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Tropical pasture establishment. 12. Pasture establishment practices and experiences in central Queensland

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Abstract

In central Queensland over 2M ha of sown pastures have been established. These areas, combined with the valuable native pasture resources of the region, provide grazing for more than 2M beef cattle. The diversity in climate, soils and land use results in a large and variable range of appropriate establishment practices in pasture development. Pastures are established by sowing into cultivated or ash seedbeds following clearing of forest and scrub country, sowing after regrowth control, and oversowing legumes into native and sown grasses using a range of techniques. The shrub legume, *Leucaena*, is being more widely sown as are ponded pastures and small areas of irrigated pastures. Forage crops are also widely sown.

In the drier areas, rainfall variability has a major influence on pasture establishment. Poor establishment occurs when stored soil moisture is low, follow-up rain fails or competition from resident grass, weeds or cover crops is high. Establishment on clay soils is most difficult and few plants, particularly perennial legumes, are suited to clays. There is an emerging need for plants that are suited to short-term (or ley) pastures for use between successive crops, and for the technologies that provide rapid and reliable establishment of these plants. Dormancy in grasses can be a problem and hardseededness in legumes often reduces establishment. Techniques to more effectively scarify legume seed and a better appreciation of how seed characteristics interact with climate and soil moisture could improve establishment of sown pastures and thus help to maintain and develop the pastoral industry of the region.

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Introduction

The central Queensland (CQ) region covers about 17M ha between Proserpine (22 °S) in the north and Cracow (25.5 °S) in the south and extends from the coast westwards to the Drummond and Great Dividing Ranges. Five major agro-ecological zones based on climate, soils, original vegetation and land use are recognised. These are the wet coast, black speargrass, brigalow lands, open downs and the eucalypt woodlands (Figure 1) (Anon. 1981).

Climate of the region is subtropical, subhumid (Anon. 1965) with >70% of the annual rainfall occurring in the summer months, but there are large differences in temperature, rainfall and evaporation between the coastal and inland areas (Figure 2). In the western areas of the region, lower rainfall (<600 mm MAR compared to >1250 mm in the coastal areas), higher rainfall variability, heat wave conditions (daily maximum temperatures >40 °C) and frosting can affect pasture establishment.

Soils of the region are predominantly uniform or gradational in texture profile or with texture contrast (or duplex) profiles and have a complex distribution pattern (Isbell and Hubble 1967). Soil type impacts on pasture establishment, primarily through variations in surface soil texture, soil water-holding capacity and fertility.

The CQ region includes almost 2M ha of sown pastures mostly in the brigalow areas on lands

