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SUMMARY

The presently available *Desmodium ovalifolium* collection comprises 137 accessions. Most of the accessions were collected in Thailand, peninsular Malaysia and Sumatra in Indonesia, during collecting missions carried out by CIAT and collaborating national research institutions, in 1979-88. Germplasm collection sites were located between latitudes 20°N and 4°S, and between longitudes 98°E and 105°E, with a concentration in southern Thailand. All accessions originated from subhumid to humid regions with an annual rainfall of 1190-4540 mm and 0-7 months of dry season. Soils at collection sites were usually acid.

A description is given of a preliminary evaluation trial which was conducted with 84 accessions at Quilichao, Cauca, Colombia. All materials demonstrated good adaptation to an acid Ultisol with 89% Al-saturation. The accessions manifested considerable variation in days to first flower, herbage production, nutritive quality and relative palatability. As a result of this study, a core collection of *D. ovalifolium* for wider regional testing is suggested. It comprises 28 particularly agronomically promising accessions as well as ecotypes that represent the natural distribution of the species. The need to collect more germplasm is discussed and several countries worthy of further collection are identified.

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GERMPLASM COLLECTION AND PRELIMINARY EVALUATION OF *DESMODIUM OVALIFOLIUM* WALL.

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INTRODUCTION

Desmodium is one of the largest of the tropical legume genera and comprises about 350 species. Its distribution is pantropical, with Southeast Asia as an important center of species diversification (Williams 1983). Some of the better known species that originate from this region are *D. heterocarpon*, *D. heterophyllum*, *D. ovalifolium* and *Codariocalyx gyroides* (syn. *D. gyroides*).

Desmodium ovalifolium has been known for some time as a commercial cover legume in SE Asian plantation agriculture (Imrie *et al*. 1983). Its importance there, however, has declined considerably because of its susceptibility to pink disease (*Sclerotium* (formerly *Corticium*) *salmonicolor*) (Y.K. Chee, pers. comm.). Research on its potential as a pasture legume is more recent, and has shown *D. ovalifolium* to be particularly well adapted to the acid, low-fertility soils of tropical America's high-rainfall regions. The species is considered as promising in Bolivia, Brazil, Colombia, Costa Rica, Cuba, Ecuador, Honduras, Mexico, Nicaragua, Panama, Peru, and Venezuela (Pizarro 1985). Because of its stoloniferous, mat-forming growth habit, it is a good legume for association with stoloniferous, aggressive grasses such as *Brachiaria* spp. (Grof 1982). It is considered as low to medium quality only (Salinas and Lascano 1983). Yet, *D. ovalifolium*, as represented by the commercial cover crop variety (accession CIAT 350), has produced, in association with *B. dictyoneura*, over three years, average animal liveweight gains of 400-700 kg/ha/year (CIAT 1987).

The factors which limit the wider use of the commercial *D. ovalifolium* variety as a pasture legume are: pests, that is, the *Desmodium* root-knot nematode, *Meloidogyne javanica* (Lenné 1981), and a recently discovered stem-gall nematode, *Pterotylenchus cecidogenus* (Siddiqui and Lenné 1984); false rust, a fungal disease caused by *Synchytrium desmodii* (Lenné 1985) which, as yet, is a problem principally in Colombia; low feeding value because of high tannin content (Rotar 1965); slow rate of establishment (Ridzwan and Sariam 1982); and drought periods longer than 3-4 months (CIAT 1979).

Past research on *D. ovalifolium* was performed within a very narrow germplasm range which was, in practical terms, restricted to the commercially available SE Asian cover crop variety. By the late 1970's, an 18-accession collection of *D. ovalifolium* germplasm had been assembled at CIAT through correspondence and direct field collection. It was described and evaluated by Sobrinho (1982). Since then the collection has continued to increase through the work of collecting missions in SE Asia.

TAXONOMY OF D. OVALIFOLIUM AND D. HETEROCARPON

In his taxonomic revision of Southeast Asian *Desmodium* species, Ohashi (1973) does not recognise *D. ovalifolium* as an independent species. Rather he considers it as part of *D. heterocarpon* DC. ssp. *heterocarpon* var. *heterocarpon*. However, we suggest that, for the sake of better communication among tropical pasture scientists, the use of the old species name is preferable. We reached this conclusion because of a series of morphological differences between both species that we observed on living plants of more than 300 different populations of the very polymorphic *D. heterocarpon* and of *D. ovalifolium* Wall. *ex* Gagnep., not only in their natural habitat in SE Asia but also under experimental field conditions. Based on these observations, we refer to *D. ovalifolium* as a herb or sub-shrub that is always prostrate, strongly stoloniferous and mat-forming; with leaves that in young plants are always unifoliolate, in mature plants partly unifoliolate, partly trifoliolate; with leaflets that are ovate to ovate-acuminate, glabrous and brilliant on the upper surface, somewhat coriaceous, and without any markings; and with compact inflorescences that produce densely pubescent pods. In contrast, the typical *D. heterocarpon* is an erect to semi-erect shrub or sub-shrub, with trifoliolate leaves, and obovate to ovate-acuminate leaflets which are opaque on their upper surface, not coriaceous and with light-green to white markings; inflorescenses are elongated and produce pods that are glabrous to slightly pubescent.

Undoubtedly both species overlap in their morphological features. At plant nursery level we have observed, in a few cases, continuous segregation of morphological characters in populations which obviously are natural hybrids between both species. Successful interspecific hybridisation has also been reported from the University of Florida (K. Quesenberry, pers. comm.).

GERMPLASM COLLECTION

The present world collection of *D. ovalifolium* germplasm which is held at CIAT comprises 137 accessions. Twenty-two percent (30 accessions) are introductions from gene-banks and experimental stations such as the CSIRO Division of Tropical Crops and Pastures and the University of Florida's Agricultural Research Center Fort Pierce, and from commercial sources. Mostly their origin is unknown, although the majority are probably duplicates of commercial lines as represented by CIAT 350, CPI 30012, or IRFL 1090. The remaining 107 accessions were collected in the wild, mostly during collecting missions carried out in 1979-88 by CIAT and collaborating national institutions, in Thailand, Malaysia and Indonesia (Pattanavibul and Schultze-Kraft 1985; Schultze-Kraft *et al*. 1987) (Table 1 and Figure 1).

D. ovalifolium germplasm has been collected in Laos (accession CIAT 23618, syn. CPI 45379, collected by L. R. Humphreys, University of Queensland), Thailand, peninsular Malaysia, and Indonesia (Sumatra). No collections are known from the remaining SE Asian countries, Burma, Kampuchea, Vietnam, the Philippines, Papua New Guinea, and tropical China, nor from Indonesian islands other than Sumatra. Because most authors have either not recognised *D. ovalifolium* as a distinct taxon in the sense used in this paper or have deliberately merged it with *D. heterocarpon* (Ohashi, 1973), its presence in Burma, Kampuchea and Vietnam is not discernible from the literature. Until collecting is undertaken with the recognition of the species as used here, its distribution throughout these countries and Laos (where only one collection is known), will remain obscure.

