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RESEARCH PAPER

ABA flow modelling in *Ricinus communis* exposed to salt stress and variable nutrition

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Abstract

In a series of experiments with *Ricinus communis*, abscisic acid (ABA) concentrations in tissues and transport saps, its *de novo* biosynthesis, long-distance transport, and metabolism (degradation) were affected by nutritional conditions, nitrogen (N) source, and nutrient limitation, or salt stress. In the present study these data were statistically re-evaluated, and new correlations presented that underpin the importance of this universal phytohormone. The biggest differences in ABA concentration were observed in xylem sap. N source had the strongest effect; however, nutrient limitation (particularly phosphorus limitation) and salt also had significant effects. ABA was found in greater concentration in phloem sap compared with xylem sap; however, the effect of treatment on ABA concentration in phloem was lower. In the leaves, ABA concentration was most variable compared with the other tissues. This variation was only affected by the N source. In roots, ABA was significantly decreased by nutrient limitation. Of the compartments in which ABA was quantified, xylem sap ABA concentration was most significantly correlated with leaf stomatal conductance and leaf growth. Additionally, ABA concentration in xylem was significantly correlated to that in phloem, indicating a 6-fold concentration increase from xylem to phloem. The ABA flow model showed that biosynthesis of ABA in roots affected the xylem flow of ABA. Moreover, ABA concentration in xylem affected the degradation of the phytohormone in shoots and also its export from shoots via phloem. The role of phloem transport is discussed since it stimulates ABA metabolism in roots.

Key words: ABA, castor bean, flow models, nutrition, phloem transport, signalling, salt stress, stomatal conductance, xylem transport.

Introduction

Abscisic acid (ABA) is a major plant signal related to abiotic and biotic stress. The most prominent role of ABA is the effect on stomata due to drought and salt stress (Schachtman and Goodger, 2008; Osakabe *et al.*, 2014). ABA is also paramount for regulation of plant growth and development (Wilkinson and Davies, 2002; Cutler *et al.*, 2010; Antoni *et al.*, 2011). In particular, the impact of ABA on plant growth is well documented for seed development, and root and leaf growth (Wilkinson and Davies, 2002; Hartung *et al.*, 2002; Dodd, 2005; Schachtman and Goodger, 2008; Cutler *et al.*, 2010; Boursiac *et al.*, 2013; Chater *et al.*, 2014).

The definition of a phytohormone—as for all hormones—is a biologically active substance where the site of synthesis is spatially separated from the site of signal perception and effect. Therefore, the transport via the long-distance transport system xylem is pivotal for the effects of ABA on stomata (Sauter *et al.*, 2001; Hartung *et al.*, 2002; Dodd, 2005; Jiang and Hartung 2008; Schachtman and Goodger, 2008;