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Helical Buckling of Plant Roots: Mechanics and Morphology JESSE SILVERBERG, Department of Physics, Cornell University, ROSLYN NOAR, Department of Plant Pathology, North Carolina State University, MICHAEL PACKER, Department of Physics, Cornell University, MARIA HARRISON, Boyce Thompson Institute, Cornell University, CHRIS HENLEY, ITAI COHEN, Department of Physics, Cornell University, SHARON GERBODE, School of Engineering and Applied Sciences, Harvard University — How do plant roots respond to heterogeneities in their environment as they grow? Using a simple model system consisting of a layered hydrogel, we present a controlled mechanical barrier to the roots allowing us to perturb their growth. Interestingly, we find a localized helical root morphology which forms prior to the root passing through the gel layer interface. We interpret this geometry as a combination of a purely mechanical buckling caused by continued root elongation modified by the growth medium and a simultaneous twisting near the root tip. We study the morphology of the helical deformation as the modulus of the gel is varied using 3D time-lapse imaging and demonstrate that its shape scales with gel stiffness as expected by a simple model based on the theory of buckled rods. Our results demonstrate that mechanics is sufficient to account for the shape and its variations. In addition, we hypothesize that the twisted growth near the root tip arises from a touch-activated growth response that we call thigmotorsion.

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