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MANAGING PASTURES FOR BETTER SOILS:

SUMMER GRASSES - WHERE DO THEY FIT?

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In northern Australia, dryland pasture plantings consist of summer species. In southern Australia, these tropical pastures are replaced with temperate species. Somewhere in between these two areas is a boundary, which unfortunately is not a straight line. The objective of the paper is to try and ascertain, at an individual property level, where the southernmost limit is for the planting of summer grasses. It then looks at the benefits of improved versus native species and questions the justification of replacing productive, persistent and palatable native species with other improved grasses. The paper concludes with some recommendations on where the most suited improved summer grasses could be tried.

INTRODUCTION

At the outset of this paper it is important to establish exactly what we are talking about. The subject of the paper is "summer grasses". This term is not used in the restrictive sense as it relates to the common grasses of the *Digitaria* genus. Rather it is used in the broader sense to include all grasses that grow during the hot or warmer months of the year and are dormant in winter. These grasses are commonly referred to as tropical and subtropical grasses.

These species generally mature and set seed before winter after which their quality deteriorates rapidly. In contrast, the temperate grasses which grow in the cooler months of the year provide high quality feed in the winter months, and in most cases, mature and seed in the spring-summer period.

WHERE DO SUMMER GRASSES GROW?

According to Milton-Moore (1973), the boundary between the tropical and temperate regions in eastern Australia is taken to be a line running north-west from latitude 32°S on the high rainfall coast to latitude 29°S at the inland limit of the sub-humid area defined as the 508 mm annual rainfall isohyet. North of this line the temperate *Danthonia* and *Stipa* genera which provide the native grass species which are dominant in temperate Australia are largely replaced by the tropical genera, *Dichanthium* and *Bothriochloa*' (Figure 1). The common names for these species in northern NSW are: *Danthonia* spp. - wallaby grasses; *Stipa* spp. - spear grasses; *Dichanthium* spp. - Queensland blue grass; and *Bothriochloa* spp. - red grasses.

In practice, this definition is a bit too specific as there are certainly numerous instances of temperate species growing above this line and summer grasses growing below it.

Variation in summer and winter rainfall and temperature

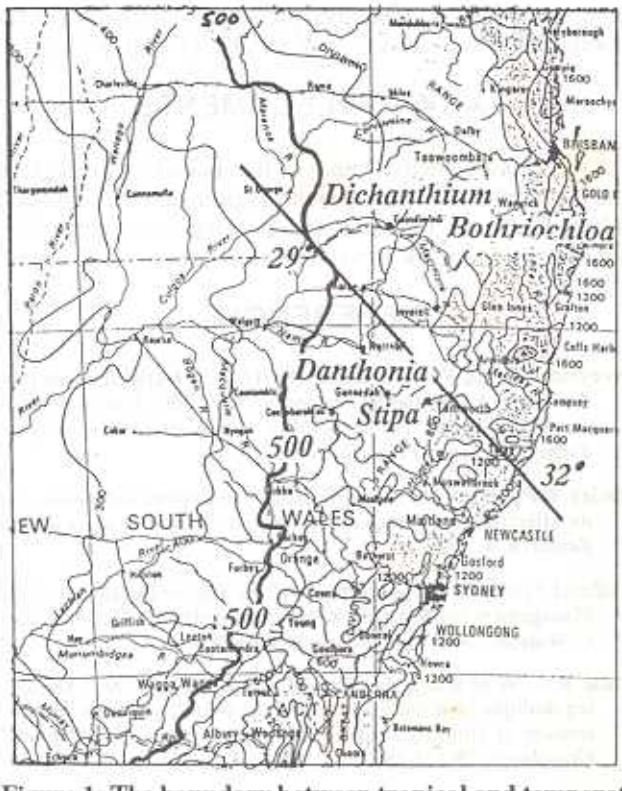

Figure 1: The boundary between tropical and temperate grass adaptation (Milton-Moore, 1973)

regimes are the main criteria that determine the suitability of 'which' summer or temperate species is best suited 'where'. Both of these components are affected by altitude and day-length. In most cases, maturity and seed production are favoured by decreasing day-length in summer grasses and increasing day-length with temperate species.

