

Lotus research update from Eastern Australia

JOHN F. AYRES

Agricultural Research & Advisory Station, 'Centre for Perennial Grazing Systems', NSW Agriculture, PMB Glen Innes, New South Wales, Australia

In recent years, I have pursued 3 major studies on lotus improvement. The first project (*'Birdsfoot trefoil & Greater lotus in temperate perennial pasture'*) investigated the potential of lotus-based pastures to improve grazing production in the high rainfall zone of eastern Australia and reflected on the respective zones of adaptation of birdsfoot trefoil and Greater lotus. The second project (*'New lotus varieties for acidic soils in northern NSW'*) characterised birdsfoot trefoil germplasm for traits associated with adaptation under short photo-period conditions and identified promising selections for subsequent breeding work. The third study (*'Development of birdsfoot trefoil cultivars for permanent pastures in the northern recharge zone'*) is currently developing experimental varieties of birdsfoot trefoil. Highlight findings include:

'Birdsfoot trefoil & greater lotus in temperate perennial pasture' (1994 - 2000). The adaptation of greater lotus and birdsfoot trefoil to low fertility acidic soils and the presence of condensed tannins in lotus foliage make greater lotus and birdsfoot trefoil potentially valuable legumes for the Australian grazing industries. However, use of lotus in Australian pastures has been limited by a) lack of knowledge of the respective zones of adaptation of Greater lotus and birdsfoot trefoil, and b) lack of adapted varieties. To bridge this knowledge gap, I led a state-wide study in NSW comprising a grazing experiment replicated in 4 environments (Northern Tablelands, North Coast, Southern Tablelands and South Coast) supported by co-learning studies at 17 farm sites in coastal and tablelands districts. The experiment provided results for the establishment and management of lotus-based pastures and the expression of persistence mechanisms in these 4 environments. The co-learning phase demonstrated the adaptation of lotus to a diversity of climatic, edaphic and enterprise applications across the high rainfall zone. This project achieved significant outcomes including:

- Improved definition of the lotus zone – Greater lotus for high rainfall coastal districts and niche hinterland and tablelands sites, and birdsfoot trefoil as a new alternative legume for northern NSW.
- Increase in the knowledge base of lotus technology – establishment requirements, management practices for persistence and cultivar evaluation results.
- Increased farmer awareness of the unique and valuable properties of birdsfoot trefoil – drought tolerance and adaptation to low fertility acidic soils, potential to lift the productivity of marginal grazing lands and to increase water use on acidic soils in dryland salinity recharge areas.
- The project identified the need for development of a broad adaptation Greater lotus cultivar and a short photo-period birdsfoot trefoil cultivar.

‘New lotus varieties for acidic soils in northern NSW’ (1999 - 2001). The most significant result of my research with lotus to this point indicated that the northern limit to the zone of adaptation of birdsfoot trefoil in Australia is determined by photo-period. Moreover, I concluded that if widespread adoption were to be accompanied by increased susceptibility to fungal diseases (as experience in North America has indicated), maintenance of population density by seedling recruitment will also be essential for long term persistence.

Consequently, the aim of this study was to characterise a world-sourced set of birdsfoot trefoil lines and undertake selection for flowering prolificacy. This work developed data-sets of vegetative and reproductive traits for some 50 birdsfoot trefoil lines, collected *ca.* 70 elite genotypes, and determined the genetic variability and heritability of seed yield components (flower/tiller, umbels/tiller, pods/umbel, seeds/pod) in these populations to validate a breeding project to follow. One birdsfoot trefoil breeding line and 4 selected populations were identified as suitable for progressing to experimental variety status.

‘Development of birdsfoot trefoil cultivars for permanent pastures in the northern recharge zone’ (2002 -2005). Work in the previous 2 projects identified elite birdsfoot trefoil germplasm. At this stage of the birdsfoot trefoil improvement program, I was commissioned by the Dryland Salinity CRC ‘...to progress birdsfoot trefoil germplasm to experimental variety status by 2005 to achieve a new deep-rooted perennial legume for the upper catchment Murray-Darling Basin’.

This is a current project in which I am polycrossing selected genotypes to form breeding lines, characterising the breeding lines, and evaluating genetic gain in Syn 1 and Syn 2 populations against the unselected population. Preliminary data to hand comparing the seed yield components of the selected genotypes against the unselected population shows dramatic genetic gain from 2 rounds of recurrent selection.