Commercial development of *Stylosanthes* pastures in northern Australia.

II. *Stylosanthes* in the northern Australian Beef Industry

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Abstract

Varieties of *Stylosanthes* have been keenly adopted in the pastoral areas of northern Australia ever since the value of *Stylosanthes humilis* was recognised early in the 1900s.

There are now at least 600 000 ha contributing some $20 million annually to beef production through higher turnoff weights, improved weaner and heifer nutrition and reduced drought risk. Adaptation is best to lighter-textured soils with annual average rainfall above 500 mm. Stylo establishes easily, spreads naturally, resists drought, fire and overgrazing and increases beef production. Technologies of seed production, sowing and management are well-developed and an extra 50 000 ha are sown to stylo annually.

Introduction

Beef producers in northern Australia have always wanted a forage plant that was easily established, spread without assistance, needed no fertiliser, resisted drought, was readily accepted by livestock and made cattle fat. Various species of *Stylosanthes* have come extraordinarily close to this ideal and stylos are now a feature of beef production in those parts of northern Australia with sufficient rainfall.

We give here a brief history of stylo, make some estimates of the extent of commercial adaptation and use, and provide a description of how it is used and managed in production systems.

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History

Stylo has been part of beef production in northern Australia since around 1910, according to Humphreys' (1967) entertaining account of early Australian records. Even in those early days, while its forage value was keenly appreciated, it (Townsville lucerne, *Stylosanthes humilis*) was referred to as a weed, testifying to its ability to survive and spread unassisted. Graziers and extension officers spread seed enthusiastically along roads, railways and stock routes so that, by 1925, the stage was set for its large-scale invasion. By the 1970s, there were at least 0.5 M ha naturalised in northern Australia and tens of thousands of hectares were also being sown each year.

Meanwhile, Schofield (1941) and others in the wet tropics found that some lines of *Stylosanthes guianensis* were admirable pioneer legumes, and, in the 1940s, released a variety later known as Schofield. This must have been the world's first deliberate release of a stylo. It was followed in the 1970s by cultivars Cook, Endeavour and Graham. Very little stylo can now be found in humid environments.

Down in the subtropics, a few devotees discovered that fine-stem stylo (*S. guianensis* var. *intermedia*) was well-adapted to sandy soils and was tolerant of heavy grazing and cold. Released in 1969, it had a slow beginning because of seed production difficulties.

In the dry tropics during the 1960s and 1970s, pasture research was building a large effort around the promise of the genus. Three cultivars of *S. humilis* were released in the late 1960s to provide named sources with different flowering times for different rainfall environments. Concurrently, lines of other species were being evaluated. Just as this latter effort was about to bear fruit in the 1973–75 period, the fungal disease anthracnose devastated all known Townsville stylo, as *S. humilis* was now pedantically termed by the academic community. Many producers still mourn its passing because, throughout much of its range, it thrived on the most unproductive parts of the landscape and cattle have never been so fat since.

The pastoral industry was therefore ready for Verano (*S. hamata*) when it was released in 1973, and only the beef market crash of 1974–77 slowed its enthusiastic reception. Despite beef industry gloom, Seca (*S. scabra*) was released in 1976 because it held such high promise for the seasonally-dry tropics and was totally different in morphology and behaviour from any previously known stylo. Luckily, Seca turned out to be more variable in flowering time than originally thought and its area of adaptation consequently much larger than originally thought. Over the past 8 years, an average of more than 130 t of stylo seed have been marketed, representing at least 60 000 ha sown annually. More recent releases, Amiga (*S. hamata*) and Siran (*S. scabra*), have had more specific purposes and more marginal application and adoption.

Current use

Sown pastures are used by producers when they have confidence that the technology will work for them on their properties. At release, stylos, like other pasture cultivars, have been tested in relatively few locations, in small plots, and with some fairly specific management. There is usually no extended history of grazing. In these circumstances, it is an act of faith for a producer to sow a new cultivar in the first 10 years of its life. The R&D industry is fortunate that so many producers are natural experimenters and make this leap in faith, for it is only by hard experience that the real limits to adaptation and usefulness are discovered.

