Persistence of phalaris-legume mixtures on the North West Slopes, NSW

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Evaluation of introduced temperate grasses on the North West Slopes showed phalaris to be the most persistent (Archer 1989) of the species tested. Such grass pastures also need a legume to optimise production and persistence (Kemp 1991) with subterranean clover filling this role. Lucerne is also widely grown in the region, although mostly as a pure sward. Whilst it produces high quality feed and is excellent for animal production, its ground cover tends to be poor and there are several animal health risks such as bloat in cattle and red gut in sheep. The addition of a grass to a lucerne pasture could alleviate these problems, but no studies have been conducted in the region.

This paper reports on the persistence of lucerne-phalaris and subterranean clover-phalaris mixtures in studies on the North West Slopes and discusses directions for future work.

METHODS

In autumn 1998, eight phalaris lines were sown with subterranean clover and lucerne at sites near Tamworth, Manilla and Coonabarabran. Plots were sown with a cone seeder, in a split plot design with legume as the main plot in two replicates. Phalaris (*Phalaris aquatica*) lines, ranged in habit and summer dormancy and were sown at 3 kg/ha. Lucerne (*Medicago sativa*) cv. Genesis, a winter active multipurpose type was sown at 1 kg/ha in alternate rows to phalaris. The subterranean clover (*Trifolium subterranean*) was a mixture of three cultivars ranging in maturity and was sown at 3 kg/ha. The subterranean clover mixture was different at each site (Table 1).

Plots were ungrazed for the first 12 months. In the second and subsequent years, the plots were leniently grazed by sheep. Persistence of each species was measured as relative plant frequency and monitored each year in two fixed quadrats (0.9 m^2) per plot. Data are presented for 1998-2001.

RESULTS AND DISCUSSION

All species established well and frequency counts were similar at each site (Fig 1). However, the three sites responded differently reflecting the effect of soil type and environment on persistence, as well as the complexity of the interaction between legumes and a grass.

Phalaris persistence

The most persistent phalaris lines were two Perla Retainer lines and Sirolan, while Australia II was the least persistent. The two Perla Retainer lines were summer dormant types and Sirolan a highly vigorous erect type. Australian II is a seed retaining version of Australian phalaris, that also did not persist well in adjacent phalaris evaluation sites at Tamworth and Manilla. Australian II flowered 23 days later than Australian at Tamworth suggesting that it may have a higher requirement for cold vernalisation (R. Culvenor, pers comm). This cultivar has been reported to have better persistence on the Northern Tablelands (C. Harris, pers comm), where winters are colder.

The eight phalaris lines responded similarly to the legume treatments ($P>0.05$), however the phalaris response

Table 1. Subterranean clover cultivars sown, soil classification and rainfall for the three trial sites.

Characteristic		Tamworth	Manilla	Coonabarabran
Subterranean clover cultivars		Seaton Park, York, Rosedale	Dalkeith, Seaton Park, Clare	Nungarin, Dalkeith, Junee
Soil type[1]		Brown vertosol	Brown chromosol	Brown vertosol
Annual rainfall (mm)	1998	925	886	852
	1999	748	574	792
	2000	827	535	858
	2001	594	595	575
Long term average		674	617	634

