Tropical pasture establishment. 8. Management of establishing pastures

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Abstract

Pasture sowing can be expensive and efforts to ensure survival and early productivity have large financial benefits. Grazing and fertiliser application have only minor effects during germination and emergence of sown pasture because of the overwhelming influence of seed and seedbed characteristics and soil moisture supply. Thereafter, and until pasture survival is assured, root competition is the major influence on seedling growth and survival, with limited capacity for management to moderate that competition. We suggest some grazing management and fertiliser application guidelines but conclude that regular care and attention to new pasture is the most important role for management.

Introduction

Management is concerned with security of the sown plants, in order to avoid replanting, and with grazing at the earliest opportunity, in order to maximise economic returns. Table 1 illustrates the effect of delays in establishment on economic returns as well as the considerable delay in repaying investment capital even when establishment is rapid.

Pasture establishment, in this discussion, is taken to be the period between sowing and a time when growth of the pasture into the next growing season is assured. That time may be as early as the end of the first growing season when adequate seed set ensures regeneration in the next season or it may be as late as the end of the second growing season when little or no seed set occurs in the first. Successful establishment does not imply full pasture productivity, which can take up to 3 years in intensive situations (J.K. Teitzel, personal communication) and as long as 8 years in low-input, low-rainfall situations (Anon. 1992). Management refers to interventions other than those concerned with seed and seedbed characteristics, which are dealt with in previous papers of this series. Interventions include grazing, fertilising, burning and using cover crops.

Two phases in establishment are recognised: germination and emergence, followed by seedling growth and survival (Cook 1980).

Table 1. Economic penalties of delays in pasture establishment for 900 ha fertilised stylo carrying 456 home-bred steers.

	Time to full productivity		
	1 year	3 years	5 years
Payback period (yrs)[1]	4	6	8
Net Present Value of sowing ($'000)[2]	110	64	23

[1] Time to restore original cash flow.
[2] At 6% discount rate.

Germination and emergence

The effects of weather, seed characteristics and seedbed conditions are so dominant at this stage that management is almost irrelevant. An exception concerns oversown pasture where manipulation of cover prior to germination can influence drying of the soil surface. Under hot conditions, some cover can extend the period of moist soil

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surface for more than 24 hours (Mott *et al.* 1976). The same effect is sometimes observed in open woodlands where establishment occurs under trees but not in the open. However, there are few prospects for organising the appropriate degree of cover without increasing the degree of competition seedlings will later face from the sward providing the cover. In practical oversowing in the tropics, dry season burning of native pasture followed by immediate sowing, to allow weathering to soften hard seed (McKeon and Mott 1984), usually means that there is no cover at the time of first rain. In the subtropics, where spring pasture growth begins in response to rising temperature, rather than rain, there are better prospects for managing cover through grazing and burning. In sod-seeding and similar situations, manipulation of pasture cover through combinations of burning, grazing and herbicide should become relatively simple, through developments like the band-seeder.

Any effect of fertiliser on germination and emergence is usually negative with superphosphate (Harty 1967; Kerridge and Cook 1990) although no such adverse effects have been observed with non-acidic monoammonium phosphate or sulphate of ammonia (C.P. Miller and A.E. Holmes, unpublished data).

Seedling growth and survival

Whatever the success of germination and emergence, the pasture that finally results is a product of seedling growth and survival. In the tropics and subtropics, where soil water deficits are common during the growing season, this phase is more critical than germination and emergence (Ive 1976; Cook and Dolby 1981; McIvor and Gardener 1981; Cook 1984). Emergence rates are commonly 10–50% of viable seed sown while final survival rates at the end of the first growing season are commonly less than 5% (Cook and Dolby 1981; McIvor and Gardener 1981; Cook 1984).

Once the seedling radicle has penetrated the soil and root growth has begun, the objective of management is to maximise growth of the sown plants and minimise competition. As with germination and emergence, any effects of management can easily be dominated by drought (Rickert and Prinsen 1981; Cook 1984) and competition for nutrients (Cook and Ratcliffe 1985) and moisture (Ive 1976). Moreover, since root competition seems to be more important than shoot competition (Cook and Ratcliffe 1985), there is limited scope for management to favour sown seedlings. Against this background, we propose, in Table 2, a scheme to rank the importance of various management options in post-emergence pasture management.

Grazing or mowing

Defoliation of competing grasses seems to have minor effects on legume seedling survival in the subtropics (Cook 1984). It seems likely that in the less competitive grasslands of the tropics the effects would be even smaller. Recommendations for early grazing management of oversown pastures (Graham 1968; Cook and Lowe 1977; Bowen and Rickert 1979; Edye and Gillard 1985; Partridge and Miller 1991) seem to be based on notions of relative palatability of legumes and grasses. If cattle diet preferences in various circumstances were known, the recommendations for early grazing might make some sense. Without that knowledge, there seems little point in recommending anything other than thoughtful watchfulness.

Winks *et al.* (1974) reported preferential grazing of Townsville stylo yet heavy summer grazing was a common recommendation for its establishment (Edye and Gillard 1985). Similarly, while light to moderate grazing of Siratro

Table 2. Objectives and means of post-emergence management of establishing pastures, in order of potential benefit.

