Native grasses: an example of using on-farm biodiversity

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Abstract

Native grass pastures can have high conservation value. Some of the most significant grasslands in south-eastern Australia have been used for occasional stock grazing. The possibility of managing what you have in the back paddock for multiple purposes, grazing and seed harvesting are discussed. Some common native grasses are described, along with techniques for harvesting their seed, from the simple to the highly mechanical. A range of native grass cultivars have been selected for various purposes, from revegetation and pasture through to turfs. There is a current demand for native grass seed, and seed prices reflect this demand. Native grasses may also provide potential new crop and pastures species, and new medicines.

Keywords

cultivar selection, grasses, native grasses, native grass pasture, seed harvesting

Introduction

Native grasslands are one of the most threatened ecosystems in Victoria. In 150 years, a staggering 99.5% of these grasslands have been destroyed, reducing this once extensive native vegetation to small isolated remnants (Scarlett et al 1992). These native grasslands contain a disproportionate number of threatened plants and animals. With little representation in public land reserves, private land is the key to the survival of grassy ecosystems and the threatened plant and animal species associated with them.

There is a large range of native grasses in Australia — approximately 1085 species. Native grass pastures can have a range of production, environmental and economic advantages:

- many are drought resistant
- nearly all native grass species are perennial, and some are summer-growing
- they are naturally adapted to local soil and rainfall conditions
- they can be an important genetic resource for developing new pasture and crop varieties
- many have aesthetic values and have potential for horticulture and ecotourism (Barlow 1998).

In addition to these benefits, native grass pastures provide important habitat for wildlife. Many of the native animals that live in native grasslands play a significant role in controlling insect pests in nearby pastures.

In recent years there has been growing interest in the use of native grasses for pastoral, amenity, recreational, land reclamation and revegetation purposes (Lodge and Groves 1991). It is only in recent years that native grass seed has become available through domestication (registration of cultivars) and seed harvesting. The Australian situation contrasts sharply with the situation overseas: about 50% of the forage plants sown in the United States and most of the species sown in Europe are based on locally domesticated native species (Lodge 1994). Native grasses could provide us with important new pasture and crop varieties, as well as potential medicines.

This paper will discuss how landholders can capitalise on a patch of native grasses that on their land, without harming the conservation value. I will also describe some of the common native grasses, the cultivars that have been selected, and the techniques that can be used for harvesting native grasses.

Native grassland and native grass pastures

The definition of native grassland and native grass pasture is often confusing. A native grassland is a treeless community that is composed of native grasses as well as a range of other species, including herbs and shrubs. A native grass pasture can be defined as a pasture that is primarily composed of native grasses. It is usually a native grassland that has undergone modification in the form of grazing by domestic stock and the introduction of legumes, such as subterranean clover. Native grass pastures can have high conservation significance (Barlow 1998); for example, some of the most significant grasslands in south-eastern Australia are used for occasional stock grazing. This is the case with Terrick Terrick National Park. Terrick Terrick has a long history of grazing by sheep. This grassland is currently considered to be one of the most diverse native grasslands in south-eastern Australia, supporting rare and threatened species of flora and fauna such as the Plains Wanderer.

Values of native grasses on farm

Native grasses have an evolutionary history of adaptation to our climate and soil conditions. An ideal pasture species would be a persistent species that is matched to soil type and provides ground cover while producing dry matter for livestock production (Simpson and Langford 1996). In recent years there has been increased interest in the role of native grasses in agriculture (Garden et al. 1996). It is unfortunate that many native grass species have been dismissed out of hand, as many species are potentially useful, productive, of moderate to high quality, and have good drought tolerance (Lodge 1994). The production and quality values of some of our common native grasses are listed in Table 1. Many native grasses are perennial, deep-rooted and tolerant of acidic soils, and they may play a role in helping to solve the problems of water erosion, induced soil acidity and dryland salinity.

Table 1 Current cultivars that have been selected, and proposed uses (Mitchell 2002).

