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Desmanthus: AGRONOMIC CHARACTERISTICS, GERMPLASM RESOURCES, AND FORAGE POTENTIAL IN THE CARIBBEAN

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ABSTRACT

The genus Desmanthus includes tropical and temperate species, with a center of origin in the Caribbean basin. Ecotypes range from 2m high D. virgatus shrubs to the prostrate D. depressus. Adaptation ranges from heavy clays to coarse sands and from semi-arid to wet equatorial rainfall zones. High-quality, palatable forage is characteristic, although poor acceptance by cattle of germplasm on acid, infertile soils has been observed. Age or physiological stage at defoliation affects regrowth potential. Some accessions of perennial shrubs have been called annuals due to failure to regenerate following defoliation. Collections of Desmanthus include almost 300 accessions at CSIRO, over 150 accessions at CIAT, plus collections at ILCA, CARDI, and the USDA. Forage potential includes pastures, protein banks and cut-and-carry systems. However, identification of appropriate germplasm for specific sites and determination of defoliation management for sustained, productive use have not been adequately determined. This lack of information limits commercial use of Desmanthus germplasm.

INTRODUCTION

The genus Desmanthus of the Leguminosae subfamily Mimosoideae includes approximately 40 species which range from trees and shrubs to perennial herbs with prostrate growth (Bogdan, 1977). The genus is characterized by bipinnate leaves with leaflets less than 10 mm in length. The range of natural distribution extends from Central and South America to southern Asia with a center of origin in the Caribbean basin. Although the genus is characterized by tropical species, the range extends into temperate America. Several species occur in the southern Great Plains of the USA.

Agricultural use of D. virgatus was noted by Whyte et al. in 1953. They reported its use for fodder and grazing at low elevations in Hawaii and Mauritius and for green manure and soil cover in Indonesia. Documentation of recent commercial use of the tropical Desmanthus species is lacking, although interest in the genus for forage is found among researchers in tropical America, Australia, and Africa. Recent interest in temperate Desmanthus species (Anonymous, 1984) involves range and pasture plantings, wildlife food plantings, and reclamation of

surface-mined areas in the southern Great Plains. Most of these plantings consist of the cultivar Sabine Illinois bundleflower (D. illinoensis).

Agronomic Characteristics

Whyte et al. (1953) indicated that the agronomic characteristics of D. virgatus make it an outstanding forage crop. They reported it to be palatable with excellent growth and able to tolerate cutting and grazing. Skerman (1977) reviewed the available information on D. virgatus and also concluded that it was a palatable, productive forage tolerant of defoliation. Skerman (1977) reported research from Hawaii where D. virgatus persisted under four harvests per year when cut at the early pod stage to a 5 cm stubble with no plant mortality but with a decrease in yields during the second and third years. Under this repeated defoliation, D. virgatus developed a distinct plant crown somewhat similar to that of alfalfa (Medicago sativa). The maximum annual yields of 24 t/ha with 22.4% leaf crude protein were both lower than those obtained from Leucaena leucocephala in the Hawaiian research.

Persistence under clipping has been a limitation of a broad range of Desmanthus germplasm under screening evaluations in the Caribbean. Some accessions have been called annuals because of a lack of perennation under clipping. In preliminary screening where seed increase was an initial objective and response to defoliation was subsequently evaluated in the same plantings, reduced vigor and even death of large plants following defoliation have been common (J.M. Keoghan, personal communication; and Michaud et al., 1989). Keoghan (personal communication, 1987) suggested that even though survival of defoliation by tall, woody D. virgatus plants at the mature seed stage is poor, plants browsed at earlier stages can survive as herbaceous plants under fairly close defoliation. It has been suggested that grazing often appears to be beneficial to survival of Desmanthus (R. L. Burt, personal communication). Keoghan attributed the improved survival under defoliation at earlier stages of growth to greater basal viability which is apparently reduced with plant maturity. Keoghan found that D. depressus was tolerant of heavy grazing, although Wildeus et al. (1990) reported greater trampling damage to the prostrate than to the erect types at high stocking densities.

Although the response to defoliation appears to be similar across a wide range of Desmanthus germplasm, considerable variation for other agronomic characteristics exists. This genetic diversity has resulted in different accessions proving superior at different locations as illustrated by screening of a common group of accessions on St. Croix and in Guanare, Venezuela. On St. Croix, two accessions from the Yucatan of Mexico, CF 495 and CF 543, were the most productive and

persistent accessions (Michaud et al., 1989). At Guanare, neither of these accessions was among the superior group (Muñoz et al., 1989). Perhaps at least partially responsible for these differences, was the tremendous range in susceptibility to insect damage at Guanare where some accessions were devastated by insect attack while adjacent plants of other accessions were unaffected (A.E. Muñoz, personal communication). There may also be genetic variability for palatability to grazing livestock since reports of low palatability on infertile tropical soils (Schultze-Kraft, personal communication) contrast with the general reports of excellent palatability. This difference may also be due to nutrient deficiencies on the infertile soils.

