CARIBBEAN FOOD CROPS SOCIETY

22

Twenty Second Annual Meeting 1986

St. Lucia

Vol. XXII

GRASS AND LEGUME SPECIES FOR PASTURE ESTABLISHMENT IN BARBADOS

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INTRODUCTION

In the past, forage management in Barbados consisted almost solely of heavy applications of fertilizer to a few grass species. There was little thought given to the use of better adapted grasses, or to the use of tropical legumes to improve forage quality. Nor was the possible synergism between grasses and legumes considered worth investigating. The rapid escalation in oil prices in the ealry 1970's, and the subsequent increases in fertilizer prices, led dairy and livestock farmers in Barbados to consider how they might increase pasture productivity, while reducing, or at least not increasing, production costs.

Fortunately, the Ministry of Agriculture in Barbados began, in the mid-1960's, evaluating selected grasses from the Oakes collection, and legume species from Australia. Quintyne (1979) was attempting to find grasses of better quality, productivity and drought tolerance than those then planted, and to identify tropical legumes which could be planted in association with the newer grasses, or in pure stands, to improve the overall quality of farm produced forages.

In 1974, the International Development Research Centre, Canada, funded, through the University of the West Indies (UWI), the Forage Legume and Pasture Establishment Project. This project was transferred to CARDI in 1978, and formed the basis of a Regional Forage Programme (Keoghan, 1980). This programme is now based on collaboration between the CARICOM Ministries of Agriculture, the UWI Faculty of Agriculture, and CARDI. As a result, beginning in 1979, emphasis was directed towards on-farm forage development.

Farmers were encouraged to establish small plots of the newer improved grasses and legumes which had been found suitable for their soils and rainfall patterns. Progress was slow for many reasons, lack of appreciation of forages as crops that must be properly managed in the way other food crops are, in order to increase yields, and a lack of knowledge of how to manage forage crops for grazing or for cut-and-carry systems.

IMPROVED GRASSES

The authors have to date encouraged pasture establishment using new improved grasses based on the work of Keoghan and Devers (1977) and Quintyne (1979). These grasses were selected because they are better suited to high pH soils and are more productive under lower rainfall conditions. They also associate with the twining legumes more readily than does Pangola (Devers and Keoghan, 1978). Guinea grass and the other **Panicum** also tolerate shade sufficiently well to be interplanted with

Leucaena to form protein-energy banks (Proverbs, 1985). The grasses recommended for pasture establishment in Barbados are:

Pangola **(Digitaria decumbens)**
Transvala **(Digitaria decumbens)**
Guinea (native) **(Panicum maximum)**
Guinea (likoni) **(Panicum maximum)**
Elephant grass **(Pennisetum purpureum)**
Bambatsi **(Panicum coloratum)**
Giant African Star **(Cynodon** spp.)
Coastal Bermuda **(Cynodon dactylon)**
Coastal Bermuda CC#1 **(Cynodon** spp.)
Para **(Brachiaria mutica)**

Pangola grass: The introduction from Africa, and the subsequent widespread use of pangola in the Caribbean and many other areas of the tropics and sub-tropics, was one of the most significant events for pasture development in this region (Keogan & Devers, 1977). Pangola has many outstanding attributes, including high persistence under grazing, ability to suppress weeds and high forage quality, especially when supplied with adequate fertilizer and high moisture levels. In the drier parts of the Caribbean, such as Barbados, its strengths are also its weaknesses. Without high moisture levels and adequate fertilizer, forage yields and quality are low. Furthermore, pangola does not associate well with any of the twining legumes except Teramnus (rabbit vine). Pangola flourishes in areas receiving more than 1000 mm rainfall annually, but with the on-set of the dry season goes into a dormant state, when no amount of moisture or fertilizer will induce productive growth.

Transvala grass: This is another of the "digit" grasses from Africa and is very similar to Pangola in its growth habits. It is as dominant as Pangola but differs from Pangola in that it is resistant to Pantola Stunt Virus (PSV), a prevalent disease in South America, including Guyana. Transvala has consistently outyielded pangola in Barbados since its introduction in 1982. It associates better with the twining legumes than does Pangola.

