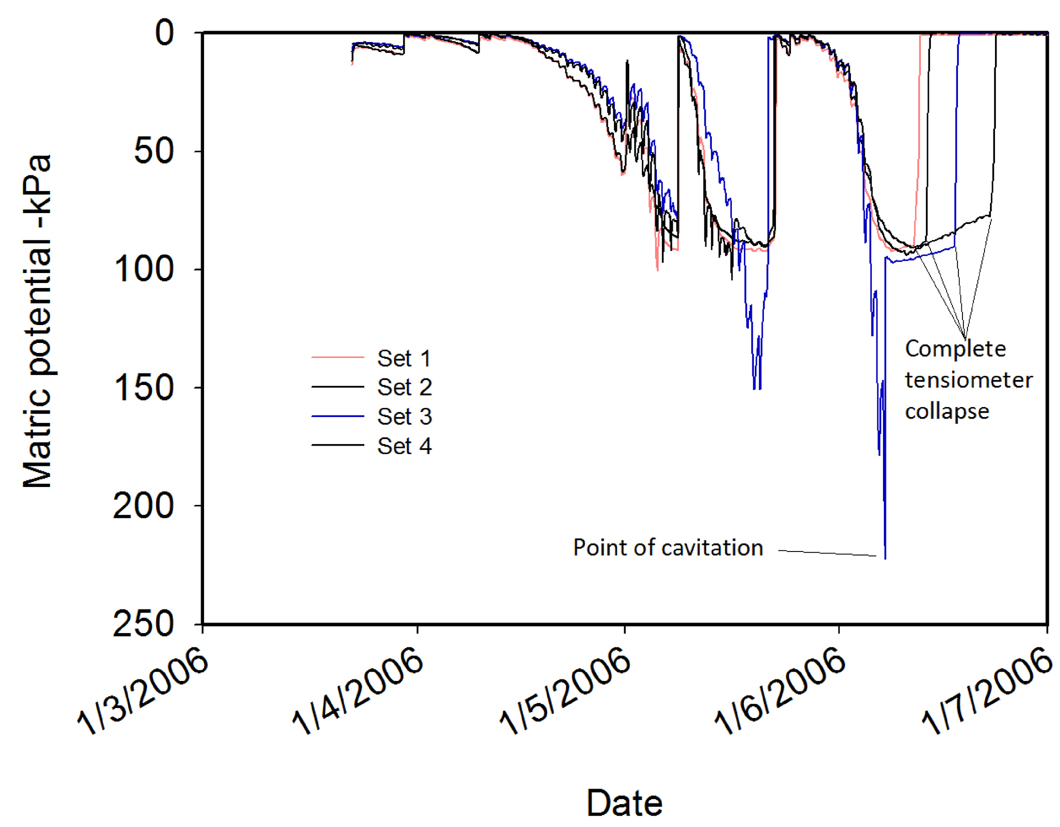
This dielectric tensiometer can be integrated with precision irrigation controllers for commercial grower applications using soil-free substrates.

Pat. App. WO 2016/024120

Water filled tensiometers



Failure stages of the water-filled tensiometer.

