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Perennial pasture species for the mixed farming zone of southern NSW – We don't have many options

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Abstract: *From 2002–08 the Cooperative Research Centre for Plant-Based Management of Dryland Salinity (CRC PBMDS) embarked upon an extensive evaluation program to identify viable alternative perennial pasture species for cropping environments across southern Australia. In southern NSW, there were relatively few species that showed adequate persistence and production. Lucerne, phalaris, chicory and cocksfoot were found to be the key species for this zone with lucerne being the only legume. Perennial veldt grass and perennial bromes exhibited desirable characteristics in small-plot experiments in the higher rainfall region, but further research is required to identify the best way to incorporate them into our farming systems. For warmer and lower rainfall regions of southern NSW, Lotononis bainseii offers some promise as an alternative legume to lucerne and also warrants further investigation. Sulla and Onobrychis vicifolia may be suitable alternatives as short-term forage options. This paper provides a brief overview of the relative performance of the key species tested within the CRC PBMDS program.*

Introduction

The initiative from 2002–08 to identify alternative perennial pasture species in southern Australia was motivated by i) the need to increase the proportion of the landscape under perennial plants in order to mitigate against rising water tables and the negative effects of dryland salinity, and ii) the recognition of the very limited range of perennial species currently grown in mixed farming systems (Dear and Ewing 2008). Perennial species are also known to be effective at mitigating against soil acidification (Ridley *et al.* 1990; Dear *et al.* 2009), and can offer production advantages, particularly where rainfall is low or occurs outside the normal growing season for winter-annual species (Wolfe *et al.* 1980; Hill 1985).

The range of perennial pasture species currently in use in mixed farming systems of southern NSW is very limited. Lucerne (*Medicago sativa*) is by far the most broadly utilised species and is the only perennial legume option used, outside small specific niches or the very high (>800 mm) rainfall zone (Dear *et al.* 2003). Lucerne has many desirable characteristics such as high productivity, good drought tolerance and high nitrogen fixation capacity, which perhaps explains why it is so broadly utilised. However, there are many situations where alternative perennial species would add additional value to the farming enterprise, such as on soils that are too acidic or prone to waterlogging for reliable lucerne growth, where grazing is poorly controlled or in a farm context where additional lucerne area provides little additional livestock benefit due to an inability to utilise the forage.

The introduced perennial grasses, phalaris (*Phalaris aquatica* L.), cocksfoot (*Dactylis glomerata* L.), tall fescue (*Festuca arundinacea* Schreb), and perennial ryegrass (*Lolium perenne* L.) are commercially available and offer advantages for use instead of or in conjunction with lucerne. For example, these grasses can offer improved ground cover compared to lucerne, potentially reducing the amount of runoff and erosion of the topsoil (Costin 1980). Species such as phalaris are also highly tolerant of set stocking grazing regimes which could be an advantage in cropping situations where paddock sizes are large. However, the use of these species is generally restricted to higher rainfall environments where the incidence of cropping declines. The increased sensitivity of grasses to drought compared with lucerne, the reduced nitrogen fixation from perennial grass-based pastures (Dear *et al.* 2004) or the lack of herbicide options available to control annual grass weeds (Dear *et al.* 2006b) are all constraints to the broader adoption of perennial grasses.

This paper provides an overview of the findings of 7 years of perennial pasture evaluations in southern NSW, at low rainfall (Barmedman), medium rainfall (Cootamundra, Henty, Wagga Wagga), and high rainfall (Binalong, Bookham, Holbrook, Wallendbeen) sites of the southern cropping zone.

Perennial legumes

Lucerne and perennial medics. Among the range of experiments in which it was included (that is at all sites other than Bookham and Holbrook), lucerne was the most broadly adapted species, with consistently higher productivity and persistence than most other species tested (Li *et al.* 2008b; Hayes *et al.* 2010a; Li *et al.* 2010b; Real *et al.* 2011). This result was perhaps expected given the long history of lucerne breeding and cultivation in Australia (Auricht 1999), and the relatively dry seasonal conditions experienced throughout the 7 year experimental period. Nevertheless, there were occasions where the performance of lucerne was matched or surpassed by other legume species. For example, strawberry clover (*Trifolium fragiferum*) and birdsfoot trefoil (*Lotus corniculatus*) on heavy clay soils. Lucerne is known to be sensitive to acid soils and continues to be developed for increased acid soil tolerance (Hayes *et al.* 2011), but remained the most productive and persistent perennial legume species on acid soils at Wallendbeen and Barmedman (Li *et al.* 2008b).

