

# Transport, synthesis and catabolism of abscisic acid (ABA) in intact plants of castor bean (*Ricinus communis* L.) under phosphate deficiency and moderate salinity

W. Dieter Jeschke<sup>1,3</sup>, Andreas D. Peuke<sup>1</sup>, John S. Pate<sup>2</sup> and Wolfram Hartung<sup>1</sup>

<sup>1</sup> Julius-von-Sachs-Institut für Biowissenschaften, Lehrstuhl Botanik I, Universität Würzburg, Mittlerer Dallenbergweg 64, D-97082 Würzburg, Germany

<sup>2</sup> Botany Department, The University of Western Australia, Nedlands, WA 6907, Australia

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## Abstract

Flows of abscisic acid (ABA) were investigated in whole plants of castor bean (*Ricinus communis*) grown in sand culture under either phosphate deficiency or moderate salinity. Xylem transport of ABA in P-deficient plants was stimulated by a factor of 6 whereas phloem transport was affected only very slightly. ABA deposition into leaves of P-deficient plants was not appreciably different from the controls because of strong net degradation in leaves. Since conjugation of ABA was strongly reduced in all organs of P-deficient plants ABA was presumably metabolized mainly to phaseic acid and dihydrophaseic acid. The increased import of ABA occurred predominantly into fully differentiated but not senescent leaves and showed a good correlation with the inhibition of leaf conductance under P deficiency.

As with low-P-plants salt stress increased ABA synthesis in roots and associated transport in the xylem. However, salinity caused a distinctly greater accumulation of ABA in the leaves, stem segments and the apex than in P-deficient plants. As opposed to P deficiency, ABA export in the phloem from the leaves was stimulated by salinity. Modelling of ABA flows within an individual leaf over its life cycle showed that young growing leaves imported ABA from both phloem and xylem, whereas the adult non-senescent leaves were a source of ABA and thus provided a potential shoot-to-root stress signal as well as an acceptor for reciprocal signals from root to shoot. In senescing leaves ABA flows and accumulation were somewhat retarded and ABA was lost in net terms by export from the leaf.

Key words: Abscisic acid, phosphorus deficiency, salt stress, phloem and xylem transport.

## Introduction

It now seems well established that roots of plants growing in drying soil have some capacity to sense decreasing soil water content and in response send some form of stress signal to the shoot where stomatal reactions and leaf growth can be affected, even when leaf water potentials have not changed appreciably. There is a large body of evidence that it is the plant hormone abscisic acid (ABA) which acts as the root-to-shoot stress signal, although there seem to be some situations in which other as yet unidentified hormonal factors might also be involved (Munns and King, 1988). Low moisture of soils from extreme habitats is often accompanied by high salt concentrations in the soil solution. Additionally saline soils are often very alkaline (up to pH 11, Wild, 1988) and may cause nutrient deficiencies especially of phosphate and iron by readily forming insoluble precipitates which plants are not able to utilize unless their roots acidify the rhizosphere sufficiently.

The effect of plant nitrogen supply on ABA relations has been investigated in the past by several authors. Recently Peuke *et al.* (1994, and literature on ABA and nitrogen relations cited therein) have shown that nitrate nutrition has only weak effects on long distance ABA transport, but if replaced by ammonium roots increase both their ABA biosynthesis and release of ABA to the xylem stream. Increased ABA concentration in the xylem is then well correlated with reduced leaf conductance and a general inhibition of leaf growth.

<sup>3</sup> To whom correspondence should be addressed. Fax: +49 931 8886158. E-mail: jeschke@botanik.uni-wuerzburg.de