Guinea grass: Few grasses are relished more by ruminants than Guinea grass. Like most of the tropical grasses, it is a native of Africa and today is widely cultivated in South America, Southeast Asia and the Caribbean. It has the capacity to respond to conditions of high fertility and is suited to well-drained soils of medium to high fertility. It does not tolerate poorly drained conditions. It prefers areas receiving more than 900 mm rainfall annually and is being encouraged for pasture improvement in all but the driest areas of Barbados.

Guinea grass associates well with the twining legumes Siratro, Glycine and Teramnus. Leucaena **(Leucaena leucocephala)** combines well when planted in wide rows to form a special purpose forage bank--a protein/energy bank--especially for dry season feeding (Proverbs, 1986).

Likoni guinea grass: This cultivar is very similar to the native guinea and requires similar conditions for healthy, vigorous growth. However, because of its higher leaf to stem ratio and increased palatability, it is judged to be a more productive grass. It also associates very well with Siratro, Glycine and Teramnus.

At the present time, only 1.5 ha have been established, but with the increased availability of seed from CARDI's seed production centre in Antigua, it is anticipated that another 5.5 ha will be planted this rainy season. The recommended seeding rate is 6 kg ha^{-1} (Pearen, 1980).

Elephant grass: Jamaica's dairy farmers have been the only ones in the CARICOM Region to fully exploit the true potential of elephant grass, both as a high energy and high producing grass. As a forage crop, it has been green chopped and ensiled. Until recently elephant grass was never planted to any extent for green chopping or grazing in Barbados. However, since 1980 more and more farmers are planting larger parcels of elephant grass for these purposes. It was originally considered to be a grass for areas with over 1100 mm rainfall, but is now gaining more acceptance with farmers on the deeper soils in low rainfall areas (750 mm). This corroborates reports (Keoghan and Devers, 1977) of dry matter (DM) yields of 6150 kg ha^{-1} in a high rainfall area (1050 mm) and of 4350 kg hs^{-1} DM in a low rainfall area (750 mm).

Bambatsi: Bambatsi grass, with its attractive blue/green leaves, has proved to be well adapted and productive on heavy clay soils, and to show considerable drought tolerance and dry season growth (Keoghan, 1980). It is less well adapted to droughty shallow soils derived from limestone and marl. For this reason bambatsi is recommended for the clays of the Scotland District. The one parcel where Bambatsi has been planted has grown well, but it has been overgrazed because it is very palatable. When this happens weeds tend to infiltrate between the plants quickly, thereby reducing positive productivity. Bambatsi associates well with the twining legumes Siratro, Glycine and Teramnus.

Giant African Star Grass: This is a vigorous low-growing grass which spreads by overground stems and roots readily at the nodes. As the name implies, it is a native of East Africa. It is fair to moderately drought tolerant, growing in areas receiving 650 to 1200 mm annual rainfall (CARDI, 1983). It is well adapted to grazing by sheep, goats and cattle. It can also be cut for hay or silage but the frequency of cutting should not exceed 42 days otherwise the stolons grow too long and cause problems with some types of grass cutters. This grass is unusual in that its nutritive value tends to increase with age up to 4-5 weeks (Grieve & Osbourne, 1985). Stargrass does not associate as well as the **Cynodon** spp. with Siratro and Glycine, but **Terammus** is very persistent, and from initial evaluation appears to be able to provide upto 25 per cent of the total forage dry matter.

Bermuda grass: Before any of the other improved types were introduced, 2 ha of Coastal Bermuda grass were planted vegetatively in Barbados. It showed moderate drought tolerance when grown in areas receiving between 700 and 2000 mm rainfall annually. However, in 1981 cv. Coast Cross-1 was introduced. From the 18 sprigs planted then some 50 ha have now been established. It is more drought-tolerant than either Giant African Star or Coastal Bermuda. It is adapted to a wide range of soil types including soils containing too much salt for many crops. It is decidedly more palatable than either Coastal Bermuda grass or Giant African Star. In fact, from grazing studies conducted at Springhead Farm, Coast Cross-1 has produced 40 percent more beef ha^{-1} than Coastal Bermuda. The Bermuda grasses all associate very well with the legumes Siratro, Glycine and Teramnus.