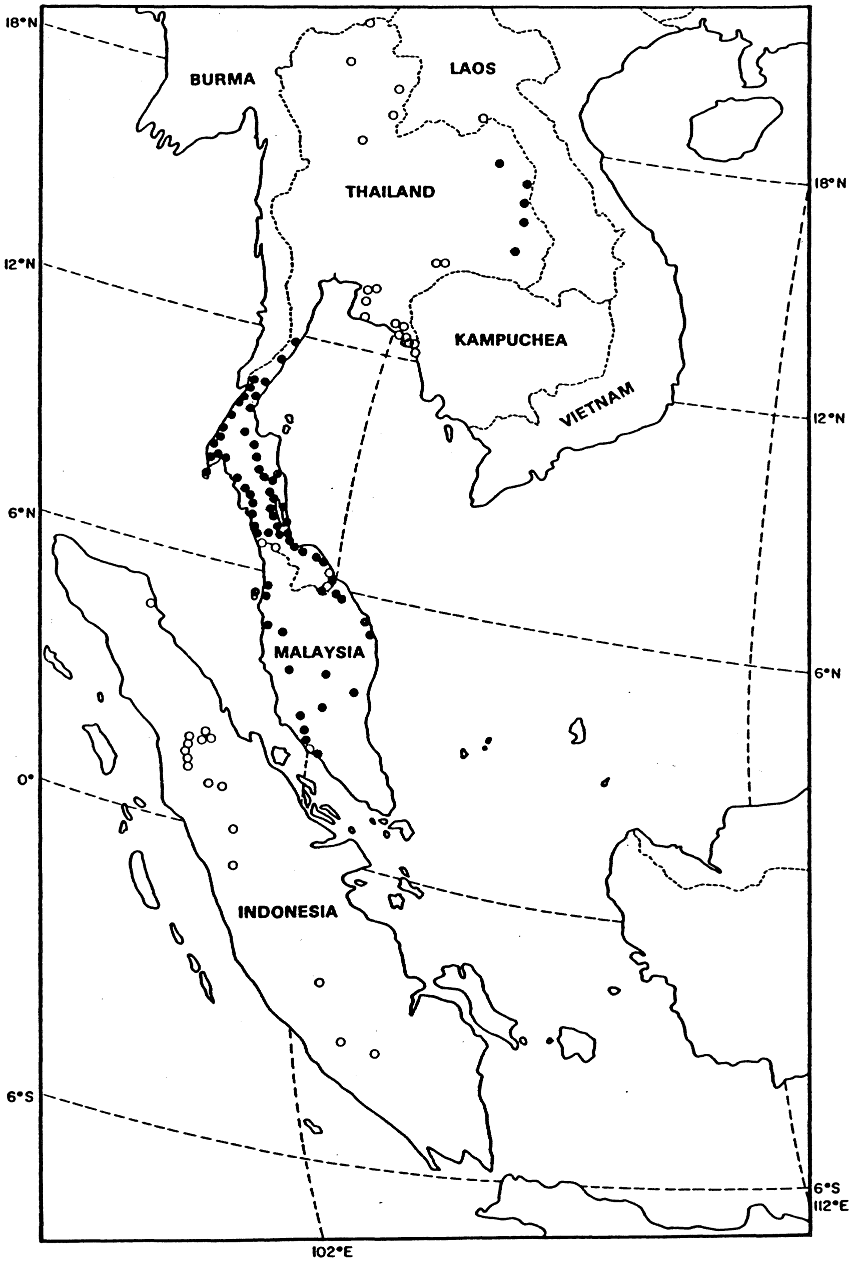

Figure 1 : Distribution of collection sites of D. ovalifolium germplasm.

● Locations of accessions used in the preliminary evaluation trial.

○ Locations of other more recent collections.

Table 1. Origin of *D. ovalifolium* accessions in the CIAT collection.

CIAT Accession No.	Province/State	Country	Latitude	Longitude	Rainfall mm/yr	Dry months (no.) <60 mm	Dry months (no.) <100 mm
33058	Chiang Rai	Thailand	20°26'N	99°54'E	1630	5	6
33059	Nan	Thailand	19°06'N	100°49'E	1330	5	7
33060	Chiang Rai	Thailand	19°04'N	99°24'E	1280	6	6
23618	Tourakhom	Laos	18°22'N	102°38'E	1660	5	6
33061	Uttaradit	Thailand	18°11'N	101°00'E	1260	5	7
33062	Uttaradit	Thailand	17°16'N	100°06'E	1350	5	6
13370	Sakhon Nakhon	Thailand	17°12'N	104°06'E	1490	5	7
13081	Muk Dahan	Thailand	16°52'N	104°41'E	1760	5	7
13082	Muk Dahan	Thailand	16°32'N	104°41'E	1490	5	7
13083	Ubon Ratchathani	Thailand	15°51'N	104°38'E	1500	5	7
13085	Si Sa Ket	Thailand	15°08'N	104°44'E	1570	5	6
13656	Buri Ram	Thailand	14°25'N	102°48'E	1320	5	6
13655	Buri Ram	Thailand	14°25'N	103°00'E	1340	5	6
13657	Chachoengsao	Thailand	13°42'N	101°18'E	1680	5	6
13646	Chon Buri	Thailand	13°07'N	100°55'E	1260	6	6
13647	Rayong	Thailand	12°42'N	101°18'E	1540	4	6
13648	Chanthaburi	Thailand	12°42'N	101°59'E	2950	3	5
13654	Chanthaburi	Thailand	12°42'N	102°05'E	3030	3	5
13649	Chanthaburi	Thailand	12°27'N	102°15'E	2930	3	5
13653	Trat	Thailand	12°16'N	102°29'E	3060	3	5
13650	Trat	Thailand	12°07'N	102°33'E	3640	3	5
13652	Trat	Thailand	12°05'N	102°33'E	3740	3	5
13651	Trat	Thailand	11°57'N	102°47'E	4540	2	4
13086	Prachuap Khiri Khan	Thailand	11°42'N	99°43'E	1190	3	7
13087	Prachuap Khiri Khan	Thailand	11°06'N	99°22'E	2290	1	4
13140	Chumphon	Thailand	10°32'N	98°54'E	2800	1	3
13088	Chumphon	Thailand	10°30'N	99°13'E	2080	0	3
13139	Ranong	Thailand	10°22'N	98°47'E	3480	3	4
13138	Ranong	Thailand	10°10'N	98°43'E	4070	3	4
13089	Chumphon	Thailand	10°01'N	99°04'E	3400	3	4
13137	Ranong	Thailand	9°54'N	98°38'E	4330	4	4
13090	Surat Thani	Thailand	9°41'N	99°07'E	3260	3	3
3776	Surat Thani	Thailand	9°37'N	99°08'E	3070	3	3
13136	Ranong	Thailand	9°26'N	98°29'E	3720	3	4
13135	Phangnga	Thailand	9°14'N	98°27'E	3420	3	4
13091	Surat Thani	Thailand	9°09'N	98°08'E	1870	3	4
13306	Surat Thani	Thailand	9°00'N	99°23'E	1850	3	4
13134,13302	Phangnga	Thailand	8°58'N	98°25'E	3060	3	3
13133	Phangnga	Thailand	8°46'N	98°16'E	2640	3	3
13092	Nakhon Si Thammarat	Thailand	8°35'N	99°27'E	2200	2	3
13130	Phangnga	Thailand	8°25'N	98°28'E	2500	3	3
13132	Phangnga	Thailand	8°24'N	98°15'E	2550	3	3
13129	Phangnga	Thailand	8°21'N	98°43'E	2420	3	3
13093	Nakhon Si Thammarat	Thailand	8°21'N	99°36'E	2370	2	3
13371	Nakhon Si Thammarat	Thailand	8°21'N	100°12'E	2450	2	4
13094	Nakhon Si Thammarat	Thailand	8°10'N	99°45'E	2410	2	3
13095	Nakhon Si Thammarat	Thailand	8°09'N	99°54'E	2440	2	4
13131	Phuket	Thailand	8°04'N	98°20'E	2630	2	3
13128	Krabi	Thailand	8°03'N	99°02'E	2460	2	3
13096	Nakhon Si Thammarat	Thailand	7°52'N	100°01'E	2350	2	3
13126	Trang	Thailand	7°48'N	99°36'E	2400	2	3
13127	Krabi	Thailand	7°45'N	99°17'E	2420	1	3
3778	Songkhla	Thailand	7°32'N	100°26'E	2200	2	3
13125	Trang	Thailand	7°30'N	99°38'E	2370	1	3
13097	Phatthalung	Thailand	7°30'N	100°08'E	2250	2	3
13124	Trang	Thailand	7°17'N	99°41'E	2320	1	2
3780	Songkhla	Thailand	7°13'N	100°34'E	2150	3	3
13098	Phatthalung	Thailand	7°13'N	100°20'E	2157	2	3
13099,13307	Songkhla	Thailand	7°08'N	100°20'E	2150	2	3
13123	Trang	Thailand	7°06'N	99°47'E	2260	1	3
13121	Songkhla	Thailand	6°59'N	100°08'E	2150	1	3
13030	Songkhla	Thailand	6°59'N	100°29'E	2150	2	3
3781	Songkhla	Thailand	6°59'N	100°41'E	2160	2	3
3794	Songkhla	Thailand	6°53'N	100°59'E	2220	1	2
13122	Satun	Thailand	6°52'N	99°48'E	2220	1	3
3784	Pattani	Thailand	6°44'N	101°04'E	2270	1	2
13118	Narathiwat	Thailand	6°42'N	101°37'E	2620	0	3
13120	Yala	Thailand	6°41'N	101°08'E	2300	1	2
3793	Songkhla	Thailand	6°39'N	100°57'E	2240	1	2
13117	Narathiwat	Thailand	6°29'N	101°41'E	2650	0	3
23763	Narathiwat	Thailand	6°26'N	101°59'E	2680	0	3
13116	Narathiwat	Thailand	6°14'N	102°05'E	2860	0	1
23764	Narathiwat	Thailand	6°03'N	101°58'E	2810	0	1
3788	Narathiwat	Thailand	5°58'N	101°53'E	2760	0	1
13289	Kelantan	Malaysia	5°50'N	102°24'E	2850	0	0
13115	Terengganu	Malaysia	5°46'N	102°26'E	2830	0	0
13100	Kedah	Malaysia	5°43'N	100°31'E	2460	0	1
13114	Terengganu	Malaysia	5°25'N	103°04'E	2900	0	0
13102	Penang	Malaysia	5°21'N	100°32'E	2910	0	0
13101	Penang	Malaysia	5°16'N	100°17'E	2610	0	1
13305	Terengganu	Malaysia	5°02'N	103°18'E	2880	0	0
13103,13104	Perak	Malaysia	4°51'N	100°41'E	4020	0	0
13105	Perak	Malaysia	4°37'N	101°08'E	2540	0	0
23655	Aceh	Indonesia	4°33'N	97°55'E	1850	0	2
13112	Pahang	Malaysia	3°57'N	102°23"E	2300	0	0
13113	Pahang	Malaysia	3°45'N	103°11'E	3030	0	0
13106	Perak	Malaysia	3°41'N	101°31'E	3050	0	0
13111	Pahang	Malaysia	3°17'N	102°27'E	1920	0	1
13107	Selangor	Malaysia	2°54'N	101°52'E	2260	0	0
13108	Negeri Sembilan	Malaysia	2°35'N	102°06'E	2680	0	0
13110	Melaka	Malaysia	2°23'N	102°13'E	3000	0	0
13109	Melaka	Malaysia	2°17'N	102°13'E	2570	0	0
23666	North Sumatra	Indonesia	2°17'N	99°44'E	2050	0	2
23665	North Sumatra	Indonesia	2°02'N	99°55'E	2380	0	1
23664	North Sumatra	Indonesia	1°44'N	99°58'E	2590	0	1
23663	North Sumatra	Indonesia	1°32'N	99°45'E	2230	0	2
23656	North Sumatra	Indonesia	1°28'N	99°44'E	2200	0	2
23657	North Sumatra	Indonesia	1°28'N	99°47'E	2270	0	2
23658	North Sumatra	Indonesia	1°23'N	99°46'E	2290	0	2
23659	North Sumatra	Indonesia	1°12'N	99°46'E	2450	0	1
23661	Riau	Indonesia	1°05'N	100°17'E	3270	0	0
23660	North Sumatra	Indonesia	1°03'N	100°02'E	2970	0	0
23662	West Sumatra	Indonesia	0°09'N	100°45'E	2750	0	0
13645,23194	West Sumatra	Indonesia	0°39'S	100°30'E	2590	0	0
23195	Jambi	Indonesia	2°43'S	102°49'E	3140	0	0
23196	South Sumatra	Indonesia	3°37'S	103°13'E	2990	0	0
23197	South Sumatra	Indonesia	3°39'S	103°45'E	3190	0	0

