

Breeding temperate legumes: advances and challenges

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Conventional breeding is an efficient tool with factors with low environmental effect, where the phenotype expression is closer to the genotype. On the other hand, selection for abiotic stresses involves complex characteristics restricting progress of conventional breeding programs. The study of the responses of several perennial legumes to selection for water and saline stress, Al tolerance and P availability is developed in the frame of the Projects LOTASSA (FP6-2003-INCO-DEV2 PL-517617) and LESIS (FTG-787/2005). Their approach involves the characterization and selection of naturalized populations for the identification of superior germplasm, as well as their metabolic and molecular analysis in order to develop strategies that could speed conventional breeding in the future. The presentation describes the approach and first results. The physiological responses of the main cultivated species to Al, saline and water stress are evaluated. Divergent selection is carried out in *Lotus corniculatus* (*Lc*) and diploid *L. uliginosus* (= *L. pedunculatus*) (*Lu*) for tolerance to water stress and Al tolerance, and the development of contrasting populations for root characteristics (root branching and density), the characterization of natural populations of *L. glaber* (= *L. tenuis*), *Trifolium repens* (*Tr*) and *T. pratense* (*Tp*) for water stress, *L. glaber* for saline stress. Chilean and Uruguayan naturalized populations of *Lc*, *Tr* and *Tp* are evaluated for water stress and prevailing diseases. Results show that there is genetic variability within the *Lc*, *Lu* and *Lg* germplasm for Al tolerance, water and saline stress, respectively, to be used in the selection process. *Lc* cultivar San Gabriel (Uruguay) was more sensitive to Al toxicity than Brazilian germplasm; the membrane potential in root cortex cells remains unchanged between pH 4.4 and 6 for the most tolerant Brazilian selections. Although saline stress stunted foliar and root growth, the evaluation at young stages (40 days) showed *Lg* entries collected in saline soils of Buenos Aires Province (Argentina) that produced 50% more forage than less adapted germplasm. There are differential responses of Chilean *Lg* accessions to water stress in leaf rate appearance, stem elongation and stem dry weight. Water stress (40% field capacity) was imposed for six months to *Lc* cultivar San Gabriel and INIA Draco. Contrasting phenotypes were identified through regrowth production (2.15 and 4.13 g/plant of fresh weight for sensitive and tolerant selections, respectively). Differences between sensitive and tolerant selections were larger for *Lu* (2.96 and 7.72 g FW/plant). Proline is one of the metabolite that shows high consistency with the response to water stress in several species of *Lotus* as well as in *Tp*. The isotopic discrimination ($\Delta^{13}C/^{12}C$) has a good correlation with water use efficiency for the cultivated *Lotus* species.