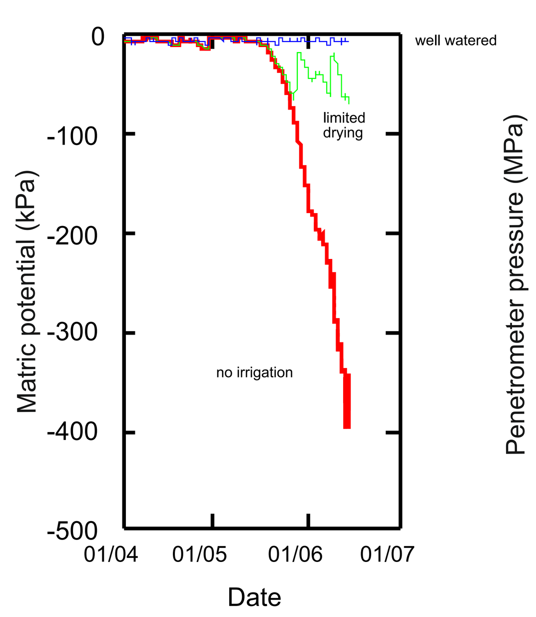


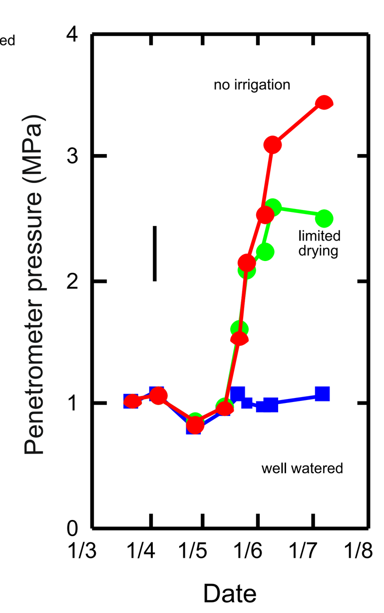
Matric potential data measured with four water-filled tensiometers used by Whalley et al. (2008). Note that one of the tensiometers recorded matric potentials as low as –200 kPa (set 3) and it cavitates at its most negative matric potential.

A robust alternative

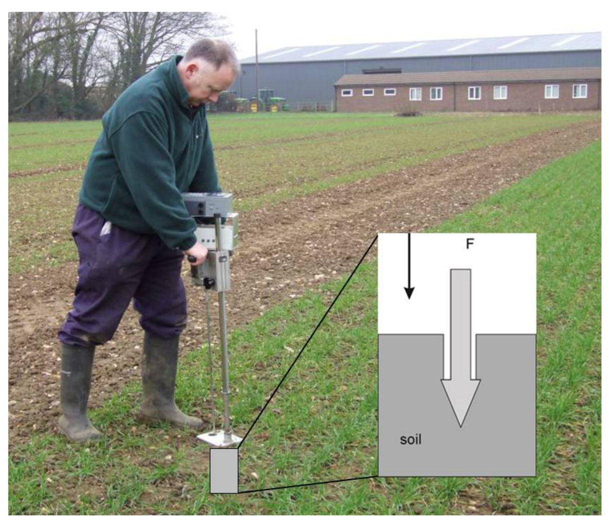
To address the cavitation failure mode of the water-filled tensiometer a novel dielectric tensiometer has been developed for use in soils. This sensor does not suffer from cavitation in very dry soils and automatically recovers from such conditions when the soil is re-wetted. Furthermore, the measurement range can extend well beyond that of a typical water-filled tensiometer.

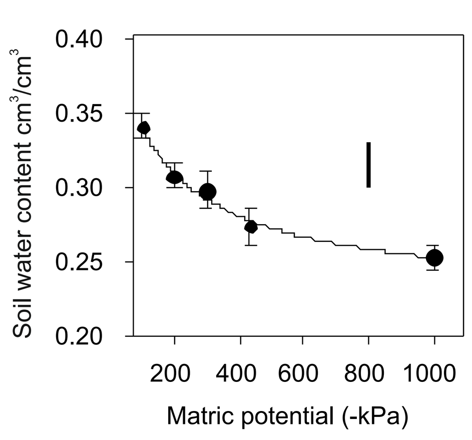
Pat. No. EP2724149, AU2012227733 Pat. App. No. CN103608670, US2014125360

