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DIVIDED ROOT SECTION TECHNIQUES

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SUMMARY: Our knowledge of water uptake by plants under heterogeneous distribution of soil water is scarce. For a better understanding of this situation, divided root section techniques were developed to create discontinuous water distribution in vertically separated soil compartments and to quantify the water uptake by roots at spatially variable soil matric potentials.

1 INTRODUCTION: Water and nutrients are heterogeneously distributed in the rhizosphere. Root activity creates gradients in the soil-root contact zone. Additionally, significant vertical gradients in the distribution of water and nutrients frequently occur in the rhizosphere. They are caused by root activity, management practices (fertilization, irrigation) or result from site- and climate-specific factors.

2 MATERIALS AND METHODS: Soil compartments were separated by paraffin layers (2-mm thick) (Fig. 1b,c) or sandy layers (8-mm thick) with grain size diameters of 2-3 mm (Fig. 1a). The paraffin layers had 100 openings (1-2 mm in diameter) through which roots could grow. The paraffin (solidification point 51-53 °C) was melted and poured into PVC-cylinders (5-mm high, 10.8-cm diameter). The plastic not yet solidified paraffin was placed on a styrofoam support, perforated with a nailboard, kept in a water bath at about 45-50 °C until needed, and then, still plastic, inserted into the soil columns. PVC-tubes (38-cm high, 10.8 cm in diameter), containing four to six soil filled compartments, 8-and 6-cm thick, respectively, were used for the experiments. A silty soil pre-equilibrated to differing soil matric potentials, ranging from -0.025 to -0.18 MPa, was filled in various combinations into the compartments. Whereas no water was exchanged through the paraffin layers, small amounts were passed through the sandy layers. On top of the soil layers, four or six seeds of corn and barley plants, respectively, which had been pre-germinated for 1 day, were sown in a 2-cm thick soil layer, the matric soil water potential of which was -0.025 MPa. Evaporation losses were reduced by a 1-cm layer of sand. The experiments ran for 20 days. Water uptake from the soil compartments was determined by gypsum block measurements or gravimetrically by frequently dissecting the soil columns. Based on these techniques, relations between soil water potential, root and shoot water potentials, as well as the dependence of root mass and root distribution on soil water distribution were investigated and are described in a related paper (Schmidhalter et al., 1991).

REFERENCES: Schmidhalter U., A. Besson and J.J. Oertli, 1991. Water uptake by roots at spatially variable soil matric potentials (this proceedings).

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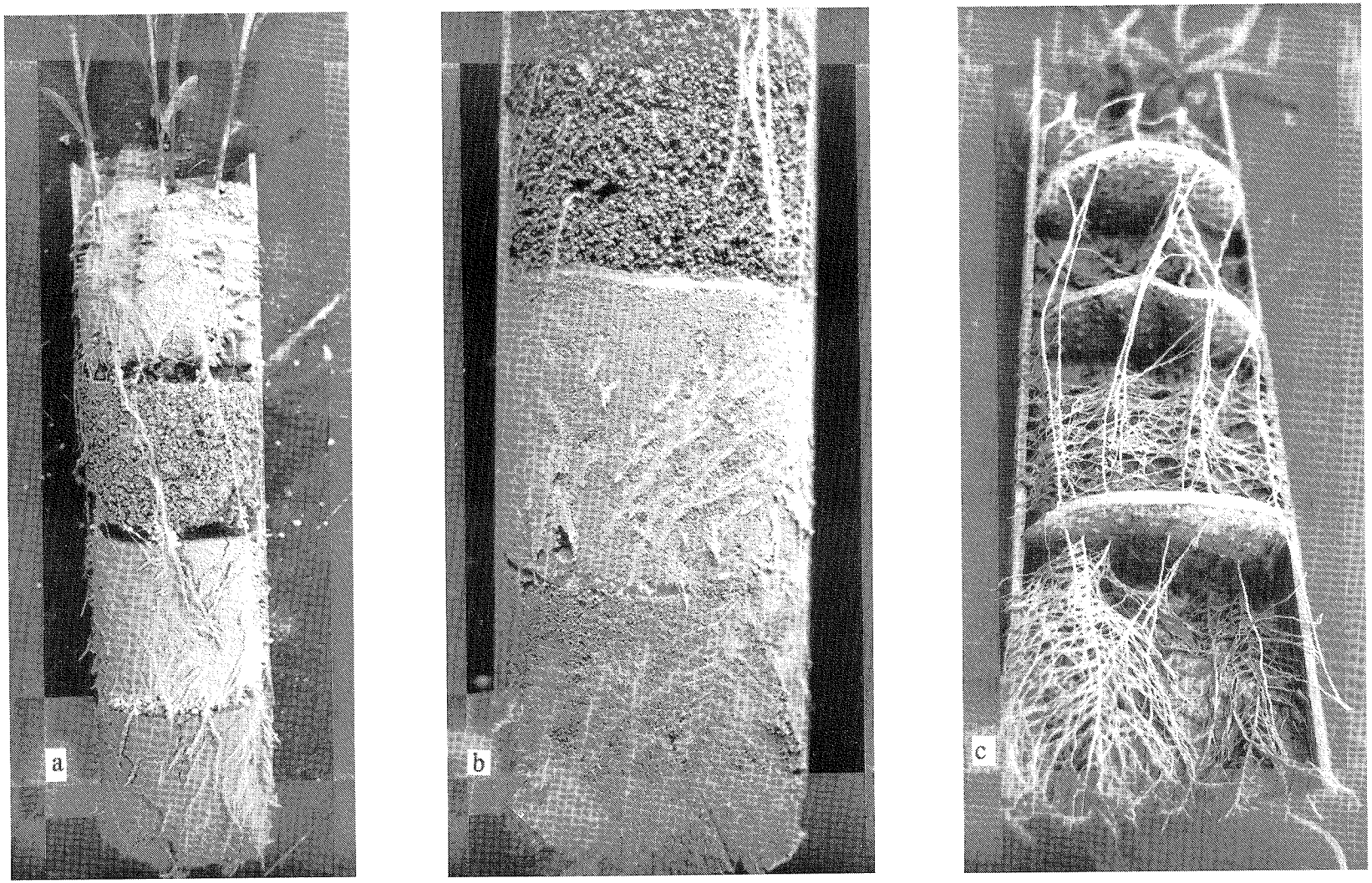

Fig. 1. Maize plants in soil columns (front cover removed) with vertically separated root compartments. Compartments were separated by 8-mm layers of sand (Fig. 1 a) or 2-mm layers of paraffin (Fig. 1 b,c).