Germination of Native Grasses and Their Establishment

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INTRODUCTION

There are about 1000 species of native grasses in Australia which must be well adapted to this environment in order to persist. An important feature of this adaption is the ability to reproduce and survive despite variable rainfall and the generally low level of available plant nutrients in Australian soils.

Different species have evolved strategies which allow them to survive in a wide range of physical and biological environments. Grime (1977) suggested that the two most important groups of factors affecting the survival of plants are stress and disturbance. He also suggested that plants have developed strategies to cope with three of the four possible combinations of high and low stress and disturbance (Table 1).

Table 1. Plant strategies associated with the four possible combinations of high and low stress and disturbance (after Grime 1977).

Intensity of disturbance	Intensity of stress High	Low
Low	Competitors (C)	Stress-tolerators (S)
High	Ruderal (R)	(No viable strategy)

The level of stress is determined by factors such as the level of soil fertility, the amount of soil water available, and similar features of the environment. Disturbance, on the other hand, refers to processes such as physical disturbance of the soil or defoliation by grazing animals. A feature of stress-tolerators (Table 1) is low seedling relative growth rate, of competitors is a somewhat higher seedling relative growth rate while the seedling relative growth rate of ruderals is the highest of the three (Table 2).

The stressful Australian environment in terms of a high probability of the occurrence of seasonal or aseasonal drought coupled with generally low soil fertility has led to the evolution of a flora containing a high proportion of stress tolerators with low seedling relative growth rates and grasses are no exception. Jones (1996) demonstrated the slow early growth rate of Wakefield microlaena and *Taranna danthonia* in comparison with four exotic perennial grasses. This slow early growth rate means that competition from weeds (ruderal species) can inhibit the establishment of native grasses from commercial sowings.

ANCILLARY STRUCTURES

The ancillary structures surrounding grass caryopses are often associated with seed dispersal and have important effects on seed germination and the subsequent establishment of seedlings. Many authors, e.g. Lodge and Whalley (1981) have shown that the removal of the ancillary structures often reduces the proportion of dormant seeds. These structures can also be important in affecting the orientation of seeds grass dispersal units on the soil surface, and germination and subsequent seedling establishment. Peart (1984) has shown that the sterile lemmas and awns of microlaena result in the seeds dropping with the embryo end downwards and that seeds remaining in this position have better germination and better seedling establishment than seeds lying horizontal. Other species have ancillary structures which function to bury seed in the soil or to move the seed along the surface of the soil until it meets an obstruction giving it a preferred micro-environment for germination (Peart, 1984). The presence or absence of these ancillary structures can be of importance in the germination of seeds of native grasses in a nursery situation.

Table 2. Seedling relative growth rates (RGR) and established strategies of several species of grasses (from Grime et al., 1988).

Plant	Seedling RGR $week^{-1}$	Established strategy
Festuca ovina	0.5 - 0.9	S
Koeleria macrantha	0.5 - 0.9	S
Anthoxanthum odoratum	0.5 - 0.9	SR & CSR
Lolium perenne	1.0 - 1.4	CR & CSR
Dactylis glomerata	1.0 - 1.4	CSR & C
Phalaris arundinacea	1.0 - 1.4	C
Poa annua	1.5 - 1.9	R

SEED DORMANCY

Seed dormancy can be centred in the ancillary structures surrounding the caryopsis, be associated with impervious seed coats, or with the embryo or endosperm itself. Freshly harvested mature seed of many species of Australian grasses will not germinate immediately and possess primary dormancy (Whalley, 1987). This primary dormancy is sometimes broken by the passage of time or it may require a specific sequence of environmental conditions before the seeds will germinate. The uneven and delayed germination can lead to problems for the commercial propagation of species with primary dormancy.

Non-dormant seed planted in the soil will sometimes develop secondary dormancy depending on the time of the year it is planted and the subsequent environmental conditions. Secondary dormancy sometimes requires specific environmental sequences for it to be broken and is also associated with the sensitivity of seed in the soil seedbank to the existence of a plant canopy which may inhibit seed germination.

A number of techniques including seed storage under room conditions, subjecting dry seeds to alternating temperatures between say 20 and 60C for several months, the use of gibberellic or sulphuric acid in seed treatments, or a number of scarification techniques have been used to break primary dormancy in seeds. When germinating fresh seed of an unfamiliar species of a native grass, it is advisable to attempt to find successful techniques which have been used in the past. An alternative approach is simply to store the seed for about 12 months before use and hope that the intervening time leads to a sufficient decrease in seed dormancy for the sample to be useful.

TEMPERATURE AND GERMINATION

Different species of native grasses will germinate over sometimes widely differing ranges of temperatures. Some have a narrow range whereas others have a far broader range. In addition, some species will germinate better under alternating than constant temperatures and there is no substitute for detailed knowledge of the germination conditions required for individual species. Whalley (1987) lists the temperature requirements for some Australian native grasses and the newly formed Australian Native Grass and Legume Seed Industry Association (ANGLSIA) hopes to start collating such information to make it generally available. In general terms, those species adapted for growth during the cool season of the year have lower germination requirements than warm season grasses.

SPACE, DEPTH OF PLANTING, AND GERMINATION

The importance of bare ground for the germination and establishment of plants ranging from rainforest species through to grasses is now well established. Most species will not germinate, or if they do the seedlings will not survive, beneath an established plant canopy. Depth of planting is also critical and in general terms, deeper plantings will be less successful with smaller seeds.

PROPAGATION OF AUSTRALIAN NATIVE GRASSES

Because the optimum conditions for the germination of seeds of many native grasses are simply not known, simply planting them in soil in a pot in a glasshouse and watering in the hope that the seeds will germinate is often a waste of time. It is better to attempt to germinate seeds on an appropriate medium in petri dishes so that some information can be obtained even from seeds which do not germinate. Many samples of native grass seed contain endogenous microorganisms both fungi or bacteria and which can be given appropriate treatment if the germination is observed on a daily basis. Successful seedlings can be carefully picked up with a pair of forceps when the radical is less than 1 cm long, planted in holes in soil and carefully watered. After establishment, many native grasses may be susceptible to over watering or the over application of nutrients particularly if the plants have become pot-bound. A good rule of thumb with established native grasses is to wait until the surface soil in the pot is dry before watering.

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