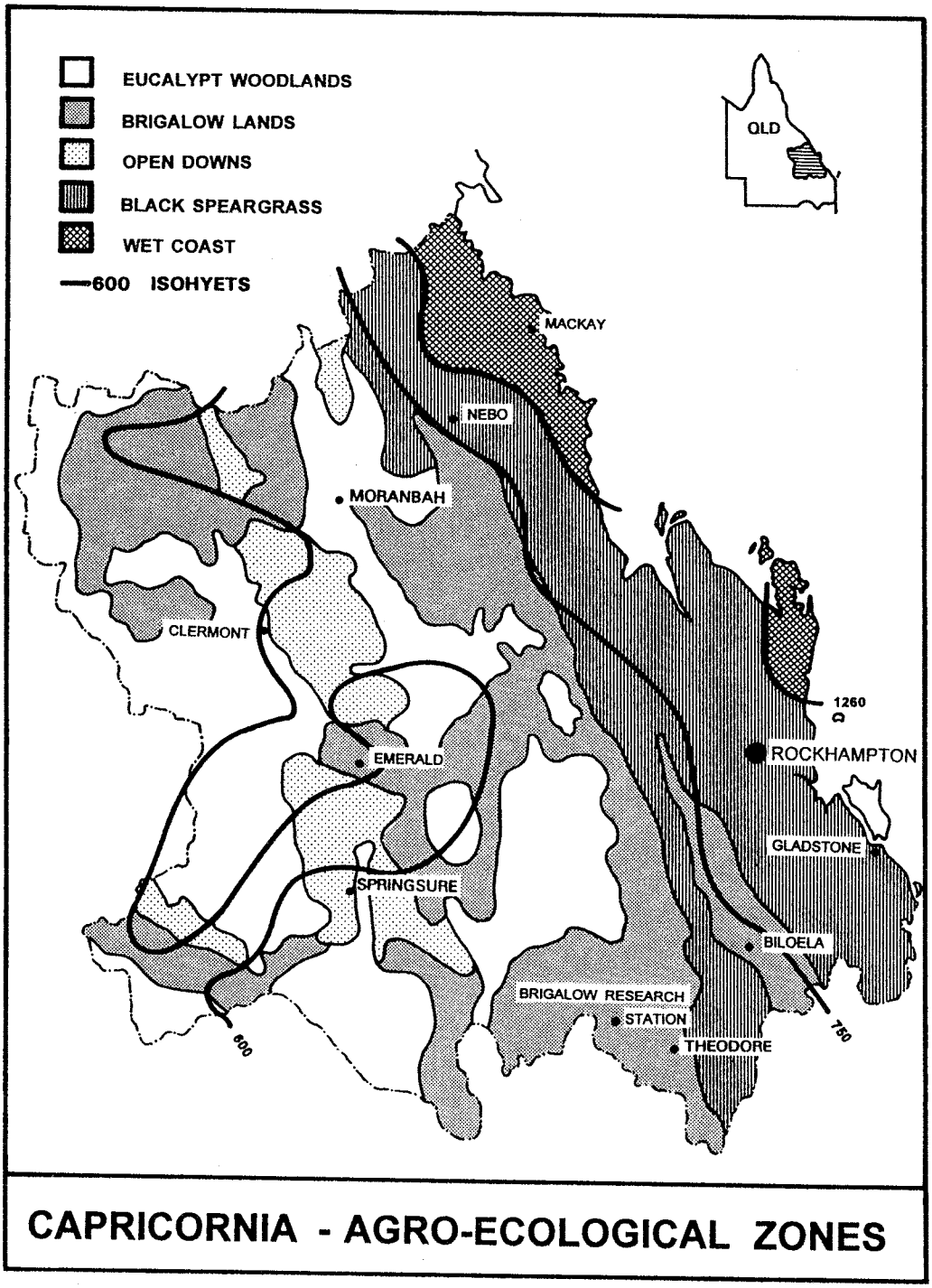

Figure 1. The agro-ecological zones of central Queensland (Anon. 1981).