A narrow range of alternative perennial medic species were assessed in NSW at Binalong, Wagga Wagga, Barmedman, and/or Henty and include *Medicago arborea*, *M. lupilina*, *M. suffruticosa*, *M. marina*, *M. papillosa* as well as 4 subspecies of lucerne (*M. sativa* subspp. *sativa*, *varia*, *falcata*, and *caerulea*). In general, perennial medic species other than *M. sativa* performed poorly in southern NSW offering little prospect for further development and deployment in this region (Li *et al.* 2008b; Real *et al.* 2011). Subspecies of *M. sativa* proved to be more promising. Subspecies *caerulea* had a very prostrate growth habit and was ranked highly for basal frequency, though lacked the productivity of common lucerne, subsp. *sativa*, whilst subsp. *falcata* was generally found to be less productive and persistent (Li *et al.* 2010b). Some authors have postulated that more prostrate subspecies, such as subsp. *caerulea*, may prove to be a beneficial character for grazing tolerance (Humphries *et al.* 2008). However, that concept is yet to be demonstrated in a farming context. The alternative subspecies of lucerne undoubtedly offer value in the variability in traits that they bring to a lucerne breeding program (Humphries and Hughes 2006), but as yet there seems little value in farmers deploying any perennial medic species other than common lucerne, in southern NSW at least.

Perennial clovers. Several lines of 11 different perennial *Trifolium* species were evaluated in two series of experiments described by Li *et al*. (2008b) and Real *et al*. (2011). As previously mentioned, strawberry clover showed superior productivity compared to lucerne on heavy clay soils. Also of note was the high persistence and basal frequency of *T. uniflorum* under drought, and at one site (near Bookham) under severely acidic soil conditions (Li *et al.* 2008a). This species had remarkable persistence under a diverse range of conditions at sites at Bookham, Barmedman, Wagga Wagga and Wallendbeen. However, it had low productivity relative to lucerne, and is unlikely to be developed commercially due to poor seed production attributes (M. A. Ewing pers. comms). Interestingly, this species is the subject of a wide hybridisation experiment by scientists in New Zealand (Williams *et al.* 2010) who are attempting to combine its superior persistence characteristics with the highly productive characteristics of white clover (*T. repens*); so perhaps future generations of Australian farmers will see more of *T. uniflorum*.

In contrast, white clover, red clover (*T. pratense*) and alsike clover (*T. hybridum*) established well but generally failed to persist, confirming their poor adaptation to cropping zone environments. Caucasion clover had high basal frequency at a site near Binalong but performed relatively poorly at the Wagga site. *Trifolium ochroleucum* was noted at an experiment at Henty as a species of interest, due to its impressive early growth. It was also observed to have a substantial quantity of hairs on its leaf leading the present authors to postulate that it may be less palatable than other hairless *Trifolium* species and therefore perhaps more persistent under grazing. However, the poor persistence and low productivity of this species does not warrant further investigation in southern NSW. Talish clover (*T. tumens*) was evaluated at only one site in southern NSW, Binalong, where soil was highly acidic with Mn toxicity (unpublished). McVittie *et al*. (2012) reported that talish clover was relatively sensitive to excess Mn. Talish clover has recently been released on the Australian market as a more drought tolerant species than white clover, but is still unlikely to be sufficiently drought tolerant to persist in most cropping environments of southern NSW where annual rainfall would seem substantially lower than its perceived zone of adaptation and where summer months are typically hot and dry. This species continues to be evaluated in the southern tablelands at sites near Goulburn (G. A. Sandral unpublished data).

In general, aside from the heavy soils niche where strawberry clover performed particularly well, there is little prospect for broader utilisation of perennial clovers in the mixed farming zone of southern NSW.

Lotononis bainseii. *Lotononis bainseii* is a subtropical perennial legume species evaluated at Binalong, Barmedman, Henty, Wagga Wagga and Wallendbeen. In general the species was found hard to establish which is consistent with previous experience (Blumenthal and Hilder 1989), but once established it was found to be highly persistent and very productive. This species was notable for its capacity to colonise areas beyond the boundaries of the plots in which it was originally sown. It performed particularly well at Barmedman and is likely to be suited to warmer environments in the north and west of our southern cropping zone. However, its performance at the cooler and more acidic Binalong site was surprisingly good (Real *et al.* 2011). This species is perhaps the only perennial legume alternative currently available to farmers in southern cropping environments, although methods to establish it reliably need to be refined.