Species	Production (tonnes/ha)	Crude protein (%)	Digestibility (%)
Wallaby grasses — *Austrodanthonia* spp.	1.8 – 7.8	10 – 25	45 – 82
Red Grass — *Bothriochloa macra*	3.8 – 10.4	4 – 15	48 – 59
Windmill Grass — *Chloris truncata*	0.32 – 3.1	7 – 12	35 – 68
Common Wheat-grass — *Elymus scaber*	3.4 – 7	10 – 36	53 – 90
Weeping Grass — *Microlaena stipoides*	1.7 – 7.4 (up to 25)	10 – 27	55 – 80
Kangaroo Grass — *Themeda triandra*	1.6 – 8.3	5 – 17	54 – 75

Native grass pastures may also provide wildlife habitats. The key habitat features of many native grass pastures are:

- rocks — basking sites and cover for small reptiles
- grass tussocks — food for invertebrates, cover for reptiles, and runways
- fallen tree debris — cover and food for invertebrates, cover for reptiles and birds
- wet depressions — aquatic environment for frogs and wetland birds.

Management of native grass pastures

The dominant grass species in native grass pastures may vary from year to year, depending on the rainfall, temperature, stocking rate, fertiliser application and other factors. Management may also alter the composition of native grass pastures (Garden et al. 2000). For example, maintaining heavy grazing over the late spring to early autumn will weaken the undesirable Wire Grass (*Aristida ramosa*), then light grazing after the autumn break and through winter and spring will encourage the establishment of more desirable species, inlcuding *Austrodanthonia*, *Microlaena* and *Bothriochloa*. For effective management of these pastures, individual species need to be recognised and their response to management known. The management adopted will thus depend on the intended land use.

The first step in the management of any native grass area is the recognition of the species present. The second step is determining what you want to achieve from this area, remembering that conservation and productivity are not necessarily mutually exclusive.

A knowledge of the response of individual species to management, particularly grazing and fertilising, provides a means of changing pasture composition.

Response to fertility. This is the response of the grass to improved soil fertility. Some native grasses increase in frequency (percentage of the sward) as fertility increases, while others disappear.

Response to grazing. This is the response of the grass to increased grazing pressure. Does the grass increase in frequency (percentage of the sward) with increased grazing, or decrease and not persist?

There are several publications that provide useful guidelines on the management of native grass pastures; see Simpson and Langford (1996) or Barlow (1998).

Features of the major temperate native grasses

I said earlier that there are approximately 1085 species of grasses that can be considered native. To simplify the discussion, I will concentrate on the six common native grasses as examples.

Wallaby grasses or White Top (*Austrodanthonia* spp.)

Wallaby grasses are among the most agriculturally valuable native grasses in pastoral areas of Australia because of their persistence, palatability and productivity (Figure 1a). They are frost-tolerant, persists under heavy grazing in the absence of intense competition, and make the most of their growth in the spring, summer and autumn (Lodge 1996). Wallaby grasses are widely distributed throughout temperate Australia, and there are 35 species in the genus. Seed heads have a white, fluffy appearance at maturity. Individual species are often difficult to identify. Species identification is based primarily on the arrangement, shape and length of the hairs on the back of the lemma and by the shape and size of the palea.

Red Grass (*Bothriochloa macra*)

Red Grass is a warm-season perennial grass that forms a prostrate tuft of basal leaves with numerous wiry stems (Figure 1b). It can grow up to 80 cm tall. Leaves are scattered with short hairs and can be up to 20 mm long and 5 mm wide. Stems are slender and red to purplish, hence the common names of Red Grass or Redleg Grass.

Red grass occurs in south-eastern Australia, mainly in coastal, tableland and slope environments. It is drought-tolerant and its main period of growth is from late spring to early autumn. Plants flower in late spring and early summer. While this is the main period for seed production, plants can flower again and set seed in summer and early autumn with adequate moisture.

Windmill Grass (*Chloris* spp.)

Windmill grass is a short-lived (2 to 3 years) perennial grass that grows rapidly in early spring (Figure 2a). The plants are prostrate and have small fibrous leaves. Windmill grass is often stoloniferous. This grass has a windmill-like seed head with 3 to 7 spikes that are 4 to 10 cm long. Windmill grass produces large amounts of dry matter after summer rainfall and is readily grazed by stock before it flowers.

Common Wheat-grass (*Elymus scaber*)

Common Wheat-grass is a tufted cool season perennial grass (Figure 2b). It produces high-quality and highly digestible green growth all year round. It is one of the first native grasses to start growing in spring, providing early green feed. There is considerable variation within this species. The common name of this grass suggests that originally it was relatively common, but today it usually occurs as scattered plants.

Figure 1 (a) Wallaby Grass (*Austrodanthonia richardsonii*). (b) Red Grass (*Bothriochloa macra*).

Figure 2 (a) Windmill Grass (*Chloris truncata*). (b) Common Wheat-grass (*Elymus scaber*).