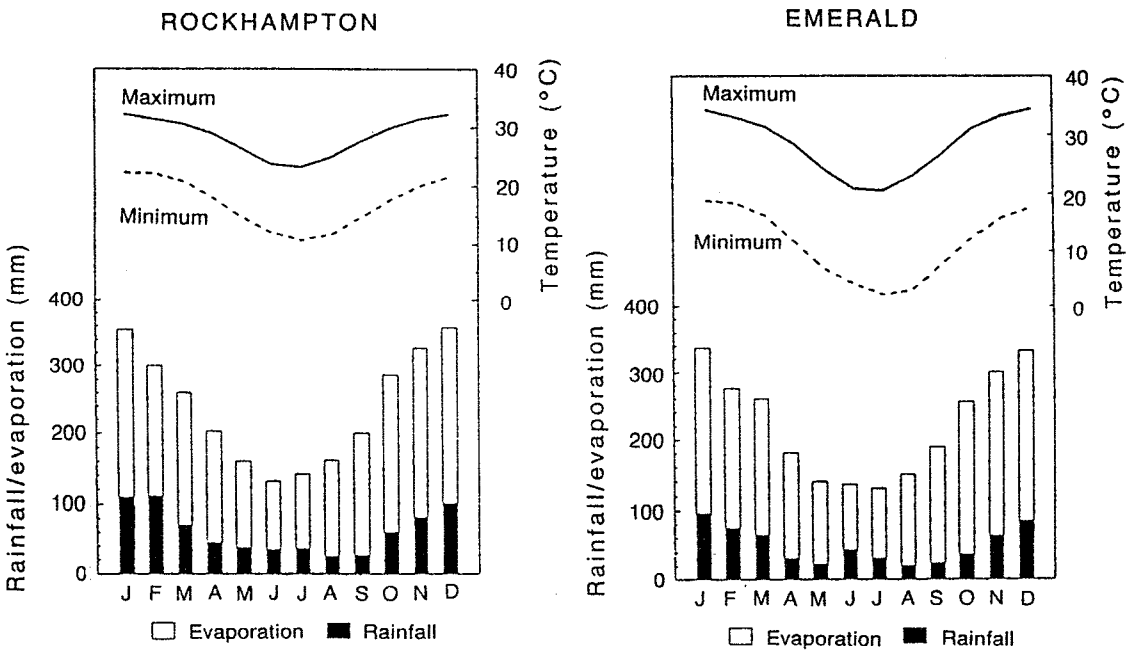

Figure 2. Monthly rainfall, evaporation and maximum and minimum temperatures for Rockhampton and Emerald.

cleared of brigalow (*Acacia harpophylla*) and gidgee (*Acacia cambagei*) and sown to introduced grasses. In the wet coastal and black speargrass zones, significant areas of native pastures have been oversown with legumes or replaced by grass-legume pastures. There are also substantial areas of special-purpose pastures including ponded pastures and leucaena (*Leucaena leucocephala*).

Pasture establishment practices

Pasture establishment practices vary to suit individual property and producer's needs. They include sowing into ash seedbeds after felling and burning scrubs and woodlands, sowing after regrowth-control operations that disturb the soil to varying extents, sowing into fully prepared seedbeds, oversowing legumes into native and sown grass pastures and specialist practices for establishing leucaena and ponded pastures.

Sowing into ash seedbeds

Development of virgin scrubs is continuing only in the northern and western areas of the CQ region where gidgee, blackwood (*Acacia argyrodendron*), bendee (*Acacia catenulata*) and a few remaining areas of brigalow are being cleared. Pasture establishment technology used in earlier development is still relevant (Cameron and Wildin 1976) but reliability of pasture establishment is lower. Lower rainfall (often <600 mm MAR) and reduced fuel loads which prevent or delay burning, and a range of soils often with lower fertility and water-holding capacity contribute to lower reliability. It is estimated that 30% of the cleared country in the northern areas (Area III of the Brigalow Development Scheme) either has not been sown to introduced grasses or was sown but failed to establish (Anderson *et al.* 1984).

Sowing following regrowth control

Blade ploughing is presently the most common method of regrowth control with large areas of brigalow lands being ploughed and resown to pasture mixtures best suited to the type of country (Agnew 1990). The success of establishment following ploughing is difficult to assess

as many areas re-establish to grass from high resident seed loads. Most producers (>70% in one survey; J. Agnew, personal communication) report good grass establishment despite the fact that ploughing is carried out throughout the year and not just over the summer months when the chances of establishment are highest. The need to allow the newly sown pastures to seed before stocking and to match stocking rate to pasture availability in the development phase is recognised and widely practised. Legumes are generally not sown because a high proportion of the soils are clays and few suitable legumes are available, and also because ploughing alone mineralises nitrogen, improves grass growth and provides high quality feed. Under these conditions, legumes may not compete with the vigorous grass growth and are unlikely to provide any benefit to animal production in the short term.