The Philippines, Papua New Guinea, tropical China, and parts of Indonesia have been recently sampled by experienced tropical forage legume collectors i.e., the Indonesian islands of Flores, Lombok, Rote, Sumbawa, Sulawesi and Timor (Mehra 1985); Sulawesi (Reid and Ivory 1983); Philippines (dela Viña and Engle 1985); Papua New Guinea by B. Pengelly (Anon. 1985); and Hainan Island, China (Schultze-Kraft et al. 1984). No D. ovalifolium was found during these collections other than one by K.L. Mehra, KLM 309 (syn. CIAT 23762) from SE Sulawesi, Indonesia which is probably a hybrid with D. heterocarpon.

The collection sites of D. ovalifolium germplasm extend between latitudes 20°N in the extreme north of Thailand and almost 4°S in South Sumatra, Indonesia, and between longitudes 98°E in Aceh, Sumatra, Indonesia and almost 105°E in northeast Thailand (Figure 1 and Table 1). There is a concentration of collecting sites in southern Thailand between latitudes 6°N and 12°N. We believe that this does represent a real concentration of the species in that zone as systematic searches have also been made throughout other parts of Thailand (Pattanavibul and Schultze-Kraft, in press).

Mean total annual precipitation and the number of dry months (defined either as mean monthly rainfall <60 or <100 mm) differed among collection sites (Table 1). Total precipitation ranges from 1190-4540 mm/year with most accessions originating from the 2000-3000 mm-range (Table 1). The driest collection sites are in northern and northeastern Thailand with a rainfall of 1200-1800 mm/year and a dry season of 4-6 months (<60 mm) or 6-7 months (<100 mm). Collection sites are, however, only scattered in these drier regions. It is noteworthy that a dry season of 1-3 months with annual rainfall in the range of 2000-3000 mm/year is characteristic of southern Thailand, the zone of major concentration of collection sites. South of 6°N the collection sites are again quite scattered. The general rainfall range continues to be the same (2000-3000 mm/year) but there is no month with <60 mm rainfall. It is, however, interesting to note that the concentration of locations in North Sumatra, Indonesia coincides with a rainfall distribution characterized by 1-2 months with <100 mm precipitation. D. ovalifolium is, therefore, a species of high-rainfall regions which, however, requires some kind of dry-season stress.

Soils at the collection sites ranged from quartz sands to cracking paddy clays and were mostly acid (pH 4-6). The natural habitat is very similar to that of most other legumes collected in SE Asia; there seem to be no ecological niches specific to D. ovalifolium. It is usually found at the edges of gallery forests or gallery scrub; on fallow and waste-lands; in Imperata cylindrica grasslands; at the borders of paddy fields and plantations of rubber, coconut, and oil-palm; and spontaneously, that is, not planted, appearing inside young tree plantations. In many instances, D. ovalifolium was found growing under shady conditions. With a few exceptions from northern Thailand,the altitudinal range of collection sites was 5-200 m. Germplasm from northern Thailand originates from sites at 310-900 m.a.s.l. D. ovalifolium is, therefore, predominantly a lowland species.

PRELIMINARY EVALUATION

The objective of the preliminary evaluation was to characterise the available D. ovalifolium collection by a series of agronomic traits and so create a base for future selection and plant breeding.

Materials and methods

The preliminary evaluation trial was conducted at the CIAT experimental station at Santander de Quilichao, Cauca, Colombia. The site is located at latitude 3° 06'N and longitude 76° 31'W and is 990 m above sea level. The experimental plots are on a deep, well-drained Ultisol (orthoxic palehumult, clayey, kaolinitic, isohyperthermic). This soil is very acid (pH 4.1), has high Al saturation (89%), medium Mn content (47 ppm), low base status (0.45 meq of Ca, 0.12 meq of Mg, and 0.12 meq of K per 100 g of soil), medium available P (5 ppm Bray II), and high organic matter (6%). The mean annual rainfall is 1845 mm and occurs in a bi-modal pattern (March-June and September-December). The mean annual temperature is 24.8°C with a mean minimum of 18.3°C and a mean maximum of 29.5°C.

The accessions used were from CIAT's D. ovalifolium collection of which 84 accessions had seed available in September 1983. Ten accessions were materials received from other research institutions and commercial sources with no information on their origins (accessions CIAT 350, 3607, 3608, 3652, 3663, 3666, 3668, 3673, 3674, and 13400). Seventy-four accessions were field collections with known sites (Figure 1).