***Lotus* species.** A range of *Lotus* species were examined in this series of evaluations. In general, these species performed better in higher rainfall environments or on the heavier soils such as near Henty (Li *et al.* 2008b). Birdsfoot trefoil was shown to be the species of this genus with the highest productivity and persistence. Subsequent to these experiments, lines of birdsfoot trefoil have been bred for increased tolerance to drought and a shorter photoperiod requirement for flowering (G. A. Sandral unpublished data). Both these attributes should enhance the adaptation of this species to environments in southern NSW. However, it is still envisaged that this plant will be only suitable to the >650 mm rainfall zones precluding it from most cropping environments of southern NSW (G. A. Sandral pers. comms). Evaluations of lines destined for commercial release continue at sites near Goulburn with more sites soon to be established elsewhere on the southern Tablelands.

Native Australian perennial legumes. Several perennial legume species native to Australia were included in these evaluation experiments. By far, the best performing species was tall verbine (*Cullen australasicum*; Dear *et al.* 2007a; Hayes *et al.* 2009). This species established readily from seed and was found to be relatively persistent and productive at most sites. The outstanding feature of this species was its superior drought tolerance, demonstrating a capacity to retain leaf and even develop reproductive organs when all other herbaceous plants in the landscape had senesced or dropped leaves. This species is relatively unpalatable to livestock. Initially this was seen as a possible advantage for retaining ground cover under heavy or uncontrolled grazing situations (Dear *et al.* 2007a). However, further assessment suggests the plant to be so unpalatable that it is difficult to add significant value to a production enterprise, particularly where lucerne is a viable alternative. Subsequent evaluations have also shown this species to be sensitive to both aluminium (Al) and Mn toxicities (McVittie *et al.* 2012), making it an unsuitable alternative in many acidic soil environments. In view of these challenges and its poor seed production characteristics (S. J Hughes pers comm.), it is unlikely to be deployed as a commercial pasture plant suitable for southern NSW.

Short-lived perennial legumes. Several species showed potential for use as short term forages. These species were highly productive but failed to persist over 3 years. Of particular note were sulla (*Hedysarum coronarium*) and *Onobrychis vicifolia* (Li *et al*. 2008b). The latter in particular is used elsewhere around the world as a forage, primarily in ‘cut and carry’ systems as opposed to grazing systems common in Australia (Dear *et al.* 2003). As our evaluation experiments were designed specifically to evaluate perennial species, further evaluation of these species is warranted to confirm their value as forage crops. For example, their establishment and productivity should be compared to productive annual species, such as arrowleaf clover (*T. vesiculosum*). To some extent this has occurred for sulla in Australia, such as in northern NSW and SA (De Koning *et al.* 2008) with sulla comparing favourably with other options. *Onobrychis vicifolia* was also promoted for a time prior to the 1990’s, particularly in SA, as an alternative to lucerne due to its non-bloating attributes. However adoption was never widespread, perhaps due to a perception of sensitivity to acid and waterlogged soils (Dear *et al.* 2003). Nevertheless, this legume species is probably underutilised as a forage crop in Australia.

Perennial grasses

Phalaris. Phalaris was the benchmark grass species for most of the evaluation experiments. It has had a long history of development under Australian conditions (Oram *et al.* 2009), it is broadly adapted and is highly productive relative to most other alternatives (Hill 1985; Reed *et al.* 2008a). At Wagga and Cootamundra

2004–08, phalaris was the most productive grass species tested (Hayes *et al.* 2010a). Several cultivars of phalaris were compared in other experiments. At Holbrook and Bookham (2005–08), cvv. Australian, Holdfast, Sirosa and Atlas PG were tested; cvv. Sirolan and Atlas PG only were included at Barmedman 2003–05. Both cultivars at the Barmedman site produced similar amounts of cumulative herbage mass and were rivalled only by Kasbah cocksfoot as being the most productive lines across all species in that trial (unpublished data). However, at the higher rainfall sites near Bookham and Holbrook, cvv. Atlas PG and Sirosa (a cultivar similar in many respects to cv. Sirolan, (Oram *et al.* 2009)) were generally not as productive as cvv. Australian and Holdfast.