Adaptation

Adaptation has many components, and interactions among them are usual. The most important environmental limits are set by latitude and altitude (as surrogates for temperature as well as daylength), rainfall and soil texture (Table 1).

Table 1. Environmental limitations to stylo success.

	Latitude at sea level	Altitude at 20° lat.	Annual rainfall	Unsuitable soil
	(deg)	(m)	(mm)	
Seca, Siran	10–25	<700	500–2000	Heavy clays
Verano, Amiga	10–22	<500	600–1500	Clays
Fine-stem	24–27	<2000	700–1100	Clays, loams
Cook	10–22	<1500	1500–4000	Heavy clays

However, these are only the broad environmental limitations. Commercial adaptation, which includes an element of productivity assessment, occurs as a mosaic within these wider limits. Seca, and to a lesser extent, Verano, are adapted over a wide range of latitude and rainfall but apparently minor variations in the main environmental features of a particular location, together with other factors, environmental and managerial (Table 2), constrain various aspects of pasture growth and development. Thus, while one producer may find a cultivar adapted, a neighbour can describe it as a failure.

Table 2. Environment and management factors in adaptation.

Managerial factors	Environmental factors
Heavy grazing	Drought
Seasonal spelling	Frost
Fire	Soil infertility
Fertiliser	Soil surface hardness
Supplement	Flooding

Extent of use

Estimates of stylo areas have been made in a number of ways. The lower and higher estimates for TOTAL AUSTRALIA given in Table 3 are the result of calculating the area from conservative and optimistic assessments of seed production. Beginning from 1974, we have assumed a sowing rate of 2 kg/ha, a final establishment of 90% of the area sown and a 5% loss each year due to fire, weed invasion and other causes. Estimates for central and south-east Queensland, where there are a large number of small properties, were from a combination of survey, official statistics and knowledge of seed production. These figures for central and south-east Queensland, together with those for the Northern Territory and Western Australia, were then subtracted from the total to give a figure for northern Queensland. The survey figures were derived by exhaustive listing of all pastoral properties together with effective area of stylo on each. Seca and Verano are often mixed in northern areas so it is not possible or relevant to make estimates of the areas of each cultivar, except to say that very little Verano exists in central and south-east Queensland and that all fine-stem stylo is in south-east Queensland. We believe these estimates, while conservative, are more accurate than official statistics, the raw data of which must often be estimated in haste and in hope. We are encouraged in this belief by the good correspondence in estimates for north Queensland made by 2 different routes.

Table 3. Effective areas of stylo.

Region	Lower estimate	Higher estimate	Survey
	(ha)	(ha)	(ha)
South-west Queensland (Wide Bay-Burnett)	100 000	150 000	
Central Queensland (Fitzroy, Mackay, Central-west)	300 000	350 000	
North Queensland	146 500	209 600	**150 800**
Northern			40 500
Far north			106 300
North-west			4 000
Northern Territory	28 700	28 700	**28 700**
Katherine-Gulf			26 200
Darwin			2 500
Western Australia (Kimberley, Pilbara)	2 200	2 200	
TOTAL AUSTRALIA	577 400	740 500	

Commercial technology

Practical production technology has been described in several accounts recently (Partridge and Miller 1991; Clem *et al.* 1993; French and Clark 1993; Partridge 1993; Shaw and Tincknell 1993; Wright *et al.* 1993; Partridge *et al.* 1994). We will deal only briefly here with the topic, concentrating on those aspects of technology that are changing.

Cultivar selection

Choice is often based on price of seed, particularly where the relative advantages of cultivars for particular environments are unclear. Mixes are normal where 2 or more cultivars are likely to be adapted. The mix may include other genera like *Chamaecrista* or *Aeschynomene*. Recommendations to mix cultivars for disease resistance as, for example, 1 part Siran to 5 or 10 of Seca to confer extra anthracnose resistance, or to sow portion of a planned Verano area to Amiga to test the latter's merits, are often not easy to put into practice when different cultivars under Plant Breeders Rights agreements have different vendors and seed supplies are erratic.

