Understanding and Modelling Plant-Soil Interactions in the Rhizosphere Environment

HANDBOOK OF METHODS USED IN RHIZOSPHERE RESEARCH

1.1. Growth Systems

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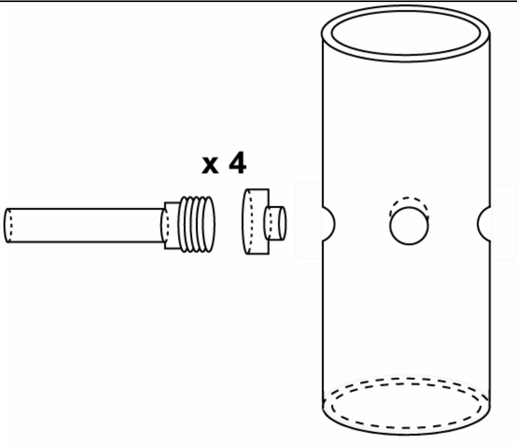
Parameter	**Soil nutrient dynamics at different distances from plant roots. Plant and fauna interactions.**
Soil type	All types
Plant species	All types
System	Microcosm
Method	
Method description	Design of a microcosm may be highly variable according to the experiment conducted. The most simplified model is a single PVC or Plexiglas tube. Its diameter and length can be varied. *Experimental design* To allow spatial studies on soil in relation to the distance from plant root system, a microcosm based on the Starpot system (Jansa et al., 2003, see the scheme below) could be used. It is based on compartmentation principle used since a long time in mycorrhiza research (Schüepp et al., 1987, Jakobsen et al., 1992, Joner and Jakobsen, 1994) It consists of a central tube (15 cm dia and 35 cm height) and four small perpendicular ones ("side arms", 4 cm dia and 20 cm long). Wall thickness of the central tube must be at least 5 mm to provide sufficient mechanical support for the side arms. The microcosm (central tube and side arms) is filled with 2 mm-sieved and remoistened soil at a final bulk density around 1.3 g cm^{-3}. Soil is then moistened to its water holding capacity. Microcosms are then placed in a growth chamber to control both temperature and humidity. Seeds are sown into the central tube. Nutrient solution and water are supplied according to plant needs and research objectives. *Flexibility and improvement of the design* In plant and rhizosphere research, the root passage to the side arms could be avoided by inserting a 25µm-nylon mesh between the side arm and the central tube. This system allows separation of bulk soil and the rhizosphere soil (Le Bayon et al., unpublished).

Method description	To collect percolation water, a funnel could be attached to the bottom of the microcoms.Soil fauna may also be introduced in microcosms, e.g. earthworms to study their burrowing network (Jégou et al., 2000) and/or their interactions with soil microbes and plant roots (Fraser et al., 2003). Complex designs hermetically closed are usually used to measure respiratory exchanges of worms and/or microorganisms (Binet and Tréhen, 1992). In this case, a trap of NaOH catches the CO_2.
Do's, don'ts, potential limitations, untested possibilities	Microcosms lead to an experimental design closer to natural conditions than small pots or rhizoboxes usually used in rhizosphere research. However, it remains enclosed and offers sometimes too little space for plants or soil fauna. The next step is probably larger designs as mesocosms both in the laboratory and in the field. Another problem is the watering of the side arms. We used in our case a baked clay system (Oil Dry Chem-Sorb WR24/18, Brenntag, Vitrolles, France; also provided by Maag Technics, Dübendorf, ZH) to helps infiltration of water from the central tube. Zones with excluded roots longer than a few centimeters may not be realistic in comparison with field conditions where inter-root distances are usually a few mm only.
References	Binet and Tréhen,1992. Soil Biol. Biochem 24:1501-1506. Fraser et al., 2003. Pedobiologia 47: 870-876 Jakobsen et al. 1992. New Phytologist 120, 371-380. Jansa et al. 2003. Agronomie 23, 481-488. Jégou et al., 2000. Eur. J. Soil Biol. 36: 27-34 Joner and Jakobsen 1994. Plant and Soil 163, 203-209. Schüepp et al. 1987. Angewandte Botanik 61, 85-96.
Links	
Additional information	 Scheme of the microcosm.