Para grass: Para grass grows well under moist conditions. Its greatest virtue is its tolerance to waterlogging: in fact it will grow out from a ditch bank into free water. Para grass is undemanding in its soil requirements and will grow in most soils if they are wet enough. It is best suited to planting on the banks of a stream and its roots will hold the soil, and with its tendency to grow into free water it helps to reduce the rate of stream flow. Para grass is readily consumed by cattle, which treat the plant as a browse by stripping the leaves off and leaving the stems bare. It is by no means as resistant to grazing as pangola, guinea or elephant grass. A recommendation widely practiced in Australia, but extremely restricted in Barbados, is the "fencing them out system". In this system Para grass is planted in the swamps and soak aways and fenced off. It is then reserved for dry season grazing only.

Sordan (Northrup King): Sordan is a commercial hybrid (sorghum x sudan grass). It can persist and yield well. It is now planted by a number of farmers as a companion crop for the stoloniferous grasses, especially Coast Cross-1. Sordan is planted at the rate of 20 kg ha^{-1} and allowed to establish. It is then interplanted with sprigs of one of the **Cynodons** so that by the time the Sordan begins to die out approximately 18-20 months after planting, there is a well established pasture of African Star or Coast Cross-1.

Sordan also associates very well with the twining legumes and improved forage quality has been obtained, especially with **Teramnus** in Sordan (CARDI, 1985).

IMPROVED LEGUMES

Much has been written about the difficulties of establishing and managing grass/legume pastures, but the advantages of such pastures far surpass these difficulties. The legumes selected and recommended for grass/legume mixed swards are:

Siratro/Mexican macro **(Macroptylium atropurpureum)**
Glycine **(Glycine wightii)**
Teramnus **(Teramnus labialis)**
Desmanthus **(Desmanthus virgatus)**
Stylo **(Stylosanthes hamata)**
Centro **(Centrosema pubescens)**
Leucaena **(Leucaena leucocephala)**

Twining Legumes: The three legumes--Siratro/Mexican macro Y61, Glycine and Teramnus--are considered here as a group because of similar growth habits. In all associated pastures they have been mixed in a ratio of 2:2:1, respectively, and sown at a rate of 5 kg ha^{-1}. These legumes have consistently shown their ability to be compatible with each other and to associate with all the recommended grasses, except pangola. Soon after germination, Sirato/Mexican macro Y61 shows dominance over Glycine and Teramnus in the sward. In well managed pastures, Siratro remains dominant to both of these for up to two years. By the middle of the third year, Glycine becomes co-dominant, and dominant by the end of the third year. Siratro ultimately becomes sub-dominant to Teramnus in the fourth year. By the end of the fifth year after establishment Glycine and Teramnus are the dominant and sub-dominant legumes, and Siratro has virtually

disappeared from the pastures. This is when "hands-on" experience is the major management skill required to maintain the total legume component at a 30-35 per cent level on a dry matter basis.

Desmanthus: Desmanthus has been sown in three guinea grass pastures where it has established well. However, because of its high palatability and severe grazing pressure, it was virtually eliminated within two years of establishment. Seed availability has been the major constraint in further establishing pastures with Desmanthus as the legume component.

Stylo: This is another legume that has not been widely planted because seeds have not been readily available. Whatever has been planted has done well on the free draining, calcareous clays in areas receiving more than 750 mm rain. In an effort to become better acquainted with the species, 25 kg of seed (cv. Verano) were imported from Australia. Germination was very poor and the seedlings showed chlorosis very soon after germination. This is understandable as Verano has been selected for acid soils. Seed form this shipment was sent to Dominica where it has grown very well. Seeds planted in another location germinated, but the plants were not very vigorous. Seeds produced from this stand were self-sown, and eventually produced seedlings which showed little or no sign of chlorosis (Quintyne, 1979). It is the authors belief that Stylo has the potential to be grown in pure stand, similar to alfalfa, for the production of a legume hay. Unfortunately, this will not be demonstrable until such time as seed can be produced in sufficient quantity from local accessions.

Centro: Centro seed was sown at 4 kg ha^{-1} in a guinea grass pasture in July 1982, but by September 1983 it had nearly disappeared from the pasture. The seed germinated well, but rainfall for that period was less than 1100 mm. Undoubtedly this led to its poor performance which was further aggravated when 2,4-D spray drift set-back its growth prior to the onset of the dry season. Spray drift is a normal occurrence in Barbados as "plant" canes are sprayed at the end of the rainy season with 2,4-D for weed control. The ability to withstand some hormone spray-drift is a high priority when selecting legumes for pasture establishment in Barbados. For this reason it was decided not to plant Centro in grass/legume associated pastures. In earlier studies, Centro was shown to have a low survivability on some of the heavy clays in a 1500 mm rainfall area. However, it grew and produced well on soils in the Scotland District.