Whilst there are several new phalaris cultivars available for use in the higher rainfall and permanent pasture zones, there remain fewer cultivar options for lower rainfall cropping environments. Atlas PG is the only cultivar currently registered for lower rainfall zones, but its performance in research experiments has been mixed. For example, it was less productive than cv. Australian at Wagga Wagga 2003–05 (Reed *et al.* 2008b). Quality of commercial Atlas PG seed has also been found to be mixed in recent years (unpublished data). Older cultivars such as Sirolan have performed well in previous experiments, such as near Junee and Barellan 1995–98 (Dear *et al.* 2007b), but low seed availability has hampered broader adoption of this cultivar. Results from experiments at Beckom and Trungally Hall that are looking to select a new phalaris cultivar for low rainfall environments indicate that few breeding populations have thus far outperformed cv. Sirolan (R. A. Culvenor unpublished data). More recently, some cv. Sirolan seed has become commercially available, so between it and cv Atlas PG there are currently at least 2 cultivar options for including phalaris in crop rotations in lower rainfall environments of southern NSW.

Cocksfoot. Six cultivars of cocksfoot (cvv. Currie, Gobur, Porto, Kasbah, Sendace and Uplands) were evaluated over 3 years in 2005–08 at Holbrook and Bookham and two cultivars (Kasbah and Currie) were tested at Barmedman in 2003–05. At the higher rainfall Bookham and Holbrook sites, cvv. Porto, Currie and Gobur were more productive than the remaining cultivars which were all summer dormant types (unpublished data). However, at the drier Barmedman site the summer dormant cv. Kasbah produced approximately 3 times more herbage than cv. Currie over the experimental period. This highlights the importance of cultivar choice of this species in particular. Cocksfoot is known to have a relatively shallow root system and a high annual turnover of roots (Ridley and Simpson 1994). Therefore, in contrast to deeper rooted species such as phalaris, cocksfoot has relatively few mechanisms available to it to survive summer droughts. Summer dormancy is a key trait in cultivars of this species (Norton *et al.* 2006) that are grown in environments where summers are typically hot and dry, such as Barmedman. However, in other environments that are cooler and that have higher incidence of summer rain, summer active types, such as cv. Porto, or intermediate types, such as cvv. Currie and Gobur are advantageous. It would have been interesting to see a greater range of summer dormant cultivars tested at the drier Barmedman site. The cultivar that performed very well there, cv. Kasbah, is almost commercially irrelevant now due to unreliable seed supply. This cultivar also performed very well at other sites such as at Wagga (Hayes *et al.* 2010a). There is currently a new research initiative underway to select and release a new summer dormant cultivar for low rainfall environments but as yet it is unclear whether a new cultivar will be released and if so, to what extent it is superior to cv. Kasbah.

Tall fescue. On the basis of the recent evaluations, tall fescue seems to be a species that is generally over-rated in the market-place, in southern NSW at least. It is commonly recommended for inclusion in pasture mixes across southern NSW, but in many situations it seems to provide little advantage over phalaris. The Mediterranean cultivars certainly provide increased persistence in drier environments over traditional continental cultivars, but in one experiment at Wagga in 2004–08, increased persistence did not lead to increased production (Hayes *et al.* 2010a). At the Wagga and the Cootamundra sites over the same period, the Mediterranean cultivar, Fraydo, had very similar persistence to phalaris cv. Landmaster, but the productivity of phalaris was roughly double that of the tall fescue. One could argue that the performance of this one cultivar of tall fescue may not be representative of the broader species. However, this cultivar was the top performer in a Victorian study among many tall fescue cultivars (Reed *et al.* 2008a), and the difference between cultivars in that study offered no evidence that an alternative cultivar might have bridged the productivity gap reported at Cootamundra and Wagga between Fraydo tall fescue and Landmaster phalaris. There was also little difference in herbage quality between the two species (Hayes *et al.* 2010a). In view of the lower production and lack of difference in herbage quality, it is difficult to justify the planting of tall fescue in southern NSW in situations where phalaris is a viable alternative.

