

Performance characteristics of *Desmanthus virgatus* in contrasting tropical environments

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Abstract

Characteristics of a number of *Desmanthus virgatus* accessions are reported from observations made in humid and subhumid tropical environments. Observations and comments on performance traits, dry matter production, and growth of plants outside the experimental area are described. In West Java, on a clay soil, CPI 40071 produced about 5 000 kg/ha dry matter in its first 9 months of growth while in north Queensland, accessions such as CPI 38351 and "Alligator Creek" had good seedling recruitment and palatability.

Introduction

Desmanthus (Figure 1) is a genus new to domestication so the behaviour of plants outside formal experiments may be of interest; plant characteristics not previously encountered may be observed. Serendipity and observation have often provided the opportunity for hypothesis generation, later to be tested in more formal experiments.

This paper reports our observations on *Desmanthus virgatus* in different environments and locations in the subhumid areas of north Queensland, and in the humid tropics of West Java, Indonesia and elsewhere.

Java, Indonesia

Late in 1989, seed of *D. virgatus* CPI¹ 40071 was received and included in a forage legume evaluation program together with *Calliandra calothyrsus*², *Gliricidia sepium*², *Leucaena leucocephala*² and *Sesbania sesban*². The plants were raised in polythene bags for 3 months and then transplanted into the field during the wet season at a spacing of 0.5 m × 1.5 m at Jonggol (Bogor Agricultural University Research Farm), West Java (6°30'S, 106°56'E, altitude 70 m), where mean rainfall is 3206 mm per annum (Conroy *et al.* 1990). Two soil types were selected for the experiment as they represented typical arable areas of the research farm.

Site 1: Eutropeptic Rendoll (a heavy clay). An A horizon of black (10 YR 3/1) well structured heavy clay, field pH 6, with some aluminium and ferrous nodulation and a B horizon of a heavy clay with pockets of calcium carbonate, field pH 8, overlying and mixed with lower calcareous parent material (Grierson 1989).

Site 2: Lithic Eutropept (undifferentiated clay soil). Well structured reddish brown (5YR 5/6) light medium clays with some coarse gravel throughout, field pH 6.0–6.5, overlying a C horizon of light white siltstone (Grierson 1989).

D. virgatus CPI 40071 performed extremely well, especially at Site 1. After 6 months in the field, the plants had a mean height of 203 cm (Thompson 1990) and formed an almost impenetrable thicket of slender stems and leaves. Dry matter yield (leaves plus stems) from 2 harvests during the first 9 months was 4993 kg/ha, compared with *Calliandra* (3036 kg/ha), *Gliricidia* (2652 kg/ha) and *Leucaena* (473 kg/ha). At 6 months, *D. virgatus* CPI 40071

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1. Commonwealth Plant Introduction number. 2. These species had already been introduced to Indonesia and have been deemed to be useful animal fodder.

