Development of management guidelines for native grass pastures on the central and southern tablelands of NSW

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Summary. The Tablelands of NSW have lagged behind the more arid areas of Australia in development of management procedures for native grass pastures. However, in recent times, successful strategies have been developed for the Northern Tablelands and Slopes of NSW to manipulate botanical composition to improve the mix of native grasses available to grazing stock. This paper describes research on the Central and Southern Tablelands to similarly define management strategies for native grass pastures. The main native grasses are described, and desirable and undesirable species identified. Difficulties in developing management strategies because of similar life cycles in desirable and undesirable plants are highlighted.

Introduction

The Tablelands of NSW have traditionally been areas where existing native pastures have been replaced by pastures containing introduced species (e.g. *Phalaris aquatica,Dactylis glome rata, Festuca arundinacea, Trifolium repens, T. subterraneum),* frequently involving cultivation. Such pastures are usually well-fertilised and grazed at moderate to high stocking rates, resulting in reduced native grass content and markedly altered composition of native grass populations. In addition, improved pastures without a vigorous introduced perennial grass tend to be invaded by cool-season annual grasses (e.g. *Vulpia,Bromus,Critesion)* which set large amounts of seed and compete strongly with other plants at establishment in autumn.

Over recent years, less attention has been paid to the maintenance of fertiliser inputs to improved pastures because of economic constraints. Also, increasing soil acidity has meant a declining content of some introduced species which are less tolerant of high soil aluminium and manganese levels (e.g. phalaris). Consequently, many improved pastures on the Tablelands are giving lower productivity than might otherwise be expected of them. For example, Munnich *et al.* (11) found that on the Southern Tablelands of NSW, previously sown pastures only had a 25% advantage in carrying capacity over natural pastures. Also, the droughts of the early 1980's have drawn to the attention of graziers the lack of persistence of some sown species and the superior drought tolerance of native grasses. For all these reasons and because of the increased emphasis on environmental issues and sustainability of agriculture, there has been an increase in the interest of graziers and researchers in better management and utilisation of native and natural pastures.

Management of native and natural pastures has long been practised in the more arid areas of Australia where the opportunity to sow introduced legumes and grasses is limited because of low rainfall. Experience over many years has elucidated management strategies for improving production and maintaining cover on grazed areas. In more recent times the principles involved have been well recorded (14, 13), and research is continuing (2). On the other hand, it is only recently that there has been detailed research carried out on the Tablelands on management of native pastures. Initially, work was carried out on the Northern Tablelands, and there has been a considerable amount of information provided on the agronomy and management of native grass pastures. This work has been well summarised by Lodge and Whalley (9). In particular, the work of Lodge (7) and Lodge and Whalley (8) was aimed at a specific problem, namely the removal of a grass with undesirable characteristics *(Aristida ramosa)* from pasture and its replacement with a desirable grass *(Danthonia* The method used was to study the phenology of the grasses concerned and apply management factors which cause maximum damage to the undesirable and encourage the desirable grass. This is a classic case of the application of the principles of grazing management to manipulate botanical composition outlined by Wilson and Hodgkinson (14).

On the Southern Tablelands, there has been some work with native grasses (e.g. 3,4,5,6), but virtually no studies on management of these grasses in natural pastures. Moore (10) summarised the expected changes in composition of a typical undisturbed native grass pasture on the Southern Tablelands following grazing over a long period. Initially, the tall summer-growing perennial species *(Themeda australis* (syn. *T. triandra), Stipa aristiglumis (= S. bigeniculata), Poa* spp.) are replaced by shorter winter-growing natives *(Danthonia* spp., *Stipa falcata (= S. scabra)).* With an increase in grazing intensity, spear grass *(S. scabra) declines* and aDanthonia *carphoides-D. auriculata* dominant community is formed together with short warm-season native species from more arid communities (e.g. *Enneapogon nigricans, Chloris truncata, Panicum effusum)* and introduced cool-season annuals (e.g. *Vulpia* spp., *Bromus* spp., *Aira* spp., *Trifolium* spp.). If superphosphate is applied, the growth of *Trifolium* species (especially *T. subterraneum)* is promoted, and the consequent increase in soil nitrogen results in further invasion by introduced cool-season annual grasses.

The current situation on the Central and Southern Tablelands reflects many phases of this succession. However, very few pastures remain in the original situation of dominance by tall summer-growing native perennial grasses. Thus, if changes in botanical composition are desired, specially designed management procedures will be necessary to overcome the present equilibrium of pastures with current management practices (9). Research is in progress to define such management procedures for native grass pastures on the Central and Southern Tablelands. This work is intended to test the established guidelines from the Northern Tablelands and modify them where appropriate for the particular situations on the Central and Southern Tablelands. There needs to be recognition that there are species and climatic differences (winter versus summer rainfall dominance), giving a greater chance of invasion of pastures by cool-season annual species (including *T. subterraneum)* if superphosphate rates are not controlled.