Weeping grass (*Microlaena stipoides*)

Weeping Grass is a tufted perennial grass with a short rhizome (Figure 3a). This species is widespread in south-eastern Australia, including Tasmania, as well as in the south-west of Western Australia. Plants of this species are recognised by their slender weeping seedhead, hence the common names of Weeping Grass or Meadow Rice-grass.

Weeping Grass produces high-quality and highly digestible green growth year round (Waters et al. 2000). This species is frost-tolerant and remains green throughout winter, although its major growth periods are spring and autumn. Plants have good drought survival and are tolerant of acid soils (Mitchell et al. 1992, Munnich et al. 1991) and responds positively to increases in soil fertility (Waters et al 2000). Weeping grass is an extremely variable species, occurring in a single tussock, small colonies or natural lawn, and is commonly grazed by native and introduced mammals (Walsh and Entwisle 1994). This species often occurs in high-fertility sheep camp areas, indicating its tolerance to hard grazing and high fertility (Magacle-Macandog and Whalley 1994).

Kangaroo Grass (*Themeda triandra*)

Kangaroo Grass is a tussocky warm season perennial grass up to 1 m tall (Figure 3b). This species is one of the most widespread Australian native grasses, ranging from alpine areas to deserts. Older leaves tend to be reddish brown. Kangaroo Grass can form a stable and resilient pasture (Noy-Meir and Walker 1986). It is drought-tolerant, with its main period of growth from late spring to early autumn.

Figure 3 (a) Weeping Grass (*Microlaena stipoides*). (b) Kangaroo Grass (*Themeda triandra*).

Potential markets

There are a number of potential markets for native grass seed. These include:

- pasture — particularly in areas that are unsuitable for introduced species; some native grasses are recognised for their tolerance to acid soils (e.g. *Microlaena stipodes*) and drought (e.g. *Bothriochloa macra*)
- Horticulture — inter-row plantings in vineyards and orchards; species such as Wallaby Grass are believed to be beneficial due to the reflection of light from their seed heads over the summer months
- Road-making — for roadside stabilisation and nature strips; CSIRO have selected native grasses specifically for this purpose, selecting for low growth and limited mowing (e.g. *Austrodanthonia richardsonii* cv Hume)
- Mining — for revegetation and rehabilitation
- Landscaping — for amenity and horticultural uses, e.g. golf course roughs (e.g. *Austrodanthonia* sp.), feature plantings and turf (e.g. *Microlaena stipoides* cv Griffin and *Bothriochloa macra* cv Bass)
- Revegetation after disturbance – e.g. under powerlines, above sewerage lines.

Descriptions of selections or registered cultivars

Native grass selection programs began in the mid 1980s, for a variety of reasons. In the drought years of the early 1980s, at a time when the cost of fertilisers was high, many graziers found that their sown introduced pastures were not persisting (Lodge 1996). Farmers began to recognise that some of the species that had persisted during droughts were native grasses. At the same time the community began to recognise the value of revegetation with native species, and an interest in landscaping with native species also increased.

Limited quantities of seed of some native grass species are now available. Table 2 lists the current varieties that are available and their targeted use. They range from highly productive grasses for pastoral use to low-growing grasses suitable for turf.

Table 2 Current cultivars that have been selected, and proposed uses (Waters et al 2000).

Common name	Species	Varietal name	Target industry
Curly Mitchell Grass	*Astrebla lappacea*	cv Yanda	pastoral
Barley Mitchell Grass	*Astrebla pectinata*	cv Turanti	pastoral, rehabilitation
Wallaby Grass	*Austrodanthonia bipartita*	cv Bunderra	pastoral
Wallaby Grass	*Austrodanthonia fulva*	LIG-179	pastoral, rehabilitation
Wallaby Grass	*Austrodanthonia geniculata*	Oxley	amenity
Wallaby Grass	*Austrodanthonia richardsonii*	cv Hume	amenity
Wallaby Grass	*Austrodanthonia richardsonii*	cv Taranna	pastoral
Red Grass	*Bothriochloa macra*	LIG-002	pastoral, rehabilitation
Red Grass	*Bothriochloa macra*	Bass	amenity, rehabilitation
Tall Windmill Grass	*Chloris ventricosa*	LIG-548	pastoral, rehabilitation
Common Wheat-grass	*Elymus scaber*	LIG-473	pastoral, rehabilitation
Common Wheat-grass	*Elymus scaber*	LIG363	pastoral, rehabilitation
Curly Windmill Grass	*Enteropogon acicularis*	LIG-046	pastoral, rehabilitation
Weeping Grass	*Microlaena stipoides*	cv Griffin	turf
Weeping Grass	*Microlaena stipoides*	cv Shannon	amenity
Weeping Grass	*Microlaena stipoides*	cv Wakefield	pastoral
Weeping Grass	*Microlaena stipoides*	LIG-183	pastoral, rehabilitation
Weeping Grass	*Microlaena stipoides*	LIG-704	pastoral, rehabilitation
Kangaroo Grass	*Themeda triandra*	cv Tangara	amenity, rehabilitation
Kangaroo grass	*Themeda triandra*	LIG-520	pastoral, rehabilitation
Kangaroo grass	*Themeda triandra*	LIG-165	pastoral, rehabilitation

