

Nitrogen metabolism in *Lotus japonicus* and the relationship with drought stress

[ANTONIO J. MÁRQUEZ](#)^{*1}, MARCO BETTI¹, MARGARITA GARCÍA-CALDERÓN¹; ALFREDO CREDALI¹, PEDRO DÍAZ², OMAR BORSANI² and JORGE MONZA²

¹ *Departamento ed Bioquímica Vegetal y Biología Molecular, Facultad de Química, Universidad de Sevilla, C/ Profesor García González 1, 41071-Sevilla, España.*

² *Departamento de Biología Vegetal, laboratorio de Bioquímica, Av. Garzón 780 CP12900 Montevideo, Uruguay*

* *Corresponding author*

In our laboratories we carry out research on nitrogen assimilation in *Lotus* plants and the possible relationships with drought stress situations that become a likely cause of the loss of these forage plants when they are cultivated (Díaz *et al.*, 2005a; 2005b). Some of our research has been conducted with the model legume *Lotus japonicus*, while other research was done on cultivated species. *Lotus japonicus* plants are able to use both nitrate and ammonium as inorganic nitrogen sources for ulterior assimilation, or, alternatively, they can also use atmospheric dinitrogen through *Mesorhizobium loti* symbiosis. Primary nitrate assimilation takes place predominantly in the roots of the plant, being strongly dependent on the age and limitation of space for root growth (Orea *et al.*, 2001; Pajuelo *et al.*, 2002). Attempts of genetic manipulation of root-shoot partitioning of nitrate assimilation, either by increasing external nitrogen availability (Orea *et al.*, 2005a), or using a transgenic approach (Orea *et al.*, 2005b), were not able to shift this partitioning to the aerial part of the plant, thus suggesting the existence of ecophysiological adaptations for a preferential use of external nitrogen in the root (Márquez *et al.*, 2005). This situation makes crucially important the mobilization of nitrogen from roots to shoots of the plant, particularly with regard to asparagine metabolism. On the other hand, in our laboratory we have also recently shown the importance for this plant of other forms of secondary nitrogen assimilation such as reassimilation of ammonium released by photorespiration. We have used a mutagenesis approach to demonstrate the essentiality of plastidic glutamine synthetase in this process. However, this was not the case for primary ammonium assimilation, a process which can rely basically on cytosolic glutamine synthetase (Orea *et al.*, 2002; Betti *et al.*; 2006). The use of these mutants enabled to show that there is also some influence of photorespiration on the level of different ammonium transporters (D'Apuzzo *et al.*, 2004) as well as nodule development and starch metabolism (García-Calderón *et al.*, 2007). Nitrogen metabolism in *Lotus* plants shows also a strong connection with drought stress situations, mainly through the biosynthesis of proline, which becomes a very nice marker of osmotic stress situations in this plant (Díaz *et al.*, 2005 b,c). Proline metabolism is greatly influenced by the type of nitrogen nutrition provided to the plant (Díaz *et al.*, 2005c). At present we are also investigating the possible interconnection between photorespiration and drought stress situations in these plants.

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