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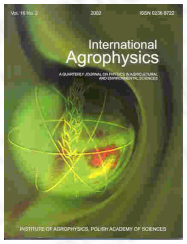

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Physical model for movement of water in split-root wheat plants

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abstract Roots can be split between soil and nutrient solution to determine the effect of soil matric potential on water relations. When such experiments are done with wheat, water from the nutrient solution side moves to the soil side and keeps it wet. Wheat grown with roots split between soil and nutrient solution grows taller than wheat with roots split between soil and soil or between nutrient solution and nutrient solution. A physical model, based on Darcy's law and an Ohm's-law analogy, is used to explain the movement of water between the roots. The model shows that the direction of water flowing in each part of a split-root system depends upon the total head for the stem, crown, and each half of the root. In practice, a root split between soil and nutrient solution acts as a wick and draws solution from the solution side to the soil side of the system. At the crown, the flow of the solution splits, and part of the solution goes up to the shoot and part goes down to the roots in soil. Nutrients feed the roots and shoots. As long as the roots can wick over the nutrient solution into the soil, the plants thrive. Such a split-root system might be realized under furrow-dike irrigation in the field, where part of a root might be in soil and part in water with fertilizer. The model permits the estimation of a crown water potential, which determines the direction of water movement (down to root in soil and/or up to shoot). The crown water potential can be used to compare culti-vars and treatments.

keywords Darcy's law, Ohm's-law analogue, split-roots, wheat