Ploughing using heavy duty offset discs and chaining are also used to control timber regrowth. The extent of soil disturbance varies but can provide the opportunity for pasture plants to establish from sown seed or re-establish from soil seed reserves. Establishing seedlings have to compete with resident herbaceous and woody plants that are generally not controlled as effectively as with blade ploughing. Judicious management to increase fuel load for burning is often part of this regrowth-control strategy.

Sowing into fully prepared seedbeds

This practice is common in the wet coastal zone, in the black speargrass region and in the brigalow region where old cropping land is being resown to pasture. Wet coastal land is cleared of timber, ploughed and sown to a range of grass and legume species (Bishop and Walker 1980). An estimated 90% of sown pastures in this zone are planted into prepared seedbeds, and most establish successfully. Similarly in the black speargrass region, sowing of pastures into more favourable areas (e.g. alluvial soils associated with creeks) using full cultivation is generally successful. However in the brigalow region establishment is more variable when pastures are sown into clay soils. Summer sowing of grasses has the highest chance of success, but competition from weeds, resident grasses and cover crops, and lack of follow-up rain or low stored soil moisture often result in poor establishment (J. Turnour, personal communication).

Oversowing native and sown grass pastures with legumes

Legumes, mainly Seca stylo (*Stylosanthes scabra* cv. Seca) but also *S. scabra* cv. Siran, Verano (*Stylosanthes hamata* cv. Verano) and Amiga (*S. hamata* cv. Amiga), Wynn cassia (*Cassia rotundifolia* cv. Wynn), Glenn jointvetch (*Aeschynomene americana* cv. Glenn) and Lee jointvetch (*A. americana* cv. Lee), are oversown into native pastures in the black speargrass and eucalypt woodlands and into rundown sown grass pastures growing on duplex soils in the brigalow region. Large areas are surface-sown after burning or grazing. Smaller areas are sown following minimum cultivation such as single discing or even stick-raking while a few producers have used band-sowing techniques and pitter-seeding machinery such as the "crocodile" roller-seeder.

Seca stylo is the most widely adapted legume and is sown from the coast to the margin of the arid zone. Its establishment is reliable but varies with rainfall. Under marginal rainfall where moisture competition with the resident grasses is high, lower growth rates and subsequent seed set can delay build up in plant populations so that it may be 3–4 years before Seca contributes to the diet and animal production.

Establishing leucaena

Leucaena has been sown on 20 000 ha in CQ (Wildin 1993). Establishment difficulties with leucaena slowed the rate of adoption (Lesleighter and Shelton 1986) but, as producers gained experience, establishment technology has evolved to one that is more reliable. The main components are:

(i) sow on well drained soils that are fertile and have a high pH (>5.5);
(ii) treat the seed with boiling water to break hardseededness and inoculate with the appropriate *Rhizobium* spp. before planting;
(iii) sow up to 50 mm deep in rows on a full profile of soil moisture. The use of dual press wheels (compacting soil on both sides of the sown row) is beneficial especially if using a parallelogram rig to sow at constant depth, but single press wheels (compacting soil over

the seed) are not recommended. Row spacing can vary to suit individual management needs;

(iv) maintain weed-free inter-rows until plants are at least 2 m tall (usually 15–18 months) when grasses can be sown between the rows preferably at the start of the wet season; and

(v) graze so as not to damage the tree seedlings until plants are well established (1–2 m tall).

Establishing ponded and irrigated pastures

The area of irrigated, tropical, perennial pastures is small but ponded pastures, using para grass (*Brachiaria mutica*), Aleman grass (*Echinochloa polystachya* cv. Amity) and Hymenachne (*Hymenachne amplexicaulis* cv. Olive) are now established on some 26 000 ha in CQ (Wildin and Chapman 1988).

These grasses are sown by runners using a range of equipment and techniques developed largely by producers. Cut planting material spread on to the soft wet soil as the water recedes from the ponded area and pressed into the soil establishes readily.