This may also be an oversimplification of the regions suitable for tropical and temperate species as the combined effects of temperature, rainfall, soil type, fertility and day length have different effects on different species. For ex-

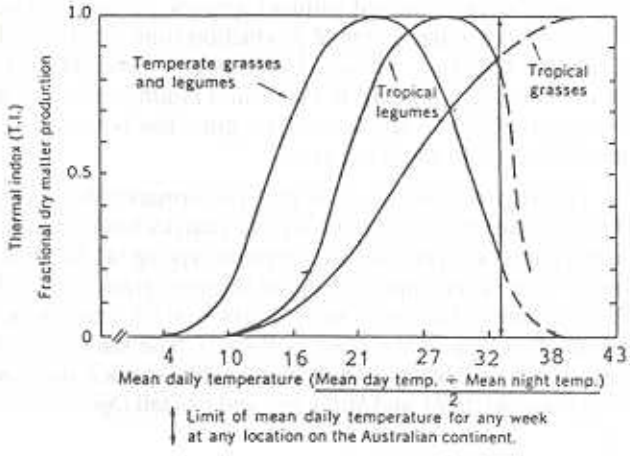

Figure 2. Thermal Index (T.I.). Relationship between mean daily temperature and fractional dry matter production in three groups of pastures (Fitzpatrick and Nix, 1970).

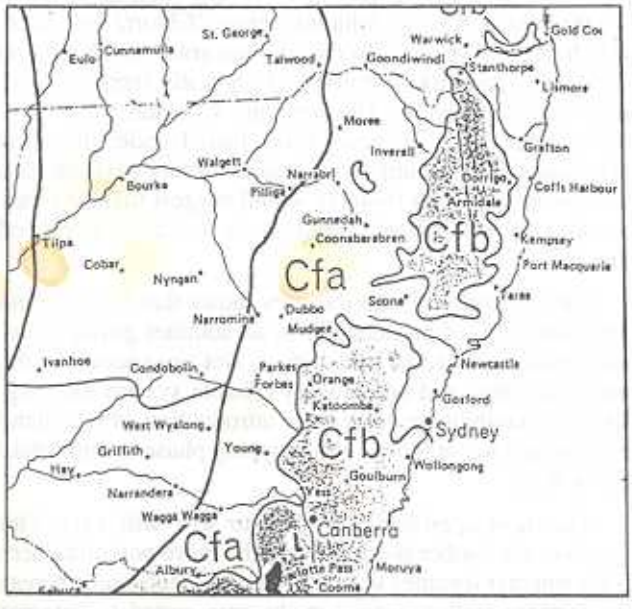

Figure 3: Koppen's climatic types for temperate/tropical areas (Dick, 1975)

ample, some free-seeding species such as buffel, purple pigeon and Katambora rhodes grasses, produce seed at all times of the growing season whereas other grasses such as Callide rhodes grass and creeping bluegrass have a delayed flowering time which confines seed-set to the late autumn period.

The same variation applies to dry matter production. For example, Green panic will provide a green pick in the middle of winter if the temperature increases following winter rain, whereas under the same conditions, purple pigeon grass will remain completely dormant. This means that the ability of a particular species to supply forage for livestock at a certain time of the year (*eg.* early spring feed) is determined by its temperature threshold which must be reached before growth commences. For example, it is generally accepted that native grasses and improved species, like Premier digit grass will start providing growth earlier than kikuyu or Callide rhodes grass.

Fitzpatrick and Nix (1973) defined these differences in

Figure 4: Composite of Figure 1 and 3 showing tropical grass areas in Cfa areas above 29°/32° boundary line.

temperature requirements between pasture species (Figure 2) which explains the temperatures favouring summer (tropical) and temperate grasses and legumes. The thermal index shown is only one of three indices which form the basis of a multiplicative total growth index which also includes indices for moisture and light.

Another approach to identifying the boundary between summer and temperate species is provided in Figure 3 which is based on the Koppen system (cited by Dick, 1975). This system differentiates climatic types within the temperate/tropical area (which is referred to as the Humid Mild Winter Zone) into two categories:

1. **Cfa** - rainfall evenly distributed with hot summers; and,
2. **Cfb** - rainfall evenly distributed with cool summers.

The superimposition of Figure 1 over Figure 3 provides a rough guide to the area in NSW where summer grasses will grow best (Figure 4). However, this is still not good enough for making recommendations at an individual property level.

A more specific recommendation would be along the following lines. Summer grasses will provide more feed than temperate grasses where: (1) the annual rainfall exceeds 500 mm; (2) the bulk of this falling in the spring/summer period; and (3) the mean daily temperature for the majority of the spring to autumn period is >33°C.