Sown grass or not?

Native grasses oversown with stylo are liable to decline because of increasing stocking rates (in the north) and strong competition, presumably for soil moisture. The question of when and how to get a sown grass established then arises. Since most oversowings involve no soil disturbance or reduction of native grass density, grass establishment at the time of oversowing is not likely to be good. Nevertheless, it is increasingly common to add a small amount of grass seed (200 g/ha) in the sowing mix, where costs can be contained to a reasonable level. Some producers, as well as some researchers (Coates 1991; McIvor and Gardener 1995), are finding that Urochloa, Indian couch and buffel grass move into stylo pastures some years after oversowing.

Establishment and early management

Most stylo seed is oversown into native pasture with no ground preparation other than a fire. Establishment remains an economic, if not a biological, problem. 'Plant and forget' is a common recipe and usually results, eventually, in a successful pasture. However, in stringent economic times, there is justifiable reluctance to have capital expenditure producing no returns for 2–4 years, and in semi-arid environments, up to 8 years. These delays are minimised by using minimum seeding rates of 2–3 kg/ha and ensuring effective spreading. On smaller properties and in regions with less certain rainfall, producers are often willing to increase the level of intervention at establishment. Tree killing, tree clearing, planting in strips cultivated or sprayed with herbicide, and full cultivation are options used commercially in attempts to reduce the risks and delays of oversowing.

Scarification of half the seed is now accepted as a means of improving establishment in central and southern Queensland and in late plantings further north. It is most conveniently done by hammermilling (Hopkinson and Paton 1993).

Nutrient-coated stylo seed is marketed as a means of enhancing establishment but we can find no evidence, experimental or practical, of any benefit. Experimentally, the coatings have usually slowed establishment. Commercially, seed coating seduces people into using fewer seeds per unit area, increasing the chances of lower stylo numbers than desirable.

Having spent the money and the effort in sowing pasture, there is some temptation to reap the benefit of higher carrying capacity rather than to accept the benefit of better stock performance and increase stocking rates slowly or not at all. Yet, many promising sowings meet early ruin from premature heavy grazing or, occasionally, fire. Only good seed set can give protection against disaster and good seed set in establishing stylo pasture is likely only at moderate stocking rates of about 4 ha per adult equivalent or lighter.

Grazing management

As with native pasture, cattle condition and an assessment of remaining feed are generally used as indicators of when to adjust stock numbers. Where the pasture is tolerant of heavy grazing, as stylo is, and maintains reasonable nutritive value when heavily grazed, as stylo does, overgrazing is a likely result. Even worse, where stylo is oversown in native pasture, the signals of overgrazing are likely to be far too late for the health of native grasses.

Spelling in the early wet season comes easily to stylo pasture managers, at least on smaller properties, because of the high nutritive value of native pasture at that time of year. Yet, because of the resilience of stylo, a spell is often not given. Many graziers spell areas for the welfare of the legume, whereas it is the grass that usually needs a spell, both to recover from grazing through the previous year and to prevent selective overgrazing of the more palatable grasses during the early wet season. Rotational wet season spelling to allow pasture seeding is being adopted by leading producers.

Fire kills stylo; sometimes all, sometimes a little. Useful forage is usually destroyed and most producers try to keep fire out. In the first few years, until a good seed bank is built up, fire can destroy a stylo pasture completely. On the other hand, where it is difficult to keep native grasses thriving in a stylo pasture, intermittent burning may be the best way to knock back the stylo.

Production management

Knowledge of the benefits to animal production of managing fertiliser, supplement and stocking rates is just beginning to influence commercial management of stylo pastures. However, many stylo users in more remote areas are unreformed pastoralists, existing management systems are fairly simple and the sown pasture area is usually insufficient for all the target cattle. Overgrazing is a common result.

Fertiliser is rarely used because of high cost. The notion of feeding phosphorus supplement on improved pasture during the growing season (Miller *et al.* 1990), when cattle and pasture are looking their best, is a difficult one to sell except in more intensively managed areas. Rationing out small areas of stylo to large groups of cattle is a difficult proposition where there are usually insufficient paddocks merely to segregate the main herd classes.