Collecting or obtaining native grass seed

The best time to harvest native grass seed is in the summer months, when grasses have set seed, usually from mid December to January (Table 3), but this may vary according to seasonal conditions and location. Mature native grass seeds can be recognised by their dark colour and firmness when squeezed between the fingernails. In cool temperate regions seed is produced in response to day length, and coincides with the end of the growing season. Because of the non-synchronous development of the seed in a number of native grass species, it is necessary to aim for a stage of development when an optimum number of mature seeds are present. For Kangaroo Grass this stage is usually earlier rather than later in the ripening process, and is indicated by the presence of dark, twisting awns attached to a well-filled dark brown seed. It is best to allow as much seed as possible mature on the plant before harvesting, because prematurely harvested seed will have poor viability. The best places to harvest seed are in areas that have a large component of native grasses and few weeds.

For many native grass species there is the potential to harvest the same area a number of times because of the asynchronous development of the seed. Also, if seasonal conditions are good the grasses will flower a number of times over the summer months. However, presently our most efficient native grass seed harvesters are only recovering about 30% of the total seed produced.

In order to collect seed you will probably need to obtain permission from landowners and local authorities. In most states and territories, permits are also required for collecting on both public and private land. In Victoria, inquiries should be directed to the Department of Sustainability and Environment.

Harvesting methods

Several methods can be used to harvest native grass seed. Different species often require different harvesting techniques (Table 3). The simplest of these is by hand with a pair of shears. Just grasp the stalks and cut off the seed heads. This method is arduous and seed yields are low. Listed below are the main harvesting techniques that are currently used to harvest larger areas of native grasses. Machinery is continually evolving and there is room for modification and fine-tuning.

The choice of machine should consider the target species, weeds, terrain and weather conditions. One harvester may not be able to harvest all possible native grasses. Efficient harvesting depends on a number of factors, including machinery set-up and plant density and maturity (Cole et al. 2000). In some instances you can hire a machine or get a contractor to harvest your native grasses for you.

Table 3 Harvesting method and timing for a range of common native grass species (Cole and Metcalfe 2002).

Common name (species)	Harvest time	Harvesting method
Wallaby Grass (*Austrodanthonia* spp.)	September – November	vacuum harvester brush harvester troughing windrowing
Red Grass (*Bothriochloa macra*)	February – March	vacuum harvester brush harvester troughing
Windmill Grass (*Chloris* spp.)	January – April	brush harvester
Common Wheat-grass (*Elymus scaber*)	September – November	brush harvester conventional header with crop lifters
Weeping Grass (*Microlaena stipoides*)	October – January	vacuum harvester brush harvester
Kangaroo Grass (*Themeda triandra*)	December – January	brush harvester conventional header

Troughing

This simple method, which is suitable only for fairly flat land, uses a trough mounted on the front of a vehicle, which is driven through the harvesting area (Figure 4a). Ripe seed collects in the trough and unripe seed remains on the plants, to be harvested later. Red Grass and wallaby grasses can be harvested using this method.

Vacuum harvester

Modified garden vacuum cleaners have been used for small areas. The seed may be vacuumed from the plant or the ground below. Care needs to be taken with vacuuming the seed from the ground to avoid contamination with soil, litter and non-target species (Cole et al. 2000). A commercial-type garden vacuum can be purchased for less than $1000. Figure 4b illustrates a vacuum harvester that has been developed specifically for harvesting Weeping Grass.

Brush harvester

This method is a non destructive harvest technique that allows multiple harvests of the one stand. The central concept of the brush harvester is a flailing nylon brush, similar to that of a road sweeper, which rotates upwards at its leading edge (Waters et al 2000). In effect the brush removes the ripe seed from the head, non destructively, allowing for multiple harvests within a season.