Even these guidelines could be debated, because at the optimal temperature for growth of temperate grasses, tropical grasses can produce more feed (Fitzpatrick and Nix, 1973). However, this does not mean that tropical grasses are better than temperate species as there is still the major difference in digestibility between the two groups to be considered. As can be seen in Figure 5, temperate grasses are more digestible than tropical grasses (Minson, 1990). Even though we would expect the digestibility of tropicals to improve the further south they are grown, they would still be inferior to temperate grasses.

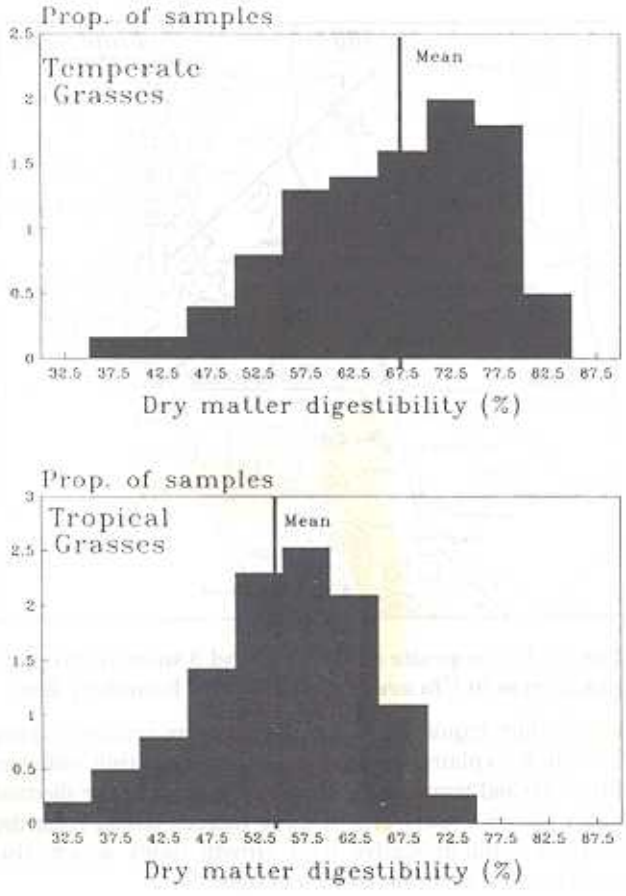

Figure 5: A comparison of the digestibility of temperate and tropical grasses based on samples submitted for quality analysis (Minson, 1990)

NATIVE OR IMPROVED SUMMER GRASSES?

Until recently, there has been strong support for the view that native grasses have only a short season before their quality declines and their capacity for growth is less than that of the selected introduced pasture plants (Humphreys, 1980). He further stated that native pastures 'are not as resistant to high stocking rates as plants selected for this virtue', and that their cold tolerance is inferior to that of introduced grasses. Thus, plants like green panic will grow when out-of-season rains do fall, whereas black speargrass (*Heteropogan contortus*) will stay quite dormant.

In 1980 the attributes of native pastures, referred to here, were generally considered as negative attributes. However, with increasing concerns about environmental sustainability, this thinking is changing. The great success stories of the past such as adapted *Bos indicus* cattle, stock supplements and fertilised grass pastures do not generate the same amount of unreserved applause now, as they did then.

A reflection of more current thinking is that expressed by Lodge (1992), "Native grasses have evolved under harsh conditions of periodic drought and low soil fertility. They have also been subjected to 200 years of grazing by domestic livestock and some have withstood the test of time."

Preliminary results of pasture research in progress at the Brian Pastures Research Station at Gayndah question the real benefits of improved summer grasses. In fact, in one study which compares animal production from plantings of a number of native grasses (*Heteropogon contortus, Dichanthium sericeum, and Bothriochloa bladhii*) along side five improved grass species, no one grass has been consistently better than any other grass.

The real difference in animal performance has been related to pasture age with liveweight gain declining significantly across all species as each pasture type aged (Robbins, 1991). This work implies that one summer grass is not all that different from another summer grass (at the same stocking rate) so long as the stock will eat it. The same results have not been obtained from unpalatable species such as wire grass (*Aristida* and *Stipa* sp.) and rats tail (*Sporobolus* sp.).

The take home message from these studies is that we need to think very long and hard before ploughing out a paddock of palatable native and naturalised grasses to plant introduced (improved) species. Consider the warm season perennials listed by McDonald (1991a) such as redgrass (*Bothriochloa macra*), windmill grass (*Chloris truncata*), couch grass (*Cynodon dactylon*), blue grass (*Dichanthium sericeum*), paddock lovegrass (*Eragrostis leptostachya*), hairy panic (*Panicum effusum*) and Coolatai grass (*Hyparhaennia hirta*). If these were planted under the same conditions as other improved grasses in this environment, the research at Brian Pastures would suggest that they may produce the same meat output as the so called improved grasses.