Objective	Means
Minimise root competition for water.	Heavy pre-sowing grazing to weaken competition.
Minimise root competition for nutrients.	Heavy pre-sowing grazing to weaken competition. Fertilise to minimise effects.
Maximise growth of sown seedlings.	Fertilise to promote growth.
Maximise seed production of sown plants.	Spelling at flowering.
Minimise shoot competition.	Grazing or mowing to reduce biomass.

pastures is recommended at establishment (Cook and Lowe 1977), Stobbs (1977) and Walker *et al.* (1981) showed that cattle avoided Siratro in summer. Seca stylo is considered lowly palatable in summer yet Hendricksen *et al.* (1987) showed that it was selected at all times of the year. The variable rarely mentioned is the associated grass, whose own, seasonally-fluctuating palatability is surely relevant in establishing relative preferences. Add to this the possibility of palatability differences between seedlings and adults and the absence of consistent advice becomes understandable. We suggest some grazing management guidelines in Table 3 but acknowledge the importance of treating each establishing pasture on its merits. Mowing or slashing has a role in situations where a broad-leaved competitor overtops sown species but has no place in oversown situations.

Fertiliser

In many areas where tropical pastures might be sown, soil levels of available phosphorus and sulphur are too low for optimum growth of sown species. Requirements of sown species for these nutrients are becoming clearer, even if the economics of fertiliser application are not. For near-optimal growth on soils with low phosphorus sorption capacity, tropical legumes require available phosphorus levels in the soil of 8ppm (e.g. Seca, Gilbert and Shaw 1987) to 14ppm (e.g. Siratro, Rayment *et al.* 1977). Introduced tropical grasses appear to have higher requirements (McIvor 1984). The response to fertiliser in the establishment season is variable, depending on species and rainfall (Cook and Taylor 1990). Absolute responses by slow-growing perennials like Seca stylo may be small in the establishment year (Gilbert and Shaw 1987). A summary of known phosphorus requirements for survival and production is given in Table 4.

Table 4. Requirements by pasture plants for bicarbonate-extractable soil phosphorus (ppm).

	Survival	Production
Seca stylo	3	8
Wynn cassia	3	na[1]
Verano stylo	4	12
Glenn jointvetch	4	na
Twining legumes	5	13
Urochloa	4	10

[1] Levels uncertain.

Phosphate-extractable sulphur levels, calculated as a weighted profile mean, need to be above 4ppm for optimum growth of legumes (Probert and Jones 1977; 1982). There is no information regarding establishment responses, Gilbert and Shaw (1979) reporting no effect on numbers or yield in the first year. Surprisingly, they also reported no adverse effect of pelleting *Stylosanthes guianensis* seed with elemental sulphur.

Fertiliser invariably attracts cattle so that in band-sown or strip-sown pastures or where only part of a paddock is fertilised, great care is needed in grazing management. Except in extremes of infertility, fertiliser in these situations is best delayed until establishment is assured.

Companion crops

Companion crops are sown either before or simultaneously with pasture to minimise the time land is out of production. The practice can be successful when undersowing winter cereals

Table 3. Grazing management guidelines for establishing pastures, based on growth form and palatability.

	Habit and palatability	Recommendation
Grasses	All	Spell until seeded.
Legumes	Low-growing, palatable (*Stylosanthes guianensis, S. hamata*)	Graze early, spell at flowering.
	Low-growing, unpalatable (*Cassia rotundifolia*)	Graze continuously.
	Erect, palatable (*Aeschynomene americana*)	Graze mid-season, spell at flowering.
	Erect, semi-palatable (*Stylosanthes scabra*)	Graze continuously (tropics). Spell at flowering (subtropics).
	Twining, palatable (Siratro, Centro)	Spell at flowering.
	Twining, unpalatable (Calopo)	Graze continuously.

(Scattini and Johnson 1988) or late in the growth cycle of summer cereals but simultaneous sowing of pasture and summer crops such as lablab depresses establishment (M.F. Quirk, unpublished data).

Practical implications

The major influences on the success of pasture establishment are weather, seed characteristics and seedbed preparation. Other aspects of management have marginal impact although bad management can easily prevent establishment.

Legumes (and grasses) superbly adapted to the environment (e.g. Seca, Verano and urochloa in the tropics, fine-stem stylo and rhodes grass in the subtropics) establish more easily than those with marginal adaptation.

Producers north of 20°S routinely oversow pastures on several thousand hectares annually with no management other than dry season burning. In the subtropics and higher latitude tropics oversowing is often much less successful for the following reasons:

1. Less reliable growing season rainfall.
2. Stronger competition from native pastures growing on more fertile soils.
3. Difficulty in synchronising pasture burning and sowing.

Producers in the tropics can reliably establish legumes in native grass but would prefer faster establishment. The price of achieving this through management would not be bearable and their best hope lies in manipulation of seed characteristics.

Producers in the subtropics clearly need to control competition for reliable establishment of most existing cultivars. Satisfactory control can be achieved by cultivation or application of herbicide, both of which can be done in strips.

Grazing management has to consider growth habit and relative palatability of sown and competing plants. Apart from the general guidelines suggested, the approach needs to be that of the careful husbandman: regular inspection of establishing pastures for overgrazing, selective grazing or uprooting of new seedlings. Stocking rates should be increased in harmony with development of the pasture.

Decisions about fertiliser rates and timing will usually be economic ones. In view of their marginal importance to establishment except in extreme situations, fertiliser applied to increase cattle productivity might best be delayed until pasture establishment is assured.

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