Plant-environment studies in regional evaluation of pasture species

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Pasture evaluation programmes should include a phase of ecological studies, to define the adaptation of promising species to regional environments. This was done with six contrasting pasture species on the far North-Western slopes of N.S.W., a frost-prone, sub-humid, summer/winter rainfall region where year-roun production requires species with complementary adaptive features (1). Methodol and results with *Medicago sativa* cv. Hunter River (lucerne), a C_3 species, and *Digitaria smutzii* (finger grass), a C_4 species, are outlined.

Methods

- A cutting trial provided the means of concurrently monitoring plant performance and climatic events over three years. Lucerne and finger grass were grown in both monoculture and mixture on a solodic soil.
- From field results, hypotheses about plant-environment and inter-species relationships were tested in climate-controlled glasshouses, using soil from the field.
- A climatic analysis was conducted to define growing seasons and the frequency of performance-related climatic events.

Results and Discussion

In the field, the mixture of lucerne and finger grass was more productive than either species grown alone (Table 1). Lucerne was much less persistent than finger grass. Hypotheses explaining these phenomena were as follows:

- The two species had complementary growth patterns resulting largely from different responses to temperature (modified by nitrogen and moisture).
- The persistence and productivity of lucerne were little affected by its association with finger grass. Rather, competitive equilibrium tended to develop between them.
- The poor persistence of lucerne was attributed to a lower tolerance of moisture excess and deficiency under adverse soil physical conditions.

Table 1 Total dry matter and nitrogen yields (kg/ha) of finger grass, lucerne and their mixture over three years at two levels of nitrogen

Nitrogen level[A]	Dry matter Yields			Nitrogen yields		
	Finger grass	Lucerne	Mixture	Finger grass	Lucerne	Mixture
N1	7 180[b]	9 150[b]	14 330[a]	92[c]	329[b]	413[a]
N2	20 990[a]	13 170[b]	19 050[a]	375[b]	498[a]	547[a]

A. N1 = no nitrogen added. N2 - Ammonium nitrate added to remove deficiency. Values associated with the same letter indicate no significant difference ($P<0.05$) between species means within nitrogen treatments.

In the main, these hypotheses were confirmed in the shorter-term glasshouse study. It highlighted the adverse effects of summer temperature on lucerne growing under poor soil physical conditions. It also defined more clearly the environmental conditions conducive to competitive equilibrium between the species (spring temperatures and moderate moisture supply) and those under which the mixture would out yield both monocultures (summer temperatures, moderate moisture and low nitrogen). However, it indicated a greater reduction of lucerne yield by the grass than was apparent in the field.

The frequency of summer flooding was estimated as one occasion in four years. The studies indicated that lucerne and finger grass might profitably be grown together in this environment provided a lucerne variety is found with greater tolerance of summer rainfall and the necessary tolerance to grazing.

Tow, P.G. PhD Thesis, University of New England, Armidale, 1975.