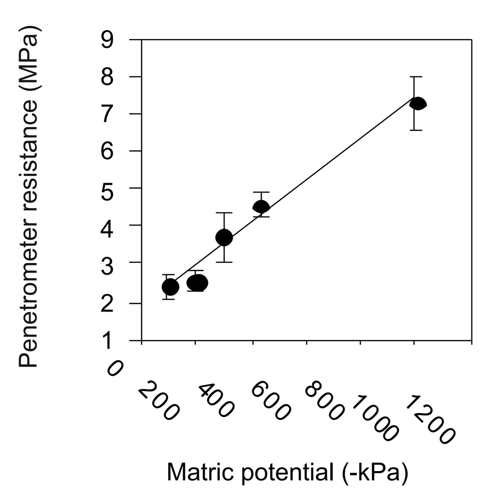


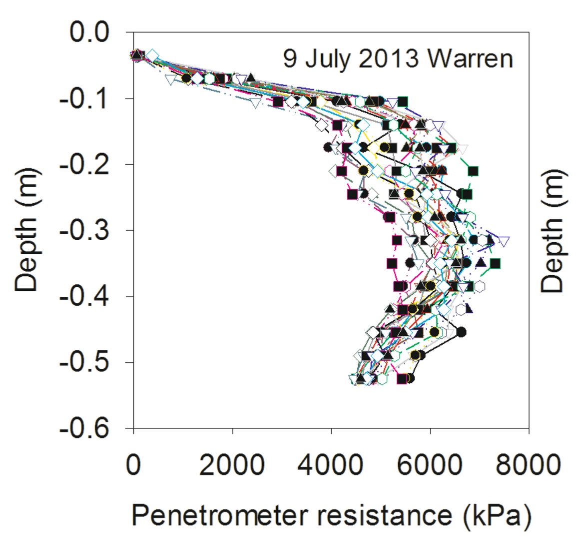


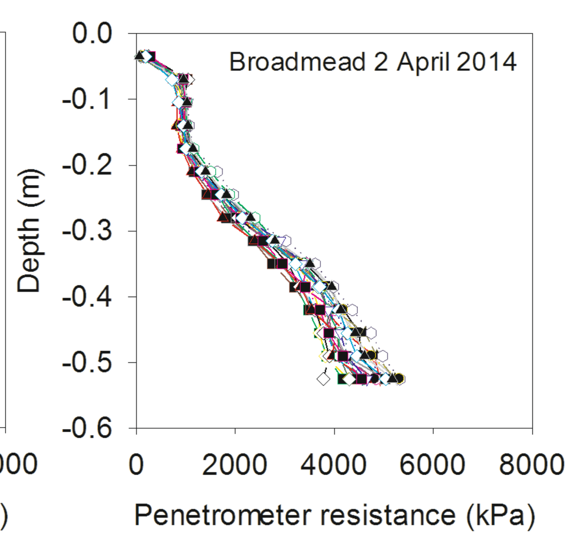
Very dry conditions

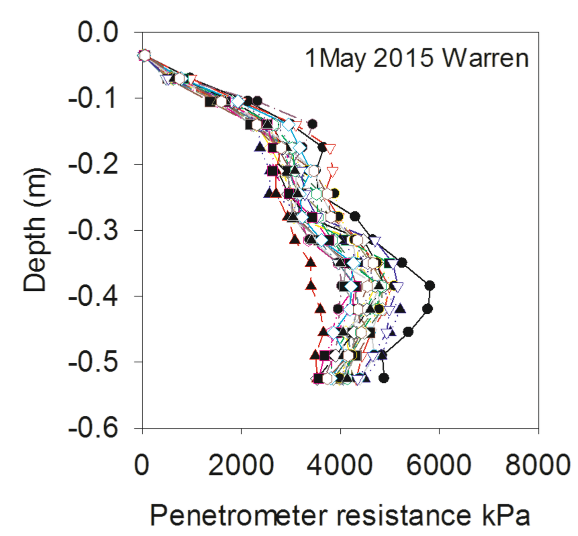












Our data suggest the indirect phenotyping of roots by measuring soil water content is likely to be more effective if the measurement method is related to the matric potential of soil water. Of the methods we have explored penetrometer measurements satisfy this requirement.