Perennial ryegrass. As a general rule, perennial ryegrass is not 'perennial' in environments outside the very high rainfall zones (800 mm+) of southern NSW. It established well in experiments at Wagga, Bookham and Holbrook, but was largely absent beyond year 1. There was a very low incursion of weeds into perennial ryegrass plots in year 2 of the experiments, attributable to the highly vigorous nature of this species in the establishment year (unpublished data). High seedling vigour is an attribute that makes this species unsuitable for inclusion pasture mixtures with more persistent species such as phalaris and cocksfoot.

Perennial veldt grass. Perennial veldt grass (*Ehrhata calycina*) did not perform well at all sites in a general evaluation, but was impressive at certain sites, such as near Keith (average annual rainfall 465 mm) in SA (Reed *et al.* 2008b). In a more detailed experiment near Cootamundra, NSW, this species also performed well (Hayes *et al.* 2010a). Its persistence and cumulative herbage mass was very similar with that of Currie cocksfoot in that environment, and it was found to be more productive than tall fescue, grazing brome, plantain and Rhodes grass in that experiment. It was observed to be very competitive against annual grass weeds. The herbage of perennial veldt grass was generally higher in protein than any other grass species tested. It was also the only grass species that grew in summer, indicating it has a year-round pattern of seasonal production, better enabling it to respond to out of season rainfall. It is also known to be a species capable of recruiting seedlings, suggesting it may require specific grazing management to maximise persistence. The study by Hayes *et al*. (2010a) was the fifth study since 1947 to identify perennial veldt grass as 'warranting further investigation' (Rossiter 1947; Bryant 1967; Reid 1994) and Flower (1993) cited by Reed *et al*. (2008b). There certainly seems to be ample opportunity to further exploit the species, particularly in environments suited to Currie cocksfoot.

Perennial bromes. Several brome species were included in the evaluation experiments including *Bromus stamineus, B. uniloides, B. coloratus, B. mango, B. valdivianus* and *B. wildenowii*. All of these species were grown near Bookham and Holbrook, with a smaller number of brome species included at Wagga and Barmedman. Most of the brome species established well and some of them, such as *B. uniloides* cv. Atom, persisted over 3 years as well as some cocksfoot, tall fescue and phalaris cultivars at the higher rainfall sites. At the Holbrook site especially, the perennial bromes were amongst the most productive of the species tested over the 2005–08 period (unpublished data). There is little doubt that these species offer opportunities for further use and development in short phases as part of a cropping rotation in higher rainfall regions. It is important to understand that an appropriate grazing regime is essential to maintain the persistence of these brome species as seedling recruitment may play an important role in their persistence. The perennial bromes certainly represent under-utilised opportunity and should be considered for further evaluation and development for use in higher rainfall regions of southern NSW.

Subtropical grass species. Several introduced subtropical grass species were included in the recent evaluations at Wagga Wagga (Reed *et al.* 2008b), Cootamundra (Hayes *et al.* 2010a) and Barmedman (unpublished data), including Rhodes grass (*Chloris gayana*), kikuyu (*Pennesitum clandestinum*) and Setaria (*Setaria sphacelata*). The subtropical grasses as a group established poorly, which is seen as the key constraint to the broader adoption of these species in southern NSW. Many roadside environments are host to subtropical species such as Rhodes grass, demonstrating that they have reasonable adaptation to our environments. However, the apparent mismatch between soil moisture and temperature in southern environments, i.e, when the soils are sufficiently moist, soil temperatures are too low for these species to emerge and *vice versa*, would seem the major impediment to their reliable establishment in a paddock situation.

Native Australian perennial grasses. Several native grass species were also evaluated, including weeping grass (*Microlaena stipoides*), kangaroo grass (*Themeda australis*) and wallaby grass (*Austrodanthonia* spp.). This group of species also established poorly. However, *Austrodanthonia caespitosa* cv Trangie released recently (Dear *et al.* 2006a) performed well in a diversity of environments with very strong recruitment from seed and with seedlings commonly invading neighbouring plots. Issues with seed availability and quality continue to plague the native grass seed industry (Cole and Johnston 2006) and remains a substantial constraint to the broader adoption of these species. The use of native perennial grasses in southern NSW is therefore likely to remain restricted to areas of the landscape where the native species already exist.

