

## The Role of Carbohydrates on the Salt Tolerance of Jojoba [*Simmondsia chinensis* (Link)] Explants *in Vitro*

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### Summary

Jojoba [*Simmondsia chinensis* (Link) Schneider.] explants were cultured *in vitro* under four levels of sodium chloride concentration during the shoot proliferation stage. The dry weight of explants as well as their water and carbohydrate content were determined during a three-month period at month intervals. Jojoba explants were tolerant to salinity up to a certain level (0.66 % w/v sodium chloride), showing increased water uptake and dry weight compared to the control. Sucrose and pinitol content were found to be higher in explants grown under saline conditions, while the opposite stood for glucose. Fructose, inositol and starch content did not exhibit any significant changes with salinity. Carbohydrates may play an osmoprotective role in jojoba salt tolerance under *in vitro* conditions, by enhancing water uptake from the medium up to a certain salinity level (0.66 % w/v), revealing thus an adaptive response of the species against the increased salinization of the growth medium.

**Key words.** hexose – osmoregulation – relative growth rate – sodium chloride – starch-tolerance index.

### Zusammenfassung

**Die Wirkung von Kohlenhydraten auf die Salztoleranz von Jojoba-Explantaten [*Simmondsia chinensis* (Link)] *in vitro*.** Jojoba- [*Simmondsia chinensis* (Link) Schneider.] Explantate wurden während der *in vitro* Proliferationsphase bei vier verschiedenen Natriumchlorid-Konzentrationen kultiviert. Das Trockengewicht der Explantate sowie ihr Wasser- und Kohlenhydratgehalt wurden während einer dreimonatigen Periode in monatlichen Abständen ermittelt. Jojoba-Explantate waren bis zu einer bestimmten Salzkonzentration (0.66 % w/v Natriumchlorid), tolerant und reagierten im Vergleich zur Kontrolle mit Erhöhung von Wasseraufnahme und Trockengewicht. Der Saccharose- und der Pinitolgehalt waren in den Explantaten, die unter Salzeinfluss kultiviert wurden, höher, während das Entgegengesetzte für Glukose zutraf. Fructose-, Inositol- und Stärkegehalt zeigten keine signifikanten Änderungen mit dem Salzgehalt. Bis zu einer Salzkonzentration von 0.66 % w/v können Kohlenhydrate durch ihre Steigerung der Wasseraufnahme aus dem Substrat eine osmoprotektive Rolle in der Jojoba-Salztoleranz unter *in vitro* Bedingungen spielen und folglich eine Anpassung an erhöhte Salzkonzentrationen im Substrat aufdecken.

### Introduction

Salinity and drought stress reduce growth and plant productivity more than any other environmental factor (BOHNERT and SHEN 1999). Most plants increase their cellular concentration of osmotically active compounds, termed compatible solutes, when in danger of becoming desiccated by either drought or external lowering of the osmotic potential, due to increases of soil salinity (FORD 1984)

Salt stress affects many physiological and biochemical processes in plants. Amongst the major effects on plant metabolic pathways are those involving carbohydrate metabolism, with the accumulation of sugars and a number of other organic solutes (ASHRAF et al. 2002; KAUR et al. 2003). Carbohydrates are frequently associated with active osmotic adjustment (DUBEY and SINGH 1999; ASHRAF et al. 2002; MELONI et al. 2003) and have long been known to increase in a wide range of plants grown under saline conditions (PEREZ-ALFO-

CEA and LARHER 1995; TATTINI et al. 1996; GUCCI et al. 1998; BOHNERT and SHEN 1999; KAFI et al. 2003).

Jojoba [(*Simmondsia chinensis* (Link) Schneider.)] is considered to be a relatively salt tolerant plant species (BENZIONI et al. 1992; MILLS et al. 1997). Nevertheless, salt damage can occur and differences in response among clones have been observed (BENZIONI et al. 1992; BOTTI et al. 1998) indicating the possibility of breeding cultivars with increased salt resistance or tolerance. According to BENZIONI et al. (1992) and MILLS and BENZIONI (1992) *in vitro* nodal segments of jojoba respond to salinity in a similar way as the whole plant. In order to be able to evaluate clones at a relatively early stage of growth, *in vitro* culture-selection can become a powerful tool based on some biochemical characteristics, which can be used in the early selection for tolerance.

In the present study, the possible contribution of carbohydrates to salinity tolerance is investigated, so as to determine whether they may be used as a research tool in the selection of salt tolerant jojoba clones.