sample preparation. It is envisaged that the range of uses for LST could also be extended through the use of optical clearing techniques similar to those we use for rendering the soil transparent in this letter. In suitable samples it is still able to produce images with a resolution of less than 3 microns with only basic image reconstruction and without any need for image processing. This resolution, the overall quality of the images and the suitability for more densely scattering samples could be increased by the introduction of techniques such as structured illumination and de-convolution.

The lateral resolution obtainable with the setup presented in this study was shown to be 2.7 μm or greater with the main limitation on resolution being the accuracy of the refractive index matching in the sample.

We have shown the feasibility of the system for plant root phenotyping when combined with novel transparent soils by obtaining images of plant roots *in situ*. Clear 3D images were obtained without using fluorescence. Long term monitoring of lettuce root during 18 hours and tracking of root cap movement were achieved, yielding quantitative information on root growth rate.

Acknowledgments

The work was funded by Engineering and Physics Science Research Council (EPSRC, grant number EP/G01213X/1), Scottish Funding Council (SFC) Horizon fund and Mylnefield Research Services Ltd. The authors also thank Graham Brodie for helping with the experimental setup, Kleber Mariano and Caroline Upton for helping with the preparation of plant samples, and the support from Chinese Scholarship Council (CSC).