Methods

Three major sites have been selected on the Central and Southern Tablelands at Bathurst, Goulburn and Dalgety. At each site, three replicates of plots (20x10 m) have been set up with six superphosphate treatments (0, 62.5, 125 and 250 kg/ha/year and 125 and 250kg/ha in 1990 only) and two grazing treatments (uncontrolled and controlled). *T. subterraneum* has been sown in all plots. Phenology of the grasses is being studied to formulate appropriate grazing management strategies, which will be tested by controlling grazing to encourage desirable species and discourage undesirable ones. Point quadrat measurements (300 points per plot) are being made at appropriate times at each site to monitor changes in botanical composition. Measurements are being made on selected treatments every six weeks of pasture growth, using exclosures.

Results and discussion

The composition of pastures at the three sites is given in Table 1. At each site there are desirable and undesirable species. At Bathurst, *Bothriochloa macra* is the dominant species. It is regarded as being productive (12), but not of sufficient nutritive value (1) and is frost sensitive. It also invades poorly managed pastures (9). Desirable species are *Danthonia* spp. and *Elymus scaber.* At Goulburn, the pasture is dominated by *Microlaena stipoides,* which is regarded as a valuable species because of its high quality and ability to respond to fertiliser (9). Other desirable species are *Danthonia* spp. and *Elymus scaber.* Undesirable species present are *Poa* spp., *Bothriochloa macra, Stipa* spp. and *Aristida ramosa.* The pasture at Dalgety is closest to the undisturbed pasture described by Moore (10), as it is dominated by *Stipa* spp., but contains *Enneapogon nigricans, Danthonia* spp., *Poa* spp., *Panicum effusum* and *Elymus scaber.* Of these, the *Stipa* and *Poa* species are undesirable and *Danthonia* spp., *Enneapogon nigricans, P anicum effusum* and *Elymus scaber* are desirable grasses (9).

Insufficient time has elapsed since the commencement of the experiments to produce measur- able changes in botanical composition from the effects of either superphosphate rate or controlled grazing.

Grazing management on the Northern Tablelands has shown that favourable manipulation of native pastures is most successful where the life cycles of the desirable and undesirable species do not coincide

(7). However, on the Southern Tablelands, there are instances where these species groups have life cycles that are similar, and development of management strategies to change the botanical composition is likely to be difficult. For example, phenological data suggest that the life cycles for *Stipa* spp. and *Danthonia* spp. are similar, with the main flowering period occurring in late spring. Similarly, the germination of both species occurs in winter, and this may cause further difficulties for changing botanical composition. More success may be obtained in increasing the proportion of *Danthonia* spp. in a *Bothriochloa macra* pasture, as *B. macra* has its main flowering period in late summer. However, the situation regarding the desirable species *Microlaena stipoides* is less clear, as it does not appear to have a clearly defined flowering period, although flowering generally occurs during summer and autumn (15). Further study of the phenology of this species is required before reliable management procedures can be defined.

There are other practical difficulties in applying management principles similar to those defined on the Northern Tablelands. For example, some species (e.g. *Stipa, Poa, Danthonia)* are able to re-commence growth and flower following unpredictable rainfall in summer. Also, competition in spring from *T. subterraneum* and the cool-season annual grasses (e.g. *Vulpia)* may be critical for the growth of perennial native grasses. In addition, the importance of ecotypic differences within native species is unknown. All these factors suggest that the definition of management strategies for native species in the Southern temperate regions of NSW will be more difficult than that for the Northern regions with significant summer rainfall influence.

Table 1. Composition of pastures at three experimental sites on the Central and SouthernTablelands of NSW.

	Bathurst	Goulburn	Dalgety
Dominant species (>20% strikes with point quadrat)	*Bothriochloa macra*	*Microlaena stipoides*	
Other major species (5-20%)	*Danthonia spp.* *Vulpia spp.*	*Danthonia spp.* *T.subterraneum* *Vulpia spp.* Forbs	*Stipa scabra* *S.bigeniculata* *Enneapogon nigricans* *Danthonia spp.* Forbs
Minor species (1-5%)	*Elymus scaber* Forbs *Trifolium spp.*	*Rushes* *Poa spp.* *Bothriochloa macra* *Elymus scaber*	*Poa spp.* *Panicum effusum* *Perennial legumes*
Trace species (<1%)	*Chloris truncata* *Aristida ramosa* *Poa spp.*	*Trifolium spp.* *Stipa scabra* *S. bigeniculata* *Aristida ramosa* *Themeda triandra*	*Vulpia spp.* *Elymus scaber* *Bothriochloa macra* *Themeda triandra*

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