The trial was established in November 1983 by transplanting 6-week-old seedlings from jiffy pots to plots of space-planted, single rows. Eight plants per accession were transplanted. The experimental design consisted of randomised blocks with four replications. The distance between plants within a row was 0.5 m and between rows 2.0 m. The fertilizers applied were P, as triple superphosphate (20 kg of P per ha at planting), and N, as urea (25 kg of N per ha at three and six weeks after planting). Since there was no previous information on Rhizobium specificity of the collection, N fertilization was considered convenient in order to avoid plant performance being masked by such Rhizobium specificity effects.

The attributes measured were:

Cover rate -- the number of days from planting to ground cover. Because D. ovalifolium is horizontally growing, a plot was considered to be covered when at least four plants in the row (50% of the plot) had touched each other and started to overlap.

Days to flower -- the number of days from planting to first flower. An accession was considered to be flowering when at least two plants were blooming.

Dry matter (DM) yields. A standardisation cut was made in July 1984. The plots were cut with shears at about 3 cm above soil level and trimmed to 1 m in width and 4 m in length. Four harvests to determine DM herbage yields were then taken at 4½ monthly intervals, using the same methodology of the standardisation cut. Whereas the samples to determine vertical growth were taken within two 0.50 x 0.50 m frames, for the lateral growth all dry matter produced beyond the original 1-m plot width was measured. This methodology takes into account that D. ovalifolium grows horizontally when space-planted in single rows. Yields, expressed as kg/plot, are, therefore, composed of: both the tops dry matter produced as a result of lateral spread beyond the plot boundary and the tops regrowth from within the 4-m^2 plot. Fresh weight was determined in the field; two subsamples, weighing 200 g each, were taken for subsequent determination of DM percentage after 48 h oven-drying at 70°C, and for separation of leaves and stems.

Plant height and lateral growth. These were measured before each cut at five randomly chosen sites within each plot (plant height) and along each side (lateral growth). The proportion of lateral growth to plant height was used to describe the growth habit of the accessions.

Chemical analyses. Protein content in leaves and stems, and Ca, P, and tannin concentrations in leaves, were analysed in the 4½-month- old regrowth harvested from the first cut.

Relative palatability. The 10-month-old regrowth after the last cut was evaluated for palatability. The trial was fenced-off with an electric fence and divided into two paddocks, consisting of replications 1 and 2, and 3 and 4, respectively. Each paddock was commonly grazed by three young Zebu steers from 08:00 to 16:00 hours over a period of seven days, during which the animals had no access to other forage. The activity of the animals and the accessions they ate were recorded every 5 minutes. The palatability of the accessions was then expressed in the form of a palatability index. This index was the ratio of the number of times an accession was eaten to the number of times an accession could be expected to be eaten if all the accessions were of equal palatability.

The accessions were classified into individual frequency distribution groups by performing cluster analyses (Ward 1963).

Results

The results are presented as frequency distribution graphs, showing in Figure 2 the number of days to ground cover, number of days to first flower, growth habit, and total dry matter yield, and in Figure 3 the concentrations, in leaves, of crude protein, phosphorus, calcium, and tannins, and the palatability index. Whereas the accessions of the respective groups are listed in the Appendix, in Tables 2 and 3 the individual data are presented for each accession. These include the number of days to ground cover and until first flower, crude protein content of stems and leaves, concentrations, in leaves, of P, Ca, and tannins, and palatability index (Table 2). The DM yields at each of the four cuts, the respective total yield, and the measured lateral and vertical plant growth are given in Table 3. Table 4 correlates all 15 attributes.

Cover rate. The cover rate ranged between 69 and 114 days from transplanting to plot cover (Figure 2). Sixty-nine percent of the collection, that is, 58 accessions, including several representatives of the commercial cultivar, needed 69-86 days. The remaining 26 accessions took even longer.

Days to flower. This characteristic was very variable (Figure 2), ranging between 72 and 174 days to first flower. Four accessions did not come to flower and were classified as "very late". It is noteworthy that these "very late" accessions constitute a group of morphologically distinct ecotypes unique for their pronounced acuminate leaflet shape and their consistently trifoliolate leaves. Furthermore, they have often markedly reddish leaves, presumably, because of a high anthocyanin content. These four accessions most likely represent an intermediate form between *D. ovalifolium* and *D. heterocarpon*.

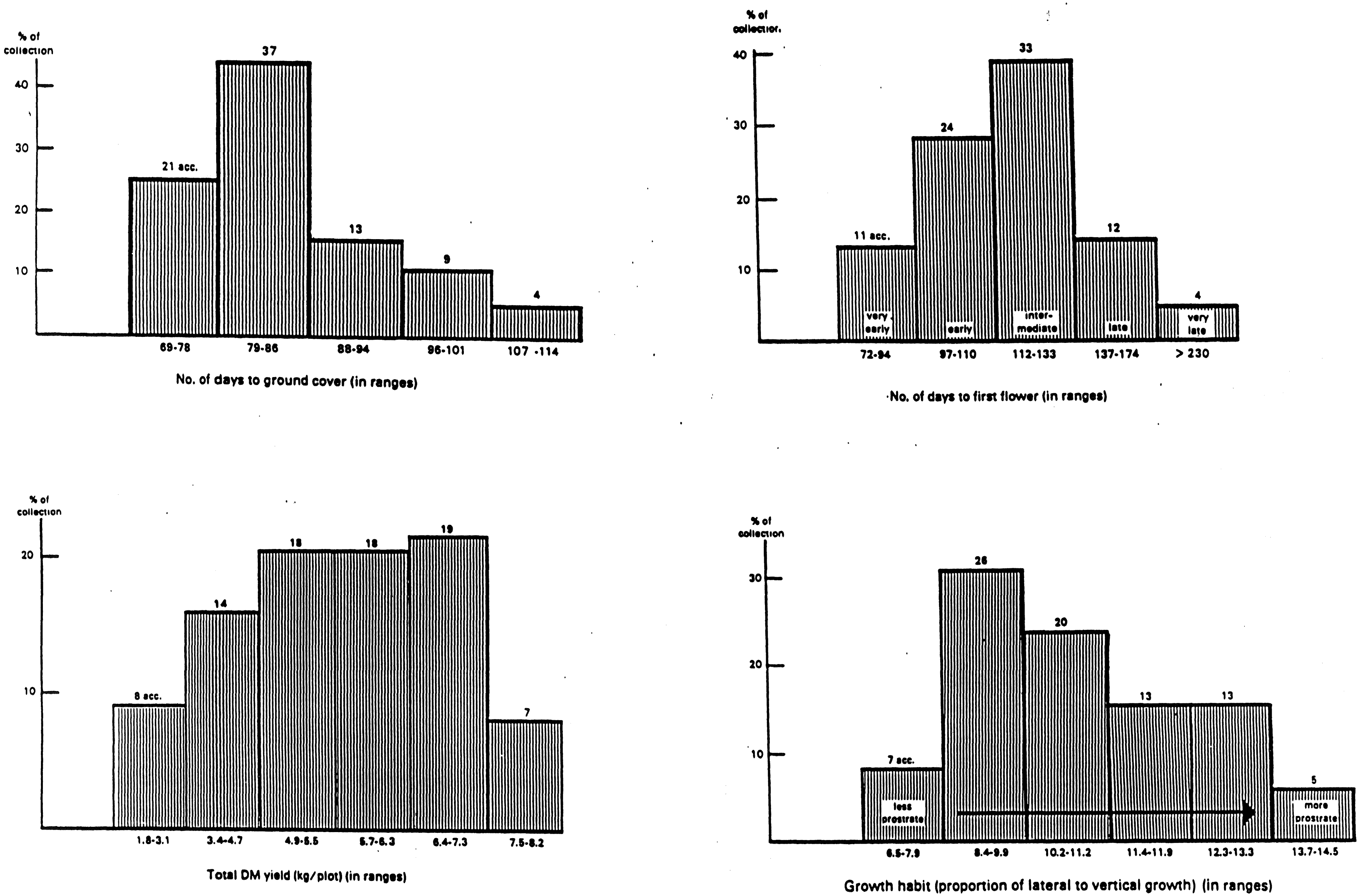

Figure 2. Frequency distribution of number of days to ground cover, number of days to first flower, total dry matter yield, and growth habit in a 84-accession collection of *Desmodium ovalifolium*, Quilichao, Colombia.