Several brush harvester are commercially available, including the 'Grasshopper' at around $8500, the 'Scorpion' and the 'Rosevale Reaper' at around $17 000 (Briggs 2001) (Figures 5 and 6).

Windrowing

This method has been used for Wallaby Grass and employs a method similar to cutting hay. The crop is cut and left to dry before being collected.

Conventional crop header

Species that have a high degree of seed retention, e.g. Common Wheat-grass, can be harvested using conventional machinery.

Cutting and baling

A method developed by the former Department of Conservation and Natural Resources (Victoria) to revegetate areas with Kangaroo Grass involves:

- cutting the area with a brushcutter or sickle-bar mower
- collecting the hay into wool bales (one bale covers 25 to 50 square metres)
- spreading this hay onto a new area immediately
- then burning the site in the spring (McDougall 1989).

Seed labelling

Harvested seed should be air-dried (down to approximately 50% weight reduction) before being stored in a dry container away from heat, light and vermin; see Mortlock (1998) for more details on seed storage). Label all seed with the date and exact location of collection (Table 4 for proposed labelling guidelines). Depending on the species it is sometimes useful to also collect one full plant (leaves, stem and seedhead) to enable later identification of the species/genotype.

Figure 4 (a) Simple trough harvester. (b) 'Bushranger' vacuum harvester.

Figure 5 'Rosevale Reaper', a combined brush and vacuum harvester.

Figure 6 Brush harvesters.

Table 4 Proposed industry code of practice for the description of physical seed quality of native grass seed (source: Australian Native Grass and Legume Seed Industry Association, in Waters et al. 2000).

Labelling requirements	Comments
Genus, species and line number	To identify the major components of the seed lot and identify the particular line/cultivar, so that good lines can be identified and any problems with performance traced back to their source.
Collection location	GPS or directions from and distance to nearest town. This will allow a buyer to assess issues of provenance.
Date of collection	The age of the seed lot has a bearing on dormancy and useful life.
The number of normal germinating seeds OR fresh non-germinating seeds	This is for the main species (per 10 g) and will take into account the chaffy impurities of the material and the presence of floral structures, as well as a provision of some measure of dormancy. This will provide the measure of seed dormancy and indicate if seed dormancy breaking treatments are necessary.
Other seeds, other species including native species	To be given on a percentage by weight basis for each species if other seeds collectively contributed more than 5% of the seed lot weight.
Important weed seeds	Number of weed seed per 10 g, or as a percentage.
Name and contact details of collector	

Supply and demand

At present native grass seed is expensive to buy, and the supply of native grass seed is not meeting the demand. For example, for its 2001–02 crop Native Seeds was selling Wallaby Grass seed cleaned down to naked caryopsis for $350/kg (Native Seeds 2002). The recommended sowing rate for this grass is 0.5 to 2 kg/ha. Weeping Grass seed was $50/kg, with a sowing rate of 20 kg/ha for pasture or revegetation and 100 kg/ha for turf. These seed prices are for seed that has been harvested from nursery stands; that is, stands that have been sown specifically for seed harvesting. Glendale Native Grass & Seeds (John Betts, Glendale Native Grasses and Seeds, pers. comm..) were selling their 2001–02 crop of Kangaroo Grass seed for $660/kg. They recommended a sowing rate of 2 to 4 kg/ha. This seed had been harvested from wild stands.

There are a number of reasons why the seed prices are high. The market will currently pay these prices when limited seed quantities are available. Nonetheless, the prices are not realistic for agricultural use, compared to the seed prices and sowing rate of phalaris. But other markets, such as horticulture, are willing and able to pay these prices. Each year a quantity of the seed harvested is replanted into nursery paddocks, which will eventually increase the harvestable areas of these grasses.

Another reason for the high seed price is that the technology to harvest and clean the seed is very new, and the seed price needs to cover these innovations. Native grass seed harvesting operations are still small, and as yet there are no economies of scale.

Conclusions

Many native grasses are perennial, deep-rooted and tolerant of acidic soils. At present native grass pastures provide important sources of feed in terms of both wool and meat production. They may also play a role in helping to reduce the problems of water erosion, induced soil acidity and dryland salinity. There is potential for native grasses in existing native grass pasture to have a role beyond the farm. They could provide the next new crop or pastures species. There may also, in future years, be other potential uses for these native pasture areas in terms of ecotourism.

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