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Getting to the root of the matter

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Like most things that exist underground, plant roots are out-of-sight and easily forgotten, but while flowers, leaves, and other aboveground plant parts are more familiar, plant roots are equally deserving of our appreciation. Beneath every towering tree, tasty crop, and dazzling ornamental lies a root system that makes it all possible. Roots provide anchor and support for plants, extract water and nutrients from soil, and reduce soil erosion. Roots also play an important role in soil carbon cycling and the global carbon balance.

A number of current issues related to water availability and climate change are giving impetus to new research aimed at roots and their functioning. The research is producing new experimental methods, data acquisition, and theoretical understanding.

Recently, scientists from the U.S. Salinity Laboratory, USDA-Agricultural Research Service, assembled a collection of new research in the form of 13 papers that are published as a special section of the August issue of *Vadose Zone Journal*. Some of the research in these papers was presented at the 2006 Soil Science Society of America Annual Meeting (Indianapolis, IN) and the 2007 European Geosciences Union General Assembly (Vienna, Austria).

Several of the collected papers take aim at the "out-of-sight" problem, using advanced imaging technologies to observe roots and their functioning at the scale of a single plant or root. Imaging technologies such as Magnetic Resonance Imaging (MRI) are more commonly used in medical and industrial applications, and their use in root research requires new measurement procedures and protocols. In the collected works, researchers were able to successfully obtain images of growing root systems and were able to observe water uptake patterns.

Another current research topic concerns the role of roots in carbon cycling and the implications for global climate change. New research reported in the special section demonstrates that root and carbon dynamics are highly complex, requiring nearly continuous monitoring to understand the biophysical factors that regulate belowground carbon dynamics.

A few of the collected papers are concerned with the development of mathematical models that simulate various root processes, including the uptake of water. These types of models form the basis for various computer simulation tools that are currently used in agricultural and environmental management. For example, one paper in the collection uses such a model to investigate the role of root uptake in regulating the movement of plutonium in soils at the Savannah River nuclear materials processing site.

Roots can also be studied at the level of plant species or biomes. Included in the new collection is research reporting on differences in root zone hydrologic behavior for various species in chaparral ecosystems. The observed differences are minor, but there are detectible differences in how different vegetation affects the water budget. Other research looks at factors affecting rooting depth for different soils, climates, and vegetation. The authors conclude that many ecological factors favor shallow roots over deep roots, and hypothesize that root distributions for particular plant communities tend to be only as deep as necessary to meet specific water requirements.

Source: Soil Science Society of America