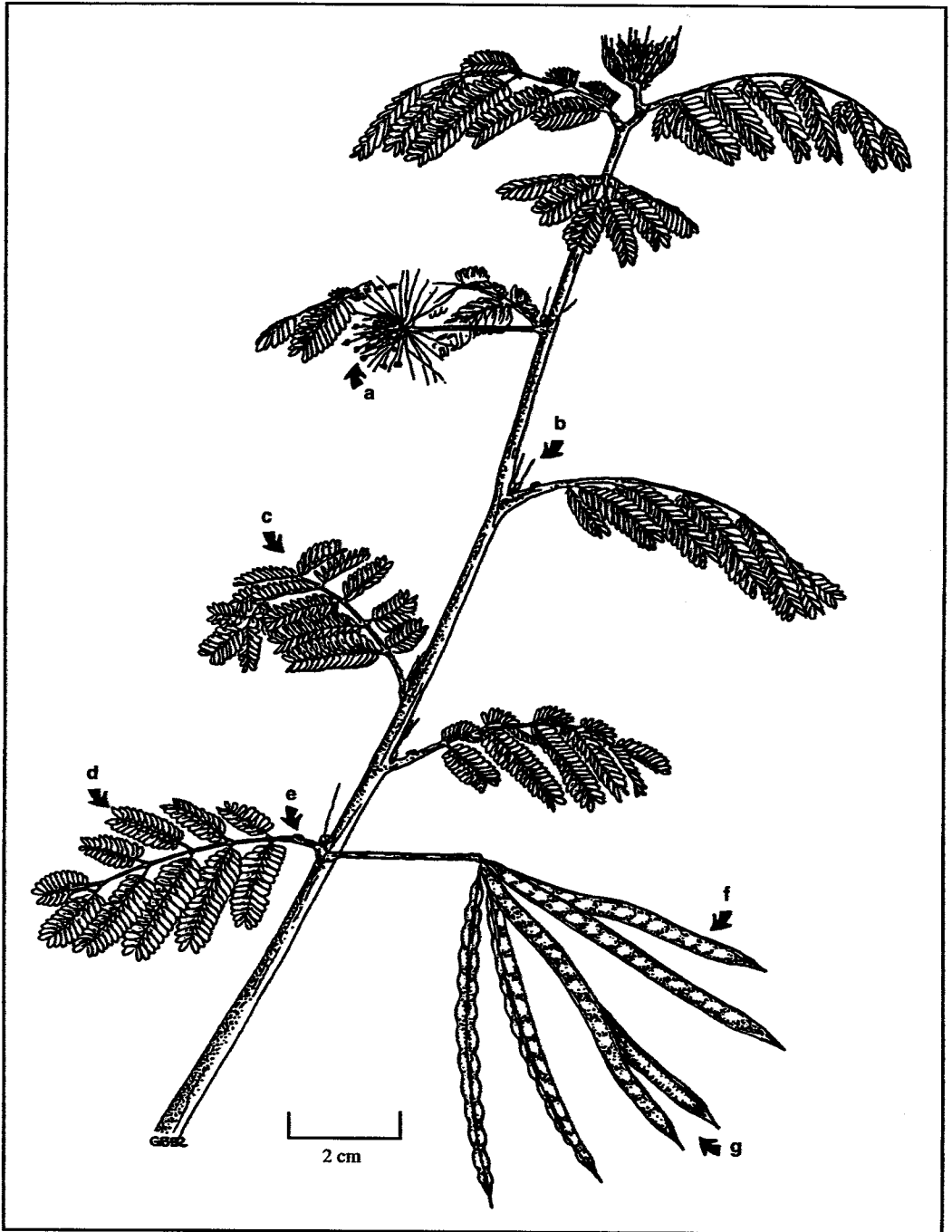


Figure 1. *Desmanthus virgatus* (L.) Willd. (a) flower; (b) stipules; (c) bipinnate leaves; (d) pinna; (e) gland; (f) pod; (g) dehiscent pod.

appeared woody, with a leaf:stem ratio of 1:1.7; and after 9 months 1:2.2, compared with the ratio for other species of approximately 1:1 (M. Waladan, personal communication). The stems of *D. virgatus* CPI 40071 were thin and slender compared with the thick, woody stems of the other species.

After cutting at either 0.5 m or 1.0 m, *D. virgatus* CPI 40071 regrew rapidly, producing numerous fine stems. This produced a change in growth form similar to that noted by Takahashi and Ripperton (1949), where plants developed a marked "crown" from which many stems were produced. From an age of 6 months, plants continuously flowered and set seed. In one harvest, 110 kg/ha seed was collected and at least 4 such harvests could occur per year. A yield of more than 400 kg seed per hectare is considerably higher than, for instance, the free-seeding annual, *Stylosanthes humilis*. This seed could be an even more important constituent of the animal's diet than that noted for *S. humilis* by Playne (1972). This author noted that legume seed is a potentially large source of nutrients for the grazing animal during the dry season, when grasses are low in quality. Massive numbers of self-seeded plants were found between and outside the cultivated rows of plants.

In this environment, *D. virgatus* CPI 40071 is clearly well adapted and has good forage potential. Moreover, its growth habit helps it to be competitive with wet tropical weeds such as *Imperata cylindrica*, and improved pasture species such as *Panicum maximum*. *Leucaena* has been devastated in this area by the psyllid insect (*Heteropsylla cubana*), and an alternative forage legume such as *D. virgatus* is required. The other species tested grew well but all have certain limitations: *Gliricidia* may require wilting prior to feeding to livestock (Simons and Stewart 1994); *Calliandra* is of low palatability (Palmer *et al.* 1994); *Leucaena* suffers from insect attack (Partridge 1989); and *Sesbania* can be short-lived under grazing (Evans and Rotar 1987; Gutteridge 1994).

Alligator Creek, north Queensland

Alligator Creek (19° 21' S, altitude 30 m) is 20 km south-east of Townsville, north Queensland in the subhumid tropical zone and receives 1500 mm rainfall per year.

The soil belongs to the "Bently" association and is a solodic (DY 3.43/3) dark grey-brown fine sandy loam A1 overlying dark yellow-brown medium clay in the B horizon (Murtha 1982), field pH changing from 6 to 8.5 down the profile.