Perceived problems in pasture establishment

Without doubt, rainfall variability has the major effect on establishment. Soil surface condition and fertility and an appreciation of how these and climatic factors interact with seed quality and germination characteristics also affect reliability and speed of establishment and rate of development of the newly sown pasture.

Rainfall variability

Soil moisture at or near the surface fluctuates with rainfall and evaporation which vary from the coastal to inland areas (Figure 1). In the drier inland areas, fewer rainfall events allow germination to commence and moisture is available to the seed and seedlings for a shorter period of time than in the higher rainfall areas. Surface-sown seed is exposed to rapid drying following rainfall and except on fully prepared weed-free seedbeds, the establishing seedlings compete with resident plants for moisture. Sowing between December–March gives best establishment because there is generally some soil moisture, and on average, rainfall is higher and evaporation is lower than in the October–December period (Figure 2). Risk of establishment failure increases and the range of pasture plants available for sowing decreases from coastal to inland areas as total rainfall decreases and its variability increases. Similarly, the risk of failure is higher where competition for available soil moisture between the establishing seedlings and resident plants is greater.

Soil constraints

Soil type, particularly surface soil texture and soil fertility, has a major effect on pasture establishment. Clay soils pose the most problems (Leslie 1965) and because they occur largely in the drier (< 800 mm) rainfall areas, the problems are exacerbated. Purple pigeon grass (*Setaria incrassata* cv. Inverell) with its larger seed and reputation for easier establishment is now widely sown either alone or with the traditional buffel (*Cenchrus ciliaris*), rhodes (*Chloris gayana*) and green panic (*Panicum maximum* var. *trichoglume*) on clay soils. Few legumes are suited to the clays although the area being sown to leucaena is increasing and lablab (*Lablab purpureus*) is used for annual forage cropping.

There remains a strong demand for the productive, high quality grasses such as green panic and buffel grass but these species can be short-lived in areas where soil fertility has declined (old cropping land and rundown pasture) and in some of the marginal lands now being developed. Buffel grass is still widely sown because of its drought tolerance but there is increasing interest in the bluegrasses (e.g. *Bothriochloa insculpta* and *Dichanthium sericeum*). Declining production of the high-fertility-demanding grasses has increased oversowing of legumes such as Seca stylo. However, in the brigalow soils, higher available nitrogen can restrict legume establishment because of strong competition for soil moisture between the perennial grasses and the establishing legume seedlings.

Soil phosphorus levels vary throughout the region (Shields and Anderson 1989) but superphosphate is not widely used at sowing except in high rainfall, coastal areas.

Seed quality, seed treatment and sowing rate

These factors are considered together as quality and germination determine what seed treatment

and sowing rate are necessary. Of practical significance to establishment success is the percentage of dormant seed in freshly harvested grasses and of hard seed in legumes. In practice very little seed treatment is done on-farm. Dormancy in grasses is rarely a problem because most seed is at least 6–12 months old and hence dormancy is already broken when it is sown. Also, seed characteristics of many legumes are changed (largely through seed pod scarification) in the harvesting and cleaning process often to the extent that the proportion of hard seed is reduced to acceptable levels for sowing. These effects, however, are highly variable between species and between samples. Leucaena and stylo are widely used legumes that generally have a high percentage of hard seed remaining following processing. For leucaena, provided the sample is hard (>90%), a boiling water treatment (Wildin 1986) is very effective. Since it is sown into the soil, a high proportion of soft seed is desirable when planting leucaena.

Seed treatment also has the potential to improve the establishment of Seca stylo. Large variations in establishment can be expected and are associated with the timing and the amount of rainfall received in relation to the sowing. There is, however, a case for sowing seed with different germination characteristics to suit individual sowing situations. For example, early sowings, particularly on relatively bare ground (heavily grazed or burnt pasture), should be made using mainly hard seed which softens in the field and germinates after each of several rainfall events. At the other extreme, sowing late in the season on to well prepared seedbeds is likely to be most successful if a high percentage of soft seed is used. Presently, seed used in the industry is softened by scarification using either dehulling machines or hammer milling.