Table 2. Days to ground cover and to first flower, stem and leaf crude protein content, concentration of phosphorus, calcium, and tannins in leaves, and palatability index of 84 *Desmodium ovalifolium* accessions.

CIAT accession no.	No. of days to		Crude protein (% N x 6.25)		Percentage in leaves			Palatability[a] index
	Ground cover	First flower	Stems	Leaves	P	Ca	Tannins	
350	96	125	7.9	12.9	0.11	0.36	32.9	0.49
3607	94	115	9.3	14.7	0.11	0.40	31.0	1.27
3608	74	106	8.4	14.2	0.12	0.45	31.5	1.22
3652	90	88	7.5	13.5	0.12	0.42	31.0	1.35
3663	81	121	8.9	12.9	0.10	0.33	32.9	0.78
3666	86	76	10.3	16.3	0.13	0.39	23.0	1.06
3668	77	109	9.3	12.4	0.11	0.36	31.5	1.59
3673	111	73	10.1	16.3	0.14	0.41	33.6	0.65
3674	80	112	9.3	13.5	0.11	0.41	33.6	0.65
3776	86	114	7.7	13.1	0.11	0.33	35.6	0.86
3778	107	119	8.9	15.1	0.16	0.31	21.7	0.65
3780	114	147	9.4	13.6	0.14	0.27	25.7	1.27
3781	78	112	9.8	13.6	0.12	0.38	34.0	0.61
3784	81	79	9.3	15.3	0.13	0.34	25.1	0.45
3788	79	72	8.9	14.0	0.14	0.34	25.5	1.51
3793	88	100	9.6	13.8	0.13	0.37	32.0	0.41
3794	78	101	8.4	13.5	0.11	0.37	34.1	0.61
13030	101	127	9.1	13.8	0.10	0.27	31.1	0.90
13081	82	174	10.0	14.5	0.11	0.36	33.6	0.53
13082	84	126	8.8	15.1	0.13	0.39	30.8	1.31
13083	84	151	10.7	15.9	0.13	0.32	33.0	1.88
13085	110	130	10.5	17.1	0.15	0.36	28.8	1.14
13086	83	125	10.0	14.7	0.11	0.39	31.1	1.84
13087	76	97	9.1	13.6	0.10	0.33	34.8	0.45
13088	86	115	8.3	13.3	0.11	0.33	34.2	1.27
13089	85	116	8.6	13.6	0.11	0.33	30.6	1.06
13090	80	131	6.3	12.6	0.10	0.31	32.5	1.06
13091	96	136	8.8	13.6	0.12	0.31	32.6	0.57
13092	80	99	8.1	12.6	0.12	0.34	32.2	1.14
13093	93	156	9.3	13.5	0.13	0.37	32.8	1.02
13094	89	141	8.3	12.9	0.11	0.33	32.5	1.39
13095	79	99	8.1	13.6	0.11	0.33	34.5	0.82
13096	81	126	7.5	13.3	0.11	0.43	32.7	0.65
13097	77	109	9.1	13.6	0.13	0.37	29.4	1.56
13098	83	120	8.3	12.3	0.11	0.30	31.9	1.15
13099	83	117	9.8	14.2	0.13	0.45	33.9	0.73
13100	77	129	10.3	13.6	0.11	0.37	32.0	1.19
13101	92	149	10.3	14.7	0.12	0.37	32.1	0.98
13102	76	102	7.0	13.8	0.11	0.44	34.5	0.74
13103	77	139	8.6	15.8	0.11	0.38	34.1	1.02
13104	84	108	6.5	12.4	0.11	0.34	31.8	0.86
13105	92	140	8.4	12.9	0.11	0.43	29.4	1.92
13106	89	138	10.0	14.2	0.12	0.36	33.7	0.73
13107	74	110	8.9	12.3	0.10	0.36	33.1	1.06
13108	80	90	8.1	14.9	0.12	0.32	33.0	0.69
13109	82	104	7.5	12.0	0.11	0.36	26.4	1.55
13110	78	93	11.6	15.9	0.14	0.57	21.1	1.35
13111	83	115	9.3	12.8	0.11	0.44	27.4	0.98
13112	69	n.f.[b]	7.7	14.9	0.14	0.38	29.9	0.78
13113	76	99	6.5	14.5	0.12	0.36	29.3	1.88
13114	81	97	7.9	14.2	0.12	0.30	35.0	0.78
13115	76	90	8.8	14.0	0.11	0.45	32.1	1.10
13116	80	107	7.7	14.9	0.13	0.38	31.4	0.69
13117	81	82	8.6	13.1	0.12	0.38	31.9	0.78
13118	76	120	8.8	13.3	0.11	0.28	36.1	0.61
13120	82	112	8.9	13.6	0.12	0.37	31.6	0.82
13121	74	97	9.6	13.5	0.13	0.37	39.9	1.02
13122	76	102	9.3	13.1	0.14	0.40	26.5	0.82
13123	80	130	9.3	14.5	0.13	0.37	30.7	0.49
13124	81	98	8.9	13.6	0.13	0.40	34.9	0.78
13125	74	115	7.5	13.6	0.11	0.35	32.5	1.27
13126	78	105	8.1	12.8	0.12	0.32	43.0	0.74
13127	80	145	8.6	14.0	0.12	0.32	35.2	0.94
13128	82	111	8.3	13.3	0.11	0.38	30.0	1.27
13129	75	110	11.8	13.5	0.12	0.27	40.2	0.37
13130	81	139	10.5	16.3	0.12	0.41	30.6	1.10
13131	81	133	11.6	16.3	0.11	0.34	38.2	1.10
13132	90	118	11.9	15.6	0.12	0.38	40.7	1.10
13133	92	129	11.2	15.9	0.12	0.39	36.0	0.69
13134	94	n.f.	7.7	16.4	0.12	0.40	30.6	0.53
13135	80	128	10.9	15.3	0.10	0.29	37.3	1.35
13136	88	117	10.7	16.3	0.12	0.33	34.1	0.74
13137	79	105	11.6	18.0	0.12	0.36	35.6	0.32
13138	96	n.f.	11.8	15.3	0.13	0.43	36.5	0.28
13139	84	104	12.4	16.6	0.12	0.38	37.5	1.02
13140	85	n.f.	11.0	15.8	0.13	0.46	39.5	0.08
13289	99	108	14.4	19.6	0.13	0.45	25.4	1.84
13302	79	115	11.2	17.0	0.11	0.40	42.2	0.78
13305	97	111	14.7	19.3	0.13	0.48	29.5	2.37
13306	98	83	10.3	14.5	0.12	0.47	29.7	0.98
13307	75	75	10.3	15.9	0.12	0.38	30.0	1.02
13370	99	118	10.1	17.5	0.12	0.42	26.8	0.90
13371	93	110	11.4	16.6	0.13	0.47	28.0	1.72
13400	95	124	10.9	16.4	0.12	0.33	32.3	1.10

a/ Palatability index = $\frac{\text{No. of times observed eating}}{\text{No. of times expected eating}}$

b/ n.f. = Plants did not flower during the experimental period.

Table 3. Dry matter yields, lateral growth and plant height (vertical growth) of 84 *Desmodium ovalifolium* accessions.