Perennial herbs

Chicory. Chicory (C*ichorium intybus*) was by far the best performing herb species, and ranked second after lucerne for broad adaptation across a range of environments (Li *et al.* 2008b). Chicory is a highly digestible forage that is high in protein (Hayes *et al.* 2010a) and rich in minerals. It is a summer-growing forage with a capacity to quickly explore the soil volume for water (Hayes *et al.* 2010b), seen as an advantage in mitigating the risks of dryland salinity and soil acidification. For all these attributes it is very similar to lucerne and certainly qualifies as a viable alternative perennial species, particularly in the medium-high rainfall regions of the mixed farming zone.

However, there are a number of differences between chicory and lucerne of which farmers need to be aware and which need to be managed. Chicory is a shorter-lived perennial compared to lucerne, unlikely to persist longer than 4 years in adequate densities in most of our environments. It is a herb, so requires a suitable companion legume to fix N to feed the chicory as well as for subsequent crops. In a recent assessment of companion legume species, lucerne was found to be the least suitable companion legume for chicory as this was the treatment that reduced chicory persistence the most (unpublished data). Chicory is less winter-active than lucerne (Hayes *et al.* 2010a) and requires lax grazing in late autumn/early winter to ensure persistence (Li *et al.* 1997). Chicory is not suitable to be established under a cover crop, due to i) its reduced establishment on account of competition from the crop (unpublished data), ii) its propensity to bolt to head in late spring making harvesting of grain more difficult, and iii) the reduced capacity to utilise first year chicory forage in year 1 when it is under a cover-crop. Chicory can be more productive in the establishment year than species such as lucerne or phalaris (Hayes *et al.* 2008) due to its short-lived nature. It therefore makes little sense to sacrifice first year production by growing it under a cover-crop.

Results from an evaluation of 7 chicory cultivars was undertaken at 5 sites in southern Australia (Li *et al.* 2010a) showed that cv. Lacerta was more winter-active than the other cultivars and inclined to bolt to head earlier in spring. Cultivar Puna II was ranked first for plant basal frequency suggesting it was amongst the most persistent of the cultivars; cultivar Chico had the lowest ranking for basal frequency. Cultivar Choice was ranked first for biomass production, but there was little difference between the cultivars for this trait. There is currently no chicory cultivar developed specifically for Australian conditions, suggesting that there may still be room for further development of this species.

Plantain and other perennial herbs. In general, plantain (*Plantago lanceolata*) was found to be less persistent and productive than chicory (Reed *et al.* 2008b; Hayes *et al.* 2010a). It appears to be better suited to higher rainfall environments or for use as specialised short-term forage crops. Its establishment was hampered by its sensitivity to the pre-emergent herbicide trifluralin, reducing options to control annual grass weeds and wireweed.

The performance of other herbs was also inferior to that of chicory. *Ptilotus polystachyus* failed to emerge at most sites (Li *et al.* 2008b); though a small handful of plants of this species was observed at the Barmedman site. It is not clear what was the reason for this dismal establishment, although poor seed quality can not be ruled out. Sheep's burnett (*Sanguisorba minor*) performed reasonably well, particularly at the Wallendbeen site, ranking tenth out of 91 for herbage production (Li *et al.* 2008b). This species was actually observed to occur naturally on the roadside near the Wallendbeen trial site. However, its absence in neighbouring paddocks along with observations of it in these experiments suggests that it is sensitive to grazing. It was certainly less robust than chicory and is unlikely to undergo further development in the foreseeable future.

Conclusion

Lucerne remains the most broadly adapted and drought-tolerant perennial pasture species for cropping environments of southern NSW. It is also one of very few perennial legume options available to increase N inputs to cropping systems. Chicory was arguably the second most broadly adapted species and is quite similar to lucerne in many respects, though is not a legume and is sensitive to grazing during winter. There are few perennial grass options, particularly for lower rainfall environments. Phalaris and cocksfoot are the most productive and persistent species, although acquiring suitable cultivars of these species remains a constraint to their broader adoption. There are several species that are currently not used widely that may offer benefits, particularly in medium-high rainfall environments (>550 mm). In particular are the perennial bromes and perennial veldt grass, which warrant further investigation in southern environments. *Lotononis bainseii* offers some promise for lower rainfall/warmer regions. Sulla and *O. vicifolia* may have potential as short-term forage legume options. It needs to be noted that adequate persistence in our 3-year evaluation experiments may not necessarily confer adequate persistence in a paddock scenario. Farmers are advised to utilise ‘new’ species on a small scale initially before adopting them more broadly across the farm.

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