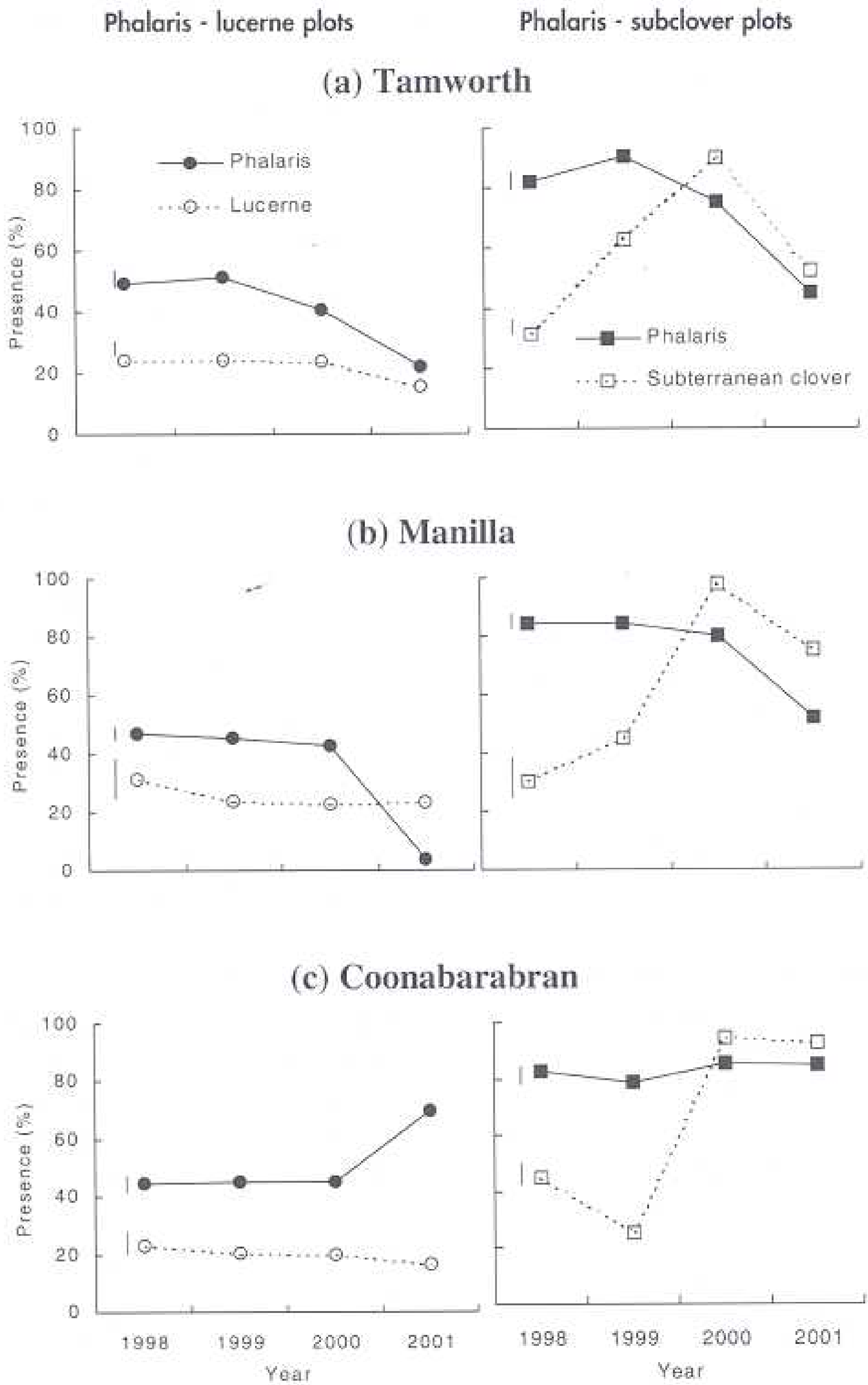
[1]Isbell (1996)

(averaged over lines) varied at the three sites. Phalaris frequency declined over time in both subterranean clover and lucerne mixtures at the Tamworth and Manilla sites. At Tamworth, the decline started in the second year (Fig 1a) compared with the third year at Manilla (Fig 1b). However, the decline was largest in the lucerne-phalaris plots ($P<0.01$) at both sites, with frequency declining by 92% at Manilla. In contrast, phalaris frequency increased at Coonabarabran in the third year in the lucerne-phalaris plots ($P<0.01$), but there was little change in the subterranean clover-phalaris plots (Fig 1c).

The large declines in phalaris frequency at the Manilla site may have been related to the light soil with a low water holding capacity and below average rainfall from 1999-2001. In comparison, the Tamworth site was on a vertosol with higher water holding capacity and rainfall was above average (Table 1).