CIAT accession no.	Dry matter yields (kg/plot) Cut 1	Cut 2	Cut 3	Cut 4	Total 1-4	Mean plant growth (cm) Lateral	Vertical
350	1.60	1.31	1.48	1.14	5.53	77.2	7.2
3607	2.41	1.80	1.00	1.21	6.42	82.6	9.8
3608	2.16	1.58	1.01	1.14	5.89	78.8	8.3
3652	1.67	1.57	1.47	1.11	5.82	77.7	8.8
3663	1.87	1.58	1.30	1.38	6.13	81.6	7.8
3666	1.11	1.15	0.82	1.23	4.31	66.4	5.7
3668	2.05	1.47	1.02	1.27	5.81	82.0	7.0
3673	1.19	1.05	0.93	1.30	4.47	71.9	5.6
3674	1.77	1.35	1.29	0.95	5.36	76.5	8.7
3776	1.90	1.73	1.25	1.08	5.96	79.4	7.4
3778	0.81	0.61	0	0.71	2.13	65.1	4.5
3780	0.80	0.40	0	0.63	1.83	54.3	4.2
3781	2.01	1.90	0.74	0.70	5.35	82.5	6.5
3784	1.17	0.86	0.66	0.89	3.58	66.3	5.6
3788	0.97	0.87	0.70	1.19	3.73	68.7	4.9
3793	0.82	0.54	0	0.73	2.09	68.1	4.8
3794	2.09	1.57	1.13	1.11	5.90	81.3	6.2
13030	2.00	2.12	1.95	1.64	7.71	92.5	7.0
13081	1.98	1.36	1.78	1.68	6.80	82.5	7.4
13082	2.23	2.04	2.01	1.55	7.83	91.3	8.2
13083	1.45	1.77	1.71	1.56	6.49	87.5	7.3
13085	1.36	1.19	0.67	1.08	4.30	68.9	5.0
13086	1.65	1.62	1.63	1.10	6.00	85.8	7.5
13087	2.13	1.74	1.79	1.15	6.81	81.9	8.7
13088	1.78	1.85	1.51	1.25	6.39	81.2	7.5
13089	2.12	2.00	1.10	1.38	6.60	79.0	8.2
13090	2.05	1.79	1.50	1.36	6.70	77.0	7.8
13091	1.07	1.04	0	0.61	2.72	65.0	4.7
13092	1.86	1.09	1.31	1.12	5.38	76.9	9.7
13093	1.09	1.27	0.72	0.91	3.99	66.7	6.3
13094	1.34	1.56	1.25	1.13	5.28	77.8	7.5
13095	1.96	1.78	1.32	1.31	6.37	80.1	7.3
13096	1.79	1.32	1.12	1.10	5.33	76.8	10.7
13097	2.27	2.33	2.08	1.36	8.04	86.6	10.0
13098	1.43	1.35	1.20	1.19	5.17	78.1	7.0
13099	1.98	1.71	1.08	1.38	6.15	76.0	5.9
13100	1.89	1.53	1.00	1.29	5.71	81.9	7.1
13101	2.01	1.36	0.96	0.97	5.30	80.9	6.6
13102	1.26	1.23	1.09	1.03	4.61	79.4	8.5
13103	1.58	1.87	1.60	1.45	6.50	80.7	6.9
13104	1.61	1.45	1.30	1.14	5.50	78.1	7.4
13105	2.20	2.34	2.09	1.61	8.24	91.5	14.0
13106	1.84	1.83	1.33	1.42	6.42	82.3	7.2
13107	1.95	1.88	1.41	1.31	6.55	87.0	10.3
13108	1.13	1.13	0.55	0.76	3.57	72.1	6.7
13109	1.54	1.26	0.69	1.12	4.61	74.8	6.3
13110	1.36	1.07	0.87	0.78	4.08	75.6	6.0
13111	1.54	1.38	1.27	1.15	5.34	79.7	9.4
13112	1.48	0.81	0.24	0.31	2.84	66.9	5.9
13113	2.23	1.36	1.34	0.87	5.80	81.8	11.0
13114	1.69	1.63	1.24	0.84	5.40	76.3	7.0
13115	2.24	1.78	1.92	1.56	7.50	83.7	9.2
13116	1.72	1.82	1.51	1.17	6.22	84.2	8.3
13117	1.47	1.14	0.91	1.17	4.69	72.9	5.9
13118	1.80	1.74	1.47	1.23	6.24	81.8	7.6
13120	1.76	1.63	1.33	1.09	5.81	81.0	7.1
13121	2.05	1.91	1.53	1.05	6.54	83.9	8.6
13122	1.09	0.85	0.90	1.02	3.86	71.4	6.6
13123	1.65	1.47	1.29	0.99	5.40	69.8	9.1
13124	1.50	1.30	1.19	1.00	4.99	77.4	7.3
13125	2.62	2.15	1.69	1.56	8.02	88.7	11.4
13126	1.67	1.59	1.33	1.22	5.81	80.2	8.4
13127	1.80	2.01	1.85	1.44	7.10	78.2	11.6
13128	2.01	2.02	1.85	1.28	7.16	86.2	8.7
13129	1.37	1.39	0.95	1.23	4.94	70.4	7.2
13130	2.20	1.81	1.56	1.04	6.61	81.7	8.7
13131	2.08	1.57	1.59	1.34	6.58	82.7	8.8
13132	1.73	1.89	1.77	1.22	6.61	84.1	9.4
13133	1.92	1.82	1.47	1.08	6.29	82.5	7.7
13134	1.15	0.85	0.64	0.31	2.95	78.7	6.2
13135	1.68	1.51	1.51	1.12	5.82	83.4	9.1
13136	1.78	1.39	0.93	1.06	5.16	75.2	8.1
13137	1.24	1.27	0.86	1.02	4.39	77.8	6.7
13138	1.01	0.88	0.32	0.86	3.07	68.7	5.5
13139	2.07	1.96	1.38	1.09	6.50	88.2	9.5
13140	1.39	0.42	0	0.18	1.99	58.0	6.0
13289	1.56	1.71	1.41	1.36	6.04	82.7	8.6
13302	1.99	2.05	1.79	1.43	7.26	85.9	9.7
13305	1.44	1.20	1.26	1.40	5.30	71.9	5.8
13306	1.62	1.71	0.69	0.90	4.92	76.8	6.1
13307	1.42	1.07	0.48	0.48	3.45	66.2	5.6
13370	2.16	1.39	1.14	0.70	5.39	82.6	7.6
13371	1.84	1.26	1.32	1.39	5.81	79.1	7.2
13400	2.03	2.28	1.83	1.64	7.78	87.4	9.0
LSD (0.01)	0.74	0.68	0.85	0.58	2.11	9.9	1.5

Table 4. Correlation coefficients for variables measured during preliminary evaluation of a 84-accession collection of <u>Desmodium ovalifolium</u>, Quilichao, Colombia.

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. DM yield Cut 1	1.00														
2. DM yield Cut 2	0.78**	1.00													
3. DM yield Cut 3	0.70**	0.83**	1.00												
4. DM yield Cut 4	0.50**	0.69**	0.77**	1.00											
5. Total DM yield	0.85**	0.94**	0.94**	0.81**	1.00										
6. Lateral growth	0.74**	0.84**	0.84**	0.65**	0.87**	1.00									
7. Plant height	0.69**	0.67**	0.72**	0.47**	0.73**	0.65**	1.00								
8. No. of days to ground cover	-0.33**	-0.23*	-0.26*	-0.08	-0.26*	-0.25*	-0.34**	1.00							
9. No. of days to first flower	-0.18	-0.30**	-0.29**	-0.42**	-0.32**	-0.22**	-0.14	0.10	1.00						
10. % of CP in leaves	-0.05	-0.003	0.05	0.05	0.01	0.07	-0.08	0.41**	-0.07	1.00					
11. % of CP in stems	-0.11	-0.04	-0.04	0.06	0.04	-0.03	-0.15	0.29**	0.04	0.64**	1.00				
12. % of P in leaves	-0.49**	-0.43**	-0.43**	-0.28**	-0.47**	-0.50**	-0.41**	0.23*	0.05	0.04	0.31**	1.00			
13. % of Ca in leaves	0.05	-0.09	-0.04	-0.11	-0.05	-0.003	-0.05	0.02	0.10	0.34**	0.32**	0.09	1.00		
14. % of tannins in leaves	0.27*	0.32**	0.27*	0.12	0.29**	0.26*	0.28**	-0.31**	0.16	-0.12	0.06	-0.24*	-0.25*	1.00	
15. Palatability index	0.21*	0.27*	0.34**	0.39**	0.33**	0.33*	0.25*	0.13	-0.28**	0.20	0.14	-0.05	0.18	-0.37**	1.00

* P <0.05; ** P <0.01

Total DM yield. This attribute was highly variable. The extremes were 1.8 and 8.2 kg/plot harvested during the 76-week experimental period (Figure 2). The highest yielding group was composed of the accessions CIAT 13030, 13082, 13097, 13105, 13115, 13125, and 13400. There was a negative, although not high, correlation between total DM yield and the number of days to first flower (r = -0.32**). For example, all of the four "very late" flowering accessions fell into the lowest DM yield group. Yields of the individual cuts followed a variation pattern similar to that of total DM yield (Table 3). The DM yields of all individual cuts were positively correlated with each other, with correlation coefficients ranging from r = 0.50** to r = 0.94** (Table 4). As expected, there was also a high positive correlation between yield and lateral plant growth, and yield and vertical growth (Table 4). All accessions proved to be well adapted to the acid soil of the experimental site; none showed nutrient deficiency nor toxicity symptoms. No diseases or insect pests were detected.

