

Smit, A.L., Bengough, A.G., Engels, C., van Noordwijk, M., Pellerin, S., van de Gijn, S.C. (ed.): **Root Methods. A Handbook.** - Springer-Verlag, Berlin - Heidelberg - New York 2000. 587 pp. DM 198.00. ISBN 3-540-66728-8.

Although roots play a vital role in uptake of water and mineral nutrients as well as in anchorage of plants, our understanding of their growth, structure and function under natural conditions is much more limited than knowledge of other plant organs. Additionally, a great deal of our knowledge comes from hydroponic studies where root behaviour can differ considerably from behaviour in the heterogeneous soil environment. The research of roots, this "hidden half of plants", under field conditions is limited by time consuming methods and also by high costs of suitable equipment and sometimes even by lack of sufficiently accurate methods.

Therefore the handbook giving a broad overview of all available methods including new and modern methods (image analysis, CT scans, *etc.*) is very useful in root research. The book consists of 16 chapters, each of them written by authorities on the subject.

In the first chapter the importance of roots is described and why and what to measure is explained. In the second chapter a brief summary of anatomical and morphological methods is introduced. It includes the most important procedures for light and electron microscopy and also clearing and squash methods. This chapter shows the importance of anatomical and morphological changes including mycorrhizae and other root symbioses, which influence activity of roots and uptake processes. A very important part of this chapter, which is not usual in handbooks on anatomy, is dedicated to studies of root-soil boundary.

Chapter 3 deals with methods available for manipulation of the soil environment (of water deficit, mechanical stress, temperature and oxygen deficit) and with measurements of these variables under laboratory and field conditions. Systematic analyses of the effect of root environment on architecture are crucial for a better prediction of root system growth under variable and fluctuating environments.

The fourth chapter deals with modelling root system growth and architecture. The models presented are

mainly devoted to a description of the kinetics of root system development and the spatial arrangement of roots. Two main categories of models are described – root depth and length density models and models of the root system architecture.

The following chapters (5 - 11) focus on the assessments of root distribution and dynamics. Sampling strategies are described in detail including auger sampling, in-growth cores, pinboard methods and trench profile techniques. Also the use of minirhizotrons and root windows is explained. Very useful is Chapter 10, focusing on new techniques of image analysis, which give quantitative information on root morphology and architecture. These timesaving techniques will gradually replace traditional methods such as linear measurement devices, line-intercept techniques, *etc.*, as they are faster and less prone to human error. Computer-assisted tomography and magnetic resonance imaging are very modern methods described in Chapter 11. Until recently, techniques for direct measurements on roots and soil water have been mostly destructive. A solution to this problem has been achieved by use of these non-invasive techniques. Of particular value is the ability of CT scanners to non-destructively characterise the internal structure and the nature of components present in the soil.

The last five chapters describe techniques for experimental determination of the functioning of roots. Chapter 12 gives an overview of stable as well as radioactive isotope use in root studies. Chapter 13, 14 and 15 and 16 introduce methods to assess nutrient acquisition, water uptake and plant anchorage, respectively.

The handbook gives a good overview of methods of root research in current use and makes them available to researchers. This work is recommended to people working in many areas of root research - in anatomy, physiology and ecology and also in agriculture, forestry and horticulture.

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