Declines in phalaris frequency over time at Tamworth and Manilla were also observed in phalaris evaluation studies at each site. However the rates of decline varied

Figure 1. Persistence (% presence) of lucerne-phalaris and subterranean clover-phalaris pastures at (a) Tamworth, (b) Manilla and (c) Coonabarabran, 1998-2001. Vertical bars to the left of the first data point represent the 1% lsd for comparisons within that treatment.



between pure and mixed swards. Phalaris losses were highest in lucerne-phalaris plots (55 and 92% for Tamworth and Manilla respectively). Interestingly, losses of phalaris sown as monocultures (49 and 72%) were higher than in the subterranean clover-phalaris plots (39 and 45%).

Legume persistence

Changes in lucerne and subterranean clover frequency varied over time ($P<0.01$), but responses were consistent at all sites. While lucerne declined slightly over time, it was only significant at Tamworth. Subterranean clover frequency increased each year reflecting favourable seasonal conditions (Fig 1).

Although not evident in the frequency data, the lucerne at the Coonabarabran site had smaller plants with dying crowns. This site had above average rainfall throughout the experiment and suffered aphid attack in 1999. These conditions over an extended period appeared to make the plants more susceptible to diseases, weakening them.

Species characteristics and possible reasons for the results

The lucerne-phalaris mixture was not as successful as the subterranean clover-phalaris mixture at Tamworth or Manilla. It appeared to be a result of the two perennial species being very competitive with each another. Both phalaris and lucerne are deep rooted and so compete for soil water. The upright nature of the three most persistent phalaris lines may have assisted their competition for light. Although phalaris and lucerne grow at different times of the year, their abilities to withstand moisture stress are different. Lucerne sheds its leaves during moisture stress and regrows quickly after rain. Phalaris requires adequate moisture at the base of its dormant culms in summer (McWilliam and Kramer 1968). Extensive losses of phalaris, particularly at Manilla suggested that lucerne dried the soil profile beyond the level that phalaris was able to withstand. At Manilla the phalaris in the lucerne mixture plots was often observed to be water stressed while phalaris in the subterranean clover mixture was not.

The subterranean clover-phalaris mixture appeared to be more stable than the perennial species mixture with the annual species being shallow rooted and opportunistic, increasing its seed bank during favourable seasons. The plots also had higher ground cover, with probably higher quality organic matter and nitrogen and so increasing phalaris survival.

Lucerne-phalaris mixtures may be more successful in higher rainfall areas on deep soils with high water holding capacity. It may also be useful to reduce the sowing rate of lucerne to 0.75 kg/ha and use a winter dormant cultivar to minimise competition.

Opportunities for future research

Competition for resources appeared to play a major role in the decline in phalaris frequency when grown with lucerne. This highlights two potential areas for further studies. Firstly, the need for a grass that can persist with lucerne. This may require traits such as a shallower root system that extracts water from a different part of the soil profile and have the ability to remain dormant when water becomes scarce. Secondly, to quantify the density of lucerne required to reduce its competitiveness in a mixture.

ACKNOWLEDGMENTS

I thank Terry Mullens for assistance with data collection, also Ian Daniells and William Manning for assistance with the soil classifications. Funding for this work was provided by the Australian Wool Innovation Pty Ltd.

REFERENCES

Archer, K.A. (1989). Persistence of temperate perennial grasses, Northwest Slopes, NSW. *Proceedings of the 5th Australian Agronomy Conference, Perth*. p. 627.

Isbell, R.F. (1996). *The Australian Soil Classification*. CSIRO Publishing.

Kemp, D. 1991. Defining the boundaries and manipulating the system. *Proceedings of the 6th Annual Conference of the Grassland Society, NSW*. pp. 24-30.

McWilliam, J.R. and Kramer, P.J. (1968). The nature of the perennial response in Mediterranean grasses. I. Water relations and summer survival in *Phalaris*. *Australian Journal of Agricultural Research* 19, 381-395.