Desmanthus plants were introduced to the area some 5 years ago. The medium-tall types of *D. virgatus* (see Burt 1986; 1993) had spread naturally throughout an orchard, possibly by grazing horses. It appears adapted to growing close to, and under, the dense shade of orchard trees such as Sapodilla and Jaboticaba. It has spread from these areas into the full-sunlight grassed areas of *Urochloa mosambicensis* (Sabi grass) and *Bothriochloa pertusa* (Indian couch) which are regularly mowed. Mowing to soil level stimulated shoot growth, either from callus tissue or from underground organs of the plant. The burning of litter from trees produced a *Desmanthus*-dominant cover both in the shade of the trees and for some distance around them. Such a response to fire (see also Rangel and Gardiner, in press), coupled with a high degree of shade tolerance, suggests that some types might be useful in shaded pastures of the dry tropics. The genotypes which behave in this way are currently being investigated (J. Rangel, personal communication). Plants of *Desmanthus* were also growing in an eroded gully in the B horizon of solodic clay soil (pH 8) with mixed habitat of weeds including *Sida* sp., speargrass (*Heteropogon contortus*) and Indian couch.

CSIRO "Lansdown" Field Station

"Lansdown" is 40 km south of Townsville with an annual rainfall of 861 mm (Cook and Russell 1983), which is strongly seasonal, approximately 75% falling between December–March (Murtha and Crack 1966). Soils are red podzolic, pH 6.3, with very dark loamy A1 horizon up to 25 cm deep and an A2 horizon grading to structured red or brown sandy clay subsoil. The vegetation (prior to clearing) was a grassy *Eucalyptus* forest, principal species being kangaroo grass (*Themeda triandra*) and iron bark (*Eucalyptus crebra*) (Murtha and Crack 1966).

In the early 1980s, field experimental plots of various accessions of *D. virgatus* were planted but the plots have since been abandoned, ploughed, treated with herbicide and a crop of

sesame grown (A. Schlink, personal communication). However, many *D. virgatus* plants still survive and are spreading by seed recruitment. The main 'types' present appear to be the medium-tall types similar to those described by Burt (1986; 1993). In nearby plots, *D. virgatus* was a vigorous component amongst shrub legume trees.

James Cook University, Townsville

Eleven accessions of *D. virgatus* and one accession of *D. bicornutus* have been grown at James Cook University, Townsville, north Queensland. Detailed observations of these are reported by Gardiner (1992).

The soils, part of the Healy soil association, are solodic, with a strongly bleached sandy loam A horizon and an abrupt change at 20–40 cm to a mottled, brownish grey and yellowish brown heavy clay B horizon with an alkaline reaction trend (Murtha 1982).

Townsville (19° 20' S) has a climate characterised by hot, humid summers and dry, mild winters. Mean annual rainfall is 1171 mm, 70% of which occurs from January–March (Murtha 1982).

The following characteristics were observed:

- the ability to spread, by seedlings, into uncultivated grassed areas of the experiment, particularly accession CPI 38351.
- the ability to grow in light conditions ranging from deep shade to full sunlight — the more prostrate types were most commonly encountered in the latter situation.
- in previously uniform rows, the sporadic production of plants of high vigour such as several exceptional plants of CPI 92803 and TQ88.
- the ability to produce roots from lateral branches particularly from a plant of the accession CPI 92803 with high vigour.
- the ability to be propagated from stem cuttings, particularly accessions CPI 38351 and 92803.
- the ability to grow through small trees. This characteristic coupled with shade tolerance, would seem to enable plants to grow, survive and spread in woody 'niches'.
- early palatability; all the *Desmanthus* accessions were grazed by sheep early in the wet season in preference to Siratro, Verano and

Sabi grass. In the dry season, *Desmanthus* produced green leaf particularly after small amounts of rain when most other introduced and native species were dead or dormant.

- drought resistance; *D. virgatus* CPI 37143 remained turgid at a time of severe moisture stress while neighbouring rows of species such as *Aeschynomene americana* (cv. Glen) and *Desmodium heterocarpon* wilted.
- production of large, numerous, active nodules on accessions such as Alligator Creek and TQ88. As noted earlier, the Alligator Creek genotype is very vigorous and capable of growth over a range of soil conditions.
- the diversity of root forms, low crown of some accessions such as CPI 92803 and the soboliferous like habit (stems arising from a plant organ below the soil surface) of CPI 38351, which may assist the plant in resistance to heavy grazing pressures.

Conclusions

Desmanthus species examined exhibit a very wide range of characteristics and, clearly, constitute a highly polymorphic group. The ability to thrive on heavy vertisol soils and to spread are of obvious value. Early palatability would be of value in contributing to the diet early in the season, when other legumes are not eaten. Those plants which outperform plants believed to be the same genetically and planted at the same time may be genetic variants or simply phenotypes which have been affected by management. In either case, further more-detailed experimentation is warranted.

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