Further work at Brian Pastures shows that to overcome this 'rundown' of productivity in all summer grasses, several strategies need to be adopted. Not unexpectedly, the most economic and consistently reliable system for long-term sustainability involves the introduction of a legume into the pasture, or the use of a cropping phase to rejuvenate the system.

The most appropriate legume to sow will vary with location: the further north you go, the more potential there is for summer legumes such as stylos and leucaena whereas the further south one goes in the area suited to summer grasses, the greater potential there is for temperate legumes such as medics, lucerne and even clovers.

While this paper is directed towards summer grasses, it is acknowledged that to maximise production from these grasses, it is important to grow mixed grass/legume stands or at least provide stock with access to a legume supplement to complement their diet.

SPECIFIC IMPROVED SUMMER GRASS RECOMMENDATIONS

Having established the need for, and the areas most suited for planting improved summer grass species, we now need to ascertain 'what should be planted where'. This is not a simple question and certainly not one that has only one answer. What may be well suited to one property may be quite inappropriate on the same soil type on the adjoining property. A good example of this is Silk sorghum, which is widely used in Queensland but considered by many people in NSW to be a weed. In fact, I think in some shires it may even be a declared Noxious weed.

Table 1: Some guidelines to assist in the selection of species to grow.

Ratings	Silk Sorghum	Purple Pigeon Grass	Rhodes Grass	Panic	Paspalum	Makarikari Grass	Creeping Bluegrass	Buffel Grass	Premier Digit Grass	Lovegrass	Mitchell Grass
Characteristics - Time to Feeding Q = 6 mths M = 1 yr S = 1 yr plus	Q	M	M	M	S	S	S	S	S	S	S
- Persistence in Lo Fertility Soils Hi Fertility Soils S = 1-3 yrs M = 4-6 yrs L = 7-12 yrs	S M	- M-L	M L	S L	- L	- L	M L	M L	L L	L L	- L
- Min'm Rainfall Req'd (mm) with most in summer months	450	450	500	500	500	400	450	300	300	400	300
- Suited to Sandy Soils Sandy Loam Loams Clay Loam Clay P = Poor F = Fair G = Good * = From Seed - = Not recommended	- P F G G	- - P F G	F G G G F	P F F F P	- P F G G	- - F G G	- F G G F	G G G G -	G G G F -	G G G - -	- - - F G
- Drought Tolerance	F	G(*)	F	F	G	G	F-G	G	G	F-G	G
- Flood Tolerance	P	G(*)	P	P	G	G	P	P	?	?	P
- Main Growth Period Sp = Spring Su = Summer A = Autumn	Sp-Su	Sp-Su	Sp-A	Sp-A	Sp-Su	Sp-A	Su-A	Sp-A	Sp-Su	Sp-A	Sp-Su

(*) Established plants may die but seedling regeneration compensates for this loss

Table 1 provides some guidelines to assist in the selection of species to plant. However, before getting to this point, a number of other questions need to be asked first (Thompson, 1988). These include:

1. *Is the need for bulk or quality feed?* For example, bulk is likely to come from short-term species such as Silk sorghum; quality will come mainly from legumes such as lucerne.
2. *When are you most likely to want feed from the paddock - all year, mainly in the winter or late in the summer?* For example, if you want all year round green feed sow lucerne or legume-grass mixtures. The idea of planting a paddock of improved pastures and expecting it to last forever no longer applies. With the exception of some species such as *Bothriochloa, Dichanthium* and some *Digitaria* species most pastures have a limited life. How long they will last is influenced by soil fertility, species selection, management and seasons.
3. *Is the pasture intended for short- or long-term use?* For example, in a rotation or short term pasture, species like lucerne and Silk are ideal, but in long-term pastures think about medics, native species and creeping blue grass as these will be more appropriate.
4. *What is the soil type and fertility level of the soil?* For example, with heavy clay soils purple pigeon grass, medics and lucerne are the best bets, whereas green panic and Callide rhodes grass are more suitable for high fertility scrub soils.
5. *In what environment are the pastures to be grown?* For example, for drought resistant species buffel and medics are most reliable.
6. *When the species most suited have been identified the next consideration concerns mixing species or planting different species in adjoining paddocks. Should species be mixed?* Mixed pastures containing more than one grass have their good and bad points including:

   - the most palatable grasses are preferentially grazed unless a strip or crash grazing management strategy is used;
   - planting short- and long-term species together can be complementary, with the short-term species providing the bulk of feed in the early years and the longer-term pastures becoming dominant with time;
   - when mixing Silk or lucerne with other grasses, the more vigorous short-term species can suppress other less competitive long-term pasture grasses in the mix;
   - commercial seed production can be difficult with mixed grass stands, although grasses like creeping blue, rhodes *etc.* can be easily separated from Silk, purple pigeon grass, Bambatsi panic. It is also possible to mix legumes with grass and still harvest good grass seed. In either case, grading may be required to obtain commercial seed;
   - in paddocks where considerable soil variation occurs, such as in melon-hole country, a mixture may be more desirable as it allows different species to occupy different niches.

CONCLUSION

In conclusion, it should be stated that making recommendations about 'Which summer grass to plant' is much more complex than making a recommendation for grain cropping. A very major difference between annual crops and pastures is that most crops are drilled deep into well-prepared seedbeds. Most pasture seeds on the other hand, are only surface planted. This means that they are much more vulnerable to environmental extremes which produce a much higher risk of germination failure.

This problem is much greater with summer species than temperates, because of the higher incidence of hot dry spells following establishment. These conditions are much more prevalent with species planted in the spring/summer months than the autumn/winter period.

So what does all this mean in the paddock? In making a pasture recommendation our main aim is to reduce the risk of failure. This invariably involves having a component in the recommendations to "hedge the bets" in the event of a failure, *ie.* planting species with varying degrees of risk of failure in adjoining paddocks. The following list is an example of some species listed in increasing order of risk:

Forage sorghum < Silk < millet < lucerne (in Autumn) < purple pigeon grass < rhodes grass < Bambatsi panic - creeping blue grass < Mitchell grass.

It is a fact that there is a lot of luck associated with summer grass plantings in unreliable rainfall areas. Therefore when you do everything right, there will still be many failures.

REFERENCES

Dick, R.S. (1975). A Map of the Climates of Australia: According to Koppen's Principles of Definition. *Queensland Geographical Journal*, **3**: December.

Fitzpatrick, E.A. and H.A.Nix (1973). The Climatic Factor in Australian Grassland ecology. In "Australian Grasslands", Edited by R.M.Moore, *Australian National University Press*, Canberra.

Humphreys, L.R. (1980). Increasing Productivity through Better Pastures. A Guide to Better Pastures for the Tropics and sub-tropics. *Wright Stephenson & Co.*, Sydney.

Lodge, G. (1992). Domestication of Australian Native Grasses. *Australian Seed Industry Magazine* , **10**:2:3

McDonald, W.J. (1991a). Pasture production for Livestock. *NSW Agriculture, Agdex 130/13.*

McDonald, W.J. (1991b). Pastures for the North-west Plains. Fourth Edition. *NSW Agriculture, Agdex 130.*

Milton-Moore, R. (1973). Australian Grasslands, Australian Grasslands. Australian National University Press, Canberra.

Minson, D.J. (1990). Digestible Energy of Forage, Forage In "Ruminant Nutrition". *Academic Press Inc*, Sydney.

Robbins, G. (1991). Brian Pastures Research Station Annual Report, Queensland Department of Primary Industry.

Thompson, P. (1988). Improving Livestock Profitability with Pasture and Forage Crops. *Cranbrook Press*, Toowoomba.

APPENDIX

Scientific and Common Names of Different Improved Summer Grasses and Legumes

Improved Summer Grasses

Angleton grass (*Dichanthium aristatum*)

Buffel grass (*Cenchrus ciliaris*)

Creeping bluegrass (*Bothriochloa insculpta*)

Green & Gatton Panic (*Panicum maximum*)

Kikuyu, Noonan and Whittet (*Pennisetum clandestinum*)

Makarikari grass - Bambatsi and Pollock (*Panicum coloratum*)

Paspalum (*Paspalum dilatatum*

Premier digit grass (*Digitaria smutsii*)

Purple pigeon grass (*Setaria incrassata*)

Rhodes grass - Katambora and Pioneer (*Chloris gayana*)

Rhodes grass - Callide and Samford (*Chloris gayana*)

Silk (Perennial sorghum sp.)

Improved Summer Legumes

Fine stem stylo (*Stylosanthes guyanensis*)

Leucaena (*Leucaena leucocephela*)

Lotononis (*Lotononis bainesii*)

Siratro (*Macroptilium atropurpureum*)