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Increases in soil strength due to drying in shrinking and non-shrinking soils

W.R. Whalley, C.W. Watts, L.J. Clark and A.P. Whitmore
Rothamsted Research, Harpenden, Hertfordshire, AL5 2JQ, UK

As soil dries from field capacity, it is its strength (i.e. resistance to root penetration) rather than low matric potential (i.e. lack of water) that is most likely to adversely affect crop growth. This is because soil strength can be sufficient to reduce root elongation even at relatively high matric potentials (wet soils), which in turn affects shoot growth, probably through root-shoot signalling. Even at a matric potential as high as -50 kPa, the yield of field-grown wheat was less than in a well-watered soil. In this paper, we explore how water stress and soil strength interact with each other in shrinking and non-shrinking soils. Evidence from field experiments show that shrinking soils stay weaker for longer than non-shrinking soils as they dry. We suggest that this behaviour is partly responsible for the higher yields of crops grown on clay soils and we provide an explanation for this behaviour based on the physics of soil shrinkage.