Seed pelleting is sometimes promoted but not widely used except to overcome handling difficulties with the fluffy-seeded grasses.

Given the large variation in seed quality, the range of species, the sowing techniques used and the expectations of individual sowings it could be expected that sowing rates vary greatly. In extensive grazing lands where mixtures are used, well adapted pasture plants can increase in populations naturally, provided they are not overgrazed and are allowed to set seed each growing season. Sowing rates of 2–4 kg/ha are widely used. Forage crops are sown at higher rates of up to 10 kg/ha for forage sorghum and up to 30 kg/ha for lablab.

Rate of development

Slow establishment is accepted by producers in the grazing industry, where generally persistent species and lower input systems are used, more than by growers in cropping industries who are trying to integrate pasture systems into their cropping enterprises. Establishment of these shorter-term pastures must be reliable and fast.

For perennial pastures, persistence of the sown species is important to provide feed and promote landscape stability over many years. In contrast, the aim of forage crops is to provide high quantities of feed in the short term (usually one season). Pastures persist either through individual plants being long-lived (e.g. leucaena) or, as occurs more generally, through seedling recruitment. Plant populations of Seca stylo can increase naturally in grazed pastures largely through high seedling recruitment (Burrows and James 1990).

In some instances, both short-lived and persistent plants are sown together, although there is some contention that this may prolong the development of the permanent pasture. This practice is common when blade ploughing. Silk sorghum (*Sorghum* spp. hybrid) and lablab are sown with the perennial grasses to provide early feed and to prevent ingress of weeds, particularly parthenium weed (*Parthenium hysterophorus*), while the perennial grasses are developing. In the cropping areas, as grain yields and protein content decline, there is an emerging need for pasture species, especially legumes, for ley pastures grown between grain crops. Fast, reliable establishment and quick, early growth of the pasture plants are key elements of this system. Currently, lablab is being used but has to be resown each year. Plants that would live for 2–3 years or re-establish readily from seed would be an advantage.

New, alternative and innovative techniques

Although not new, the practice of sowing pasture seed before clearing forest is now recommended

in gidgee development. The sown seed establishes in the areas where soil is bare or disturbed by pulling trees, and pasture that develops adds to the fuel load for the first burn which is necessary to control both woody regrowth and parthenium weed.

Band-seeding is regarded as having potential but has not been widely used. Boom spraying using Roundup® to kill established grass followed by surface spreading of Seca stylo has been used in the Calliope area as has strip sowing of pasture on the contour (Chapman 1990; Gillespie 1990). Using this technique, about 50% of the area of a paddock is cultivated and sown to pasture. A major disadvantage is the income loss due to destocking which is necessary in each of these establishment methods as with fully cultivated seedbeds.

The 'crocodile' seeder, developed in CQ, offers potential to oversow large areas of native and sown grassland with minimum disturbance to the existing pasture. This machine digs pits in the surface soil and places seed into these pits. In this way, water is concentrated in the pits and under some conditions can enhance establishment. Major benefits of using this machine are that it requires low power, can handle rough country including some sucker regrowth and minimises runoff and soil loss on erosion-prone land because most of the existing vegetation is left in place. It can also be worked in all directions on slopes because the pits fill with water and reduce runoff.

Producers who have sown large areas of leucaena have developed reliable establishment techniques with the most innovative aspects being the use of dual press wheels, the use of herbicides and insecticides to control weeds and soil insects, and double row planting.

Producers recognise the value of, and have used, sown pasture species to provide productive and profitable grazing systems in CQ. Establishment remains a key component of any pasture development program. Increasingly more reliable establishment is demanded, particularly on clay soils and in farming-grazing enterprises. A wider appreciation of the processes involved and development of current knowledge will allow more appropriate technologies to be chosen by the industry and reduce the risks associated with pasture establishment.

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