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# Flows of elements, ions and abscisic acid in *Ricinus communis* and site of nitrate reduction under potassium limitation

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## Abstract

**In a pot experiment *Ricinus communis* plants were cultivated in quartz sand and supplied daily with a nutrient solution which contained 4 mol $m^{-3}$ nitrate as the nitrogen source and either full strength potassium (1.3 mol $m^{-3}$, control) or 8% potassium (0.1 mol $m^{-3}$, $K^{+}$-limitation). Although the final fresh weight of the whole plant was not affected by $K^{+}$-limitation, the root–shoot ratio was increased due to a relatively increased root growth and inhibited development of younger shoot parts. Owing to $K^{+}$-limitation, photosynthesis was slightly decreased, while dark respiration of the shoot markedly decreased and root respiration was nearly doubled. The transport of carbon in the phloem, and to some extent in the xylem, was greater and the root was favoured in the partitioning of carbon. This was also true for nitrogen and potassium which were both taken up at lower rates, particularly potassium. In these two cases a high remobilization and recycling from the old part of the shoot was observed. By contrast, uptake of sodium was 2.4-fold higher under $K^{+}$-limitation and this resulted in increased flows in the plants, which was discussed generally as a means for charge balance (in combination with a slight increase in uptake of magnesium and calcium). Nitrate reduction took place in the same portion in the root and shoot. This was a shift to the root compared to the control and points to an inhibition of xylem transport caused by limitation of $K^{+}$ as an easily permeating countercation. Low $K^{+}$ supply also resulted in an increased biosynthesis of ABA in the roots (265%). This caused a slightly increased deposition of ABA in the roots (193%) and a 4.6-fold higher root-to-shoot and a doubled shoot-to-root ABA signal in the xylem or phloem, respectively. The high degradation of ABA in the shoots prevented ABA accumulation there.**

Key words: *Ricinus communis* L., potassium limitation, cations, anions, ABA, phloem transport, xylem transport.

## Introduction

Within the last decade a series of papers has been published dealing with the effects of nutrient deficiency and nutritional disorder in long-distance solute transport and partitioning, including the stress signal abscisic acid in castor bean plants. The nutritional conditions included the type of nitrogen source (Peuke and Jeschke, 1993), salt stress (Peuke and Jeschke, 1995; Peuke *et al.*, 1996), foliar application of nitrogen (Peuke *et al.*, 1998) as well as the limitation or deficiency of nitrogen (Peuke *et al.*, 1994*a*) or phosphorus (Jeschke *et al.*, 1996, 1997*a*, *b*). However, the influence of potassium, the third most important nutrient, has not yet been investigated in the long-distance transport of solute and stress signals.

The importance of potassium for plant life is well documented. Potassium, a macronutrient for plants, is present in plant dry matter next to carbon, hydrogen, oxygen, and nitrogen and before sulphur and phosphorus. In commercial NPK fertilizers in agriculture, potassium is used to improve the yield. Potassium plays a role in a wide range of functions in plants: photosynthesis, enzyme activation, protein synthesis, osmotic

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