Leucaena: CARDI "Cunningham" leucaena has been established both from seedlings and seed in protein and protein-energy banks. There is no other legume better able to withstand the vagaries of tropical dry and wet seasons, the abuse of over-grazing and allocation to the poorest soil in the pasture than leucaena.

Since December 1981 some 9 ha of leucaena protein/protein-energy banks have been established on many sites on eight farms in Barbados. These banks range in size from 0.1 ha to 0.75 ha. Their size is determined both by the farm's topography and forage requirements. No other tropical forage will produce as much forage dry matter as a well managed stand of leucaena (Keoghan, 1980). Furthermore, there is no other forage better suited for a reserve than leucaena. It is a deep-rooted shrub and very drought-tolerant because of its gregarious tap root. The shrubs provide some shade but do not

exclude sunlight, so that shade tolerant grasses such as Guinea grass and Green Panic can be grown in association with them. The seedlings are planted 1m apart both between and within rows in the banks and allowed to grow about 1m tall before they are coppiced to encourage branching. The banks are ready for grazing six months after transplanting the seedlings if good weed control is practiced. On the other hand, if there is no weed control then the banks cannot be grazed until 10 to 12 months after establishment.

At the present time leucaena banks are grazed exclusively. Farmers have only started making grass ensilage in the past couple of years and additional studies in harvesting and storage techniques are being undertaken with a view to encouraging farmers to begin ensiling leucaena.

COMMERCIAL PLANTINGS

Between 1979 and the present, some 249 ha of improved pastures have been established with associated grass/legume species or with pure grass swards on 18 Barbadian farms. These farms range in size from 12 to 90 ha (Proverbs, 1986).

Approximately 50 ha of Coastal Bermuda grass cv. Coast Cross-1, and 75 ha of Giant African Star grass have been established, and 30 ha each of native Guinea grass, Elephant grass, and Pangola. Eighteen hectares have been planted in Transvala, and 2.5 ha, 2 ha and 1.5 ha have also been established in Bambatsi, Coastal Bermuda and Likoni Guinea grass, respectively (CARDI, 1985). In addition, 10 ha of Sordan and eight of corn have been grown for green chop and ensilage production.

Of the 249 ha of improved pastures some 154 have been established in grass/legume associated swards. The three twining legumes Siratro, Glycine and Teramnus have been interplanted with all of the grasses except Pangola. Prior to planting, the legumes seeds are mixed in a ratio of two parts Glycine to one part Teramnus. This mixture is then planted at the rate of 5 kg ha^{-1} (CARDI, 1981). In addition to the twining legumes, Leucaena and Desmanthus have been planted in association with the grasses. Leucaena has readily gained acceptability by farmers and has been planted in pure stands to form protein banks or in grass/leucaena stands to form protein/energy banks.

FUTURE WORK

During 1986, the following four additional grasses have been introduced:

Dwarf Elephant N70 **(Pennisetum purpureum)**
Tifton 68 Bermuda Grass **(Cynodon nlemfuensis)**
Klein grass **(Panicum coloratum)**
Green Panic **(Panicum maximum)**

Sufficient seed of Klein and Green Panic have been imported to establish 7 ha of a 50:50 mixture of KLein/Green Panic at three different locations. The seed will be planted at 6 kg ha^{-1}. Over the next few years productivity, carrying capacity and regeneration rates will be evaluated. The pastures established will also be planted with the twining legumes at

5 kg ha^{-1}. Small quantities of vegetative material of Dwarf Elephant grass and Tifton 68 were acquired from Dr. Michaud of the College of the Virgin Islands. At the present time seven small nurseries have been established from the original Tifton 68 nursery planted in February. The Dwarf Elephant grass cuttings have been established in a 30 m^2 nursery from which planting material will be distributed beginning this rainy season.

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ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance and cooperation of many of dairy and livestock farmers in Barbados, in particular Messers. Peter Moores and Joseph Hassell of Springhead farm.