The natural distribution of Desmanthus suggests a range of potential sites for use of selected genotypes. Edaphic suitability ranges from sandy soils to clays (Skerman, 1977), although pH requirements provide some limitation. Generally a pH range from near 5.0 to 7.0, or perhaps slightly above, encompasses the range. At Ona, Florida, only a few plants survived from 50 accessions planted on a Spodosol with a pH of approximately 4.5. Addition of lime to a pH near 5.0 resulted in survival of plants from a number of accessions. Plant vigor and productivity were much lower on the infertile, sandy Spodosol site than on a nearby fertile, clay, reclaimed-mine site. Results from these Florida evaluations have shown frost tolerance in a range of tropical Desmanthus germplasm. In addition to wide edaphic and temperature ranges, the genus is adapted to a range in moisture regimes from semi-arid to wet equatorial conditions, however, Desmanthus is not typically reported in vegetation surveys of the humid tropics. Individual plants of selected Desmanthus accessions have proven to be tolerant of periodic waterlogging on a Florida Spodosol (Pitman and Kretschmer, 1984).

Hard-seededness is a characteristic of the genus. Evaluations of scarification methods on D. depressus seed resulted in germination of 91% with mechanical seed coat disruption, 88% from soaking for 40 minutes in 17 M sulfuric acid, and 78% following 25 minutes of soaking in 80^{o}C water compared to 3% germination for the control (Fulbright and Flenniken, 1987). Similar treatments had previously been found to be effective with D. velutinus (Haferkamp et al., 1984). Despite the characteristic hardseededness, Keoghan (personal communication, 1987) suggested that Desmanthus readily regenerates from self-sown seed following over-grazing or cultivation in Antigua. Increases in D. illinoensis stands over 4 years in a plot study in Texas were reported as seed production allowed population increases (Dovel et al., 1990). Thus, while seed scarification should be considered for rapid stand emergence with new plantings, hardseededness does not appear to be a major limitation to stand maintenance when defoliation management permits normal seed production.

Germplasm Resources

The major collections of Desmanthus germplasm are held by the Commonwealth Scientific and Industrial Research Organization (CSIRO), Division of Tropical Crops and Pastures in Queensland, Australia and Centro Internacional de Agricultura Tropical (CIAT) in Cali, Colombia. The CSIRO collection, which totals almost 300 accessions, has been subjected to considerable evaluation and characterization at the Lansdown Research Station in Australia over the past 10 years (Burt, 1984). Variation among and within species for productivity, morphological characteristics, and other growth characteristics are evident. The CIAT collection of over 150 accessions (Schultze-Kraft et al., 1987) has not been subjected to extensive screening or evaluation.

Several additional smaller collections of Desmanthus germplasm include materials at the International Livestock Center for Africa (ILCA) in Addis Ababa, Ethiopia; the Caribbean Agricultural Research and Development Institute (CARDI) in Antigua; and the United States Department of Agriculture (USDA) in Griffin, Georgia. A considerable proportion of the individual entries in the various collections are duplications, with many entries having identification numbers assigned by each collection. Thus, some confusion regarding identification of individual accessions is involved. For example, the two superior accessions from evaluations on St. Croix are CF 495 (which has also been identified as CPI 92802 and CPI 76059) and CF 543 (which has also been identified as CPI 92803, CPI 83584, CPI 76060, and ILCA 302).

Despite the duplication and lack of inclusion of all collected accessions in a single repository, the collection and availability of Desmanthus germplasm currently are far ahead of the necessary screening and evaluation stages for this germplasm to contribute to Caribbean forage programs.

Forage Potential in the Caribbean

The two species, D. virgatus and D. depressus, occur naturally on many Caribbean grassland sites and contribute to the diets of grazing livestock. Control of grazing pressure to prevent overgrazing of these highly palatable forages would allow increased benefits from natural stands.

Ahmad (1986) has recently assessed the potential of various legumes for pasture and forage use in the Caribbean region. Desmanthus was not among the legumes listed for long-term pasture, reflecting the lack of flexibility in grazing management which results in loss of stands with time. Desmanthus virgatus was listed among the legumes suited for short-term pastures, cut-and-carry systems, and protein banks.

The susceptibility of Desmanthus stands to damage by repeated defoliation will continue to limit usefulness of the genus in the Caribbean until acceptable defoliation management options along with more persistent accessions are available. Further research to determine the appropriate stage for initial defoliation and the extent of subsequent defoliation appropriate for sustained production may allow more widespread successful use of Desmanthus in pastures in the future. At present, Desmanthus should be recommended for commercial use only in those rare situations where the necessary management for successful sustained use can be anticipated. These situations include cut-and-carry systems, where lenient defoliation allows stand persistence, and pastures, where light stocking rates or rotational grazing allow sufficient opportunity for regrowth following grazing.

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