Making Decisions to Identify Forage Shrub Species for Versatile Grazing Systems

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Introduction

Grazing systems in many parts of the world face large challenges, including a declining natural resource base (*e.g.* soil fertility), marked fluctuations in feed production across seasons and years, climate change (including the contribution of greenhouse gases from livestock), and market demands for sustainable and ethical production systems. The 'Enrich' project was established in Australia (Revell *et al.* 2008; Bennell *et al.* 2010) within this broad context of emerging challenges to explore the potential of using Australian native perennial shrub species as part of the feedbase for sheep and cattle in southern Australia. The underlying rationale was to: add perennial shrub species into the existing annual-based pasture feedbase so that the forage system could tolerate extended dry periods but provide green edible plant material during periods where a 'feed gap' would otherwise exist; be productive on marginal soils where other productive options are limited (Masters *et al.* 2010); and have a positive effect on gut function and health (Vercoe *et al.* 2007); *i.e*. a versatile grazing system. This paper outlines the research approach that was taken, and reports on a 'decision tree' to prioritise species from an initial large list, based on a wide range of plant characteristics and how they can be used in a grazing system.

Experimental approach

Plant selection and field sites

The process we established for selecting perennial shrub species that may be suitable for inclusion in grazing systems is described by Bennell *et al.* (2010). In brief, the main selection criteria were: (1) having a perennial life habit and woody growth form; (2) being native to the traditional livestock-cropping zone (temperate) or the southern pastoral zone (semi-arid); (3) evidence of being palatable and no evidence of toxicity to livestock; and (4) being able to be propagated and grown under field conditions. This resulted in 101 species being evaluated in the project. The majority of these species were planted at three sites across southern Australia, varying in soil characteristics and annual rainfall (294-486 mm): sandy-loam over clay at Monarto, South Australia (S 35.12080 E 139.13763), duplex loamy sand-over-clay in Merredin, Western Australia (S 31.47201 E 118.19976), and clay loam at Condobolin, New South Wales (S 33.07763 E 147.28229). Subsets of about 15 species were also grown at over 20 smaller sites across southern Australia, in partnership with various local groups. Plants were assessed for ease of establishment, survival and biomass production over 3-6 years, biomass response to annual (autumn) grazing, and a preference value (qualitatively assessed on a 1-5 scale) shown by sheep when grazing sites with multiple species on offer.

Plant analyses

Plant samples were collected at least annually and analysed for nutritive value, including the content of organic matter (OM) and total ash, neutral detergent fibre and acid detergent fibre, hemicellulose, crude protein and mineral content and *in* vitro OM digestibility (Norman *et al.* 2010). Freeze dried plant samples were used to quantify pH, total gas production and the concentrations of volatile fatty acids, ammonia and methane in a batch *in vitro* fermentation system (Durmic *et al.* 2010). The effects of plant material on *in vitro* development of the larval stages of gastrointestinal parasites were also assessed (Kotze *et al.* 2009).

Animal performance, grazing behaviour and economic analysis

Grazing experiments were conducted at a number of different field sites to evaluate diet selection, livestock productivity, effects of different shrub combinations, and consequences of different management strategies such as stocking rate or prior experience of livestock on intake, diet selection and performance. Animal house studies focussed in greater detail on aspects of behaviour and diet selection.

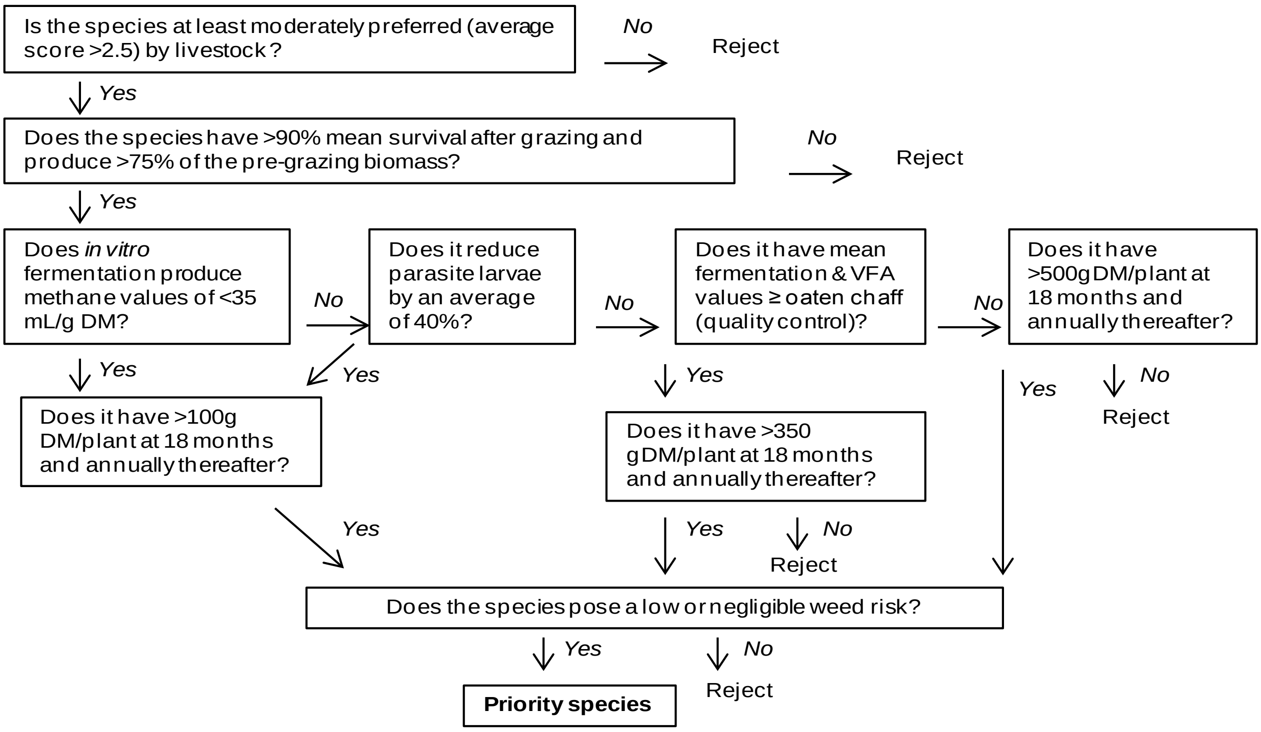

Figure 1. A decision tree constructed to develop a priority list of shrub species

The decision process to identify priority species

Many of the 101 species showed at least one good attribute, however we needed to identify a sub-set of priority species that had the most potential across the range of characteristics we had quantified, and we focused future research needs to develop strategies to increase the adoption of forage shrubs into grazing systems. We developed a decision tree that allowed us to assess a wide range of characteristics and allowed any particular shrub species to take various pathways to a point of prioritisation (Fig. 1).

The use of the decision tree (Fig. 1) identified 18 species of Australian shrubs as priorities, with species from the genera of *Acacia* (n=2 species), *Atriplex* (n=3), *Chenopodium* (n=1), *Enchylaena* (n=1), *Eremophila* (n=2), *Kennedia* (n=1), *Maireana* (n=4) and *Rhagodia* (n=5). Ongoing research and engagement activities with producer groups, natural resource managers and commercial nurseries are part of the continual process of developing locally-relevant versatile grazing systems that combine perennial shrubs and pasture to provide practical new options for producers, especially those operating in difficult environments with a variable climate, low-medium rainfall and marginal soils.

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