Australian pasture systems: the perennial compromise

L.W. Bell and M.A. Ewing
CRC for Plant-based Management of Dryland Salinity & School of Plant Biology, The University of Western Australia, 35 Stirling Highway, Crawley WA 6009, Australia, Email: lbell@agric.uwa.edu.au

Keywords: integration, annual pastures, perennial pastures, sustainability, agricultural systems

Introduction Dryland salinity, soil acidification and weed herbicide resistance challenge traditional agricultural production systems in south Australia. The pasture component of such systems rely on annuals like *Trifolium subterraneum* and *Medicago* spp. Replacing annual with perennial pastures allows some redress of the sustainability challenges, but few well-adapted species are available (Ewing & Dolling 2003). A range of perennial species are under evaluation to supplement current options. Some of these new perennial pastures may need modified production systems that allow full expression of their productive potential, especially when integrated with annual crops including cereals, pulses and oil seeds. Integrated systems rely on spatial or temporal segregation of pastures from crops. The necessary characteristics of plants for likely systems are discussed.

Systems Very important factors to design systems into which new species might be embedded are: (1) There is a trade-off between persistence and productivity. In very arid, low productivity environments, new pasture species need to have specific advantages to warrant adoption. (2) New species may vary in plant form (i.e. woody shrubs or trees to herbaceous species). Woody species, though less productive, have deep roots, maintain green leaf area and differ in growth pattern. Their purpose may be only to boost water use and fill gaps in feed supply. (3) Production systems must be flexible enough to respond to temporal changes in profitability between component enterprises. (4) The system must reflect feasible investment and input needs and have enough low risk associated with the technology to encourage wide-scale and rapid uptake.

Phase farming rotates pasture with crops. Pasture phases are flexible and allow farmers to change to crop production when desired. Farmers can integrate perennials into the pasture phase. However, the need to re-establish pastures at the start of each phase means that establishment cost must be low. Species well suited to this system must have a cheap source of seed, high early vigour, compete with weeds and withstand grazing in the year of sowing. Lucerne (*Medicago sativa*) is successful. It can be used to manage dryland salinity by establishing a dry soil buffer below the root depth of annual species to reduce recharge of groundwater tables (Latta *et al*., 2001). It also aids weed management and fixes nitrogen for subsequent crops.

Alley systems are used for woody species when spatial separation of plants is more suitable. This enables annual pastures or crops to be grown between rows of fodder shrubs or trees. Plants used in this system generally are slow to establish but are long-lived. Tagasaste (*Chamaecytisus proliferus*), Leucaena (*Leucaena leucocephala*) and Saltbush (*Atriplex spp.*) are successful. These have deep roots and can access the water table to increase water use of agricultural systems (Lefroy *et al*., 2001). They also improve the continuity of feed supply.

Intercropping (or companion cropping) is where another species is grown amongst a crop. This has been explored little with perennial pasture species. Suitable species would be leguminous, have low winter activity to reduce the competition on the accompanying crop, prostrate habit to avoid contamination of crop products and responsiveness to opportunities outside the crop-growing season. This system may enable sustainability objectives such as high water use to be achieved whilst continuing to produce crops.

Conclusion Integration of perennial pastures can improve sustainability of agricultural systems. Development of new species should address essential considerations. Production systems that integrate perennial pastures may need to evolve as new species are developed.

References

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