Seed production and processing

Stylo seed is produced mainly as a specialist crop on the moist, eastern edge of its area of adaptation. Thus, most Verano and Amiga are grown for seed at about 17°S latitude and 900 mm rainfall. Seca and Siran are more widespread as seed crops, with important production at 15°S, 17°S and 21°S, either on the coast with rainfall of 1500 mm or slightly inland with supplementary irrigation. Fine-stem stylo seed, when produced at all, is grown in inland south-east Queensland at 25°S, in its area of pastoral use with rainfall of around 700 mm. Sown, fertilised and managed intensively to ensure reliable supply, high germinability and freedom from weed seed, stylo for seed is often treated as an annual crop. It eventually requires crop rotation or shifting cultivation to cope with weed ingress.

Harvesting is begun with conventional grain combines. In Verano and Amiga, heading is at full maturity, then residues are baled and a large fraction of the remaining seed on the ground is suctioned with modified subterranean clover harvesters. Seca and Siran are headed with up to 10% immature standing seed and are suctioned only if there is a considerable quantity left on the ground. *S. guianensis* varieties are direct headed. Seed and accompanying leaf and floral parts are dried and then cleaned on conventional screen and aspiration machinery. Verano and Amiga are much more easily cleaned, in harvester and later, than other varieties.

Yields are up to 1250 kg/ha for Verano and Amiga, headed and suctioned, with up to 80% recovery. Seca and Siran yield up to 750 kg/ha direct headed with another 250 kg/ha sometimes possible from suctioning.

Production systems

Traditionally, producers have used stylo pasture for finishing steers and bullocks in the 6–12 months before turnoff because that gave them fastest financial returns to their considerable capital expense. Turnoff weights have been 30–40 kg higher than from native pasture, and in some cases, turnoff age has been reduced by a year. As weight-for-age specifications tighten for slaughter, feedlot, growout or live export, the need for sown pasture is increasing.

Many of the targets can be reached only by maintaining average cattle growth rates of 0.4 kg/d with no big checks in growth. Compensatory weight gain is not necessarily good enough and many producers are combining native pasture, sown pasture and mineral, protein and energy supplements to promote continuous cattle growth.

A typical feed sequence might look like:

December–April	Native pasture with supplement of salt and phosphorus or sulphur. Supplementary urea might be added from March.
May–July	Stylo-native pasture with supplements of salt, phosphorus and sulphur.
August–September	Stylo-native pasture with supplements of salt and sulphur.
October–November	Stylo-native or native pasture with urea, salt and 0.5–1.0 kg/d cottonseed meal.

Weaners are getting increasing attention. Apart from the need to prevent growth checks in their first dry season, there is an increasing need to provide good dry season nourishment to weaners down to 3 months of age and 90 kg. These weaners result from early weaning systems that are necessary in harsher environments to enhance reproductive rates of cows. While successful concentrate-based feeding systems have been developed for these small weaners, a more permanent solution involving stylo-based pastures is attractive and being used by a number of producers; we believe a sown grass would add great value to a pasture for very young cattle.

Although mature cows with early weaning and some supplementation can maintain high reproductive rates on native pasture, heifers, with their reproductive handicaps, will let the system down without some special attention to their prepuberty and post-calving nutrition. Furthermore, as reproductive rates rise in the harsher environments, heifers will form an expanding proportion of the herd turnoff and will need the nutrition outlined above for turnoff cattle. Again, stylo-based pastures are likely to become increasingly attractive in these roles.

Conclusion

Varieties of *Stylosanthes* are an important part of the Beef Industry in north-eastern Australia. Conservatively estimated, 600 000 ha of effective stylo result in an extra 10 000 tonnes of carcass beef each year, worth at least $20 million. The area is increasing by a net 32 000 ha annually, adding another $1 million to the annual benefit.

Producers are sowing stylo to target modern beef markets better, to reduce drought risk and to increase property carrying capacity.

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