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Legume carbon metabolism under stress: *Lotus japonicus* features

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The effect of drought on nitrogen fixation (NF) has been widely reported (see Zahran, 1999). Among the factors, such as oxygen limitation and nitrogen feedback, a shortage in nodule carbon flux has also been related to the inhibition of NF under drought (Arrese-Igor *et al*., 1999). In these conditions, nodule sucrose synthase (SS) activity sharply declines (González *et al*., 1995), thus limiting the carbon flux required for bacteroid respiration. Indeed sucrose accumulation and malate depletion take place in nodules as a result of SS down-regulation (González *et al*., 1998; Gálvez *et al*., 2005). Recently, by using a split root system in pea plants, it has been shown that the cause of NF inhibition under drought is of a local origin, rather than relying on a systemic signal (Marino *et al*., 2007). Key parameters of carbon metabolism showed also a local regulation, correlated to NF inhibition, although nitrogen feedback regulation needs to be further explored in this split root system. Both factors seem to be crucial for the regulation of NF under drought (Ladrera *et al*, 2007). However, carbon metabolism has been shown to play not such a main but a secondary role in plants of the genus *Medicago*. Naya *et al*. (2007) concluded that a decrease in SS expression and activity, although relevant, was not the cause of the drought-induced loss of nitrogenase activity in alfalfa. Interestingly, a similar response has been found in the model legume *Medicago truncatula* (R. Ladrera, E.M. González, and C. Arrese-Igor, unpublished data). A recent proteome analysis (Larrainzar *et al*., 2007) of plant and bacteroid fractions of *Medicago truncatula* root nodules under drought stress reveals that both plant and bacteroid fractions respond simultaneously to water-deficit at the protein level. It can be inferred from the proteomic analysis that the plant response in nodules involves a global reduction of plant protein biosynthesis and a down-shift of cellular carbon and nitrogen metabolism and also sulfur metabolism, thus reducing the energy-demanding process of NF. Drought response of nodule metabolism in *Lotus japonicus* has not been extensively approached by now. However, several evidences suggest that alkaline invertase could play a relevant role in nodule carbon metabolism (Horst *et al*., 2007; Flemetakis *et al*., 2006), diminishing the exclusive role of SS, as carbon supplier of nodule metabolism in the model legume *Lotus japonicus*.

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