Growth habit. Under the experimental conditions, the collection exhibited considerably more lateral than vertical growth. Although the proportion of lateral to vertical growth ranged from 6.5 - 14.5, all accessions had a pronounced prostrate growth habit (Figure 2, Table 3).

Crude protein. The CP concentration in leaves ranged from 12.0-19.6%, with almost 40% of the collection falling into the 13.1-14.1% group (Figure 3, Table 2). The accessions in the two highest CP groups were CIAT 13085, 13137, 13302, 13370, 13289, and 13305. No association was confirmed between CP content and palatability index (Table 4). However, the two accessions with the highest leaf CP values (CIAT 13289 and 13305 with 19.3% and 19.6%, respectively), also had very high palatability indices (ranking third and first, respectively). There is a positive correlation between leaf CP and stem CP (r = 0.64**) (Table 4).

P and Ca concentrations in leaves. Concentrations of P ranged from 0.10-0.16%, and of Ca from 0.27-0.57% (Figure 3, Table 2). The negative correlation between the percentage of P and all yield components (Table 4) reflects a dilution effect.

Tannin concentration in leaves. This attribute showed a continuous variation between 21.1% and 43.0% (Figure 3, Table 2). The group with the lowest values comprised accessions CIAT 3666, 3778 and 13110, two of which (CIAT 3666 and 13110) are amongst the earliest flowering accessions. However, there was no significant correlation between these attributes (Table 4).

Palatability index. The variation of this attribute was very wide -- the extremes were 0.10 and 2.37 (Figure 2, Table 2). The most palatable accession was CIAT 13305, followed by a group that comprised CIAT 3668, 13083, 13086, 13105, 13113, 13289, and 13371. As the correlation coefficients show, early flowering accessions were somewhat more palatable (r = -0.28**) as were the accessions with low tannin content (r = -0.37**) (Table 4).

DISCUSSION AND CONCLUSIONS

Further collecting in SE Asia is needed to continue broadening the germplasm base of this important forage legume. Collection should concentrate on countries so far unsampled such as Burma, Kampuchea, Laos, and Vietnam. Because of taxonomic problems, there is no botanical information on the geographic distribution of *D. ovalifolium*. As a result, no areas of any particular population frequency and diversification can be identified for

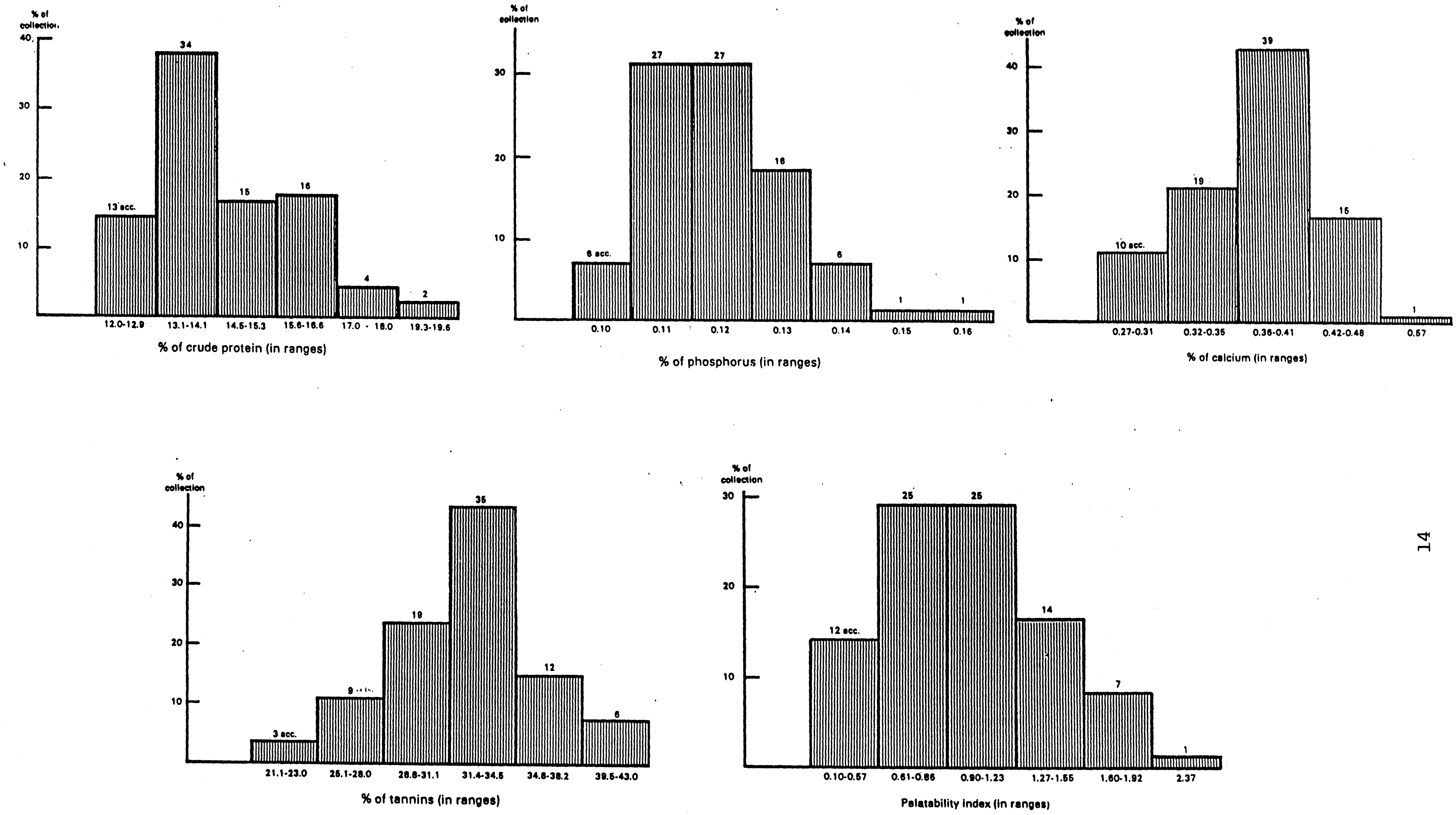

Figure 3. Frequency distribution of crude protein, phosphorus, calcium, and tannin concentration in leaves, and palatability index in a 84-accession collection of Desmodium ovalifolium, Quilichao, Colombia.

geographically focused collection activities. Future collection efforts in the region must, therefore, be broadly based.

All characters measured in the preliminary evaluation trial were moderately to highly variable. Consequently, there seems to be considerable scope for selection for further evaluation and eventual cultivar development or breeding. Examples of accessions of special value are: the very early flowering accessions which may be useful for regions with short growing seasons; and accessions with high nutritive quality (high palatability and CP content) such as CIAT 13289 and 13305.

In this experiment no evaluations on resistance to pests and diseases, particularly stem-gall nematode and Synchytrium, were performed because these problems do not exist in the Quilichao region. However, at the Carimagua research station in the Colombian Llanos Orientales, considerable intraspecific variation with respect to stem gall nematode was observed (CIAT 1985).

Two other important characteristics namely, seed-production potential and drought tolerance, were not evaluated in this experiment because of the peculiar rainfall pattern in the Quilichao region. The rainfall distribution is bi-modal and the wet and dry seasons are frequently interrupted by short dry and wet spells, respectively. The formation of seeds was, therefore, very irregular, and the dry seasons were not long enough to allow the clear expression of drought-stress symptoms.

Another character which the whole D. ovalifolium collection warrants to be screened for, is tolerance to shade. If this trait is as variable as the other characteristics observed in this preliminary evaluation trial, it might well be possible to identify accessions which are more shade-tolerant than the commercial cover-crop variety.

The P and Ca concentrations (0.10-0.16% and 0.27-0.57%, respectively) are low when compared to other tropical legumes. For example, a 130-accession collection of Centrosema brasilianum contained 0.13-0.26% of P and 0.37-1.17% of Ca in 5½-month-old tissue of whole plants (Schultze-Kraft and Belalcázar 1988). Whereas the Ca concentrations in D. ovalifolium meet animal requirements, the P concentrations are marginal (NRC 1976). However, the range of CP content in leaves (12.0-19.6%) is the same as that of C. brasilianum (Schultze-Kraft and Belalcázar 1988).

The preliminary evaluation trial did not show any relationship between the environmental conditions of the original collection sites and germplasm performance. For example, the accessions from the low rainfall areas in northeastern Thailand (1200-1800 mm/year, 5-6 dry months) were distributed across the "early" to "late" flowering groups; none of them grouped under "very early" flowering as one might have expected.

For further regional testing of D. ovalifolium we suggest to use a core collection which includes: a series of accessions that represent the wide natural distribution of the species; and accessions that, on the basis of the preliminary data reported here, are particularly promising in such important plant characters as days to flower (representatives of the principal groups), DM yields, CP content, and palatability. Such a core collection would comprise the following accessions: CIAT 350 (control), 3778, 13085, 13089, 13105, 13110, 13112, 13115, 13125, 13138, 13289, 13305, 13307, 13370, 13371, 13400, 13645, 13647, 13651, 13656, 13657, 23197, 23618, 23655, 23656, 33058, 33059 and 33060. This list will have to be modified once the remaining 53 accessions of the *D. ovalifolium* world collection have been subjected to a preliminary evaluation similar to the one described here.

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APPENDIX

A. *D. ovalifolium* accessions in cover-rate groups (no. of days to ground cover):

69 - 78	3608, 3668, 3781, 3794, 13087, 13097, 13100, 13102, 13103, 13107, 13110, 13112, 13113, 13115, 13118, 13121, 13122, 13125, 13126, 13129, 13307
79 - 86	3663, 3666, 3674, 3776, 3784, 3788, 13081, 13082, 13083, 13086, 13088, 13089, 13090, 13092, 13095, 13096, 13098, 13099, 13104, 13108, 13109, 13111, 13114, 13116, 13117, 13120, 13123, 13124, 13127, 13128, 13130, 13131, 13135, 13137, 13139, 13140, 13302
88 - 94	3607, 3652, 3793, 13093, 13094, 13101, 13105, 13106, 13132, 13133, 13134, 13136, 13371
96 - 101	350, 13030, 13091, 13138, 13289, 13305, 13306, 13370, 13400
107 - 114	3673, 3778, 3780, 13085

B. *D. ovalifolium* accessions in days to flower groups (no. of days to first flower):

72 - 94	3652, 3666, 3673, 3784, 3788, 13108, 13110, 13115, 13117, 13306, 13307
97 - 110	3608, 3668, 3793, 3794, 13087, 13092, 13095, 13097, 13102, 13104, 13107, 13109, 13113, 13114, 13116, 13121, 13122, 13124, 13126, 13129, 13137, 13139, 13289, 13371
112 - 133	350, 3607, 3663, 3674, 3776, 3778, 3781, 13030, 13082, 13085, 13086, 13088, 13089, 13090, 13096, 13098, 13099, 13100, 13111, 13118, 13120, 13123, 13125, 13128, 13131, 13132, 13133, 13135, 13136, 13302, 13305, 13370, 13400
137 - 174	3780, 13081, 13083, 13091, 13093, 13094, 13101, 13103, 13105, 13106, 13127, 13130
> 230	13112, 13134, 13138, 13140

C. *D. ovalifolium* accessions in total DM yield groups (kg/plot):

1.8 - 3.1	3778, 3780, 3793, 13091, 13112, 13134, 13138, 13140
3.4 - 4.7	3666, 3673, 3784, 3788, 13085, 13093, 13102, 13108, 13109, 13110, 13117, 13122, 13137, 13307
4.9 - 5.5	350, 3674, 3781, 13092, 13094, 13096, 13098, 13101, 13104, 13111, 13114, 13123, 13124, 13129, 13136, 13305, 13306, 13370
5.7 - 6.3	3608, 3652, 3663, 3668, 3776, 3794, 13086, 13099, 13100, 13113, 13116, 13118, 13120, 13126, 13133, 13135, 13289, 13371
6.4 - 7.3	3607, 13081, 13083, 13087, 13088, 13089, 13090, 13095, 13103, 13106, 13107, 13121, 13127, 13128, 13130, 13131, 13132, 13139, 13302
7.5 - 8.2	13030, 13082, 13097, 13105, 13115, 13125, 13400

D. D. ovalifolium accessions in growth habit groups (proportion of lateral to vertical growth):

6.5 - 7.9	13092, 13096, 13105, 13113, 13123, 13125, 13127
8.4 - 9.9	3607, 3608, 3652, 3674, 13087, 13089, 13090, 13097, 13102, 13107, 13111, 13115, 13121, 13126, 13128, 13129, 13130, 13131, 13132, 13135, 13136, 13139, 13140, 13289, 13302, 13400
10.2 - 11.2	350, 3663, 3776, 13081, 13082, 13088, 13093, 13094, 13095, 13098, 13104, 13108, 13114, 13116, 13118, 13122, 13124, 13133, 13370, 13371
11.4 - 11.9	3666, 3668, 3784, 13083, 13086, 13100, 13103, 13106, 13109, 13112, 13120, 13137, 13307
12.3 - 13.3	3673, 3780, 3781, 3794, 13030, 13099, 13101, 13110, 13117, 13134, 13138, 13305, 13306
13.7 - 14.5	3778, 3788, 3793, 13085, 13091

E. D. ovalifolium accessions in % of crude protein groups:

12.0 - 12.9	350, 3663, 3668, 13090, 13092, 13094, 13098, 13104, 13105, 13107, 13109, 1311, 13126
13.1 - 14.1	3608, 3652, 3674, 3776, 3780, 3781, 3788, 3793, 3794, 13030, 13087, 13088, 13089, 13091, 13093, 13095, 13096, 13097, 13099, 13100, 13102, 13106, 13114, 13115, 13117, 13118, 13120, 13121, 13122, 13124, 13125, 13127, 13128, 13129
14.5 - 15.3	3607, 3778, 3784, 13081, 13082, 13086, 13101, 13108, 13112, 13113, 13116, 13123, 13135, 13138, 13306
15.6 - 16.6	3666, 3673, 13083, 13103, 13110, 13130, 13131, 13132, 13133, 13134, 13136, 13139, 13140, 13307, 13371, 13400
17.0 - 18.0	13085, 13137, 13302, 13370
19.3 - 19.6	13289, 13305

F. D. ovalifolium accessions in % of P groups:

0.10	3663, 13030, 13087, 13090, 13107, 13135
0.11	350, 3607, 3668, 3674, 3776, 3794, 13081, 13086, 13088, 13089, 13094, 13095, 13096, 13098, 13100, 13102, 13103, 13104, 13105, 13109, 13111, 13115, 13118, 13125, 13128, 13131, 13302
0.12	3608, 3652, 3781, 13091, 13092, 13101, 13106, 13108, 13113, 13114, 13117, 13120, 13126, 13127, 13129, 13130, 13132, 13133, 13134, 13136, 13137, 13138, 13139, 13306, 13307, 13370, 13400
0.13	3666, 3784, 3793, 13082, 13083, 13093, 13097, 13099, 13116, 13121, 13123, 13124, 13140, 13289, 13305, 13371
0.14	3673, 3780, 3788, 13110, 13112, 13122
0.15	13085
0.16	3778

G. D. ovalifolium accessions in % of Ca groups:

0.27 - 0.31	3778, 3780, 13030, 13090, 13091, 13098, 13114, 13118, 13129, 13135
0.32 - 0.35	3663, 3776, 3784, 3788, 13083, 13087, 13088, 13089,

	13092, 13094, 13095, 13104, 13108, 13125, 13126, 13127, 13131, 13136, 13400
0.36 - 0.41	350, 3607, 3666, 3668, 3673, 3674, 3781, 3793, 3794, 13081, 13082, 13085, 13086, 13093, 13097, 13100, 13101, 13103, 13106, 13107, 13109, 13112, 13113, 13116, 13117, 13120, 13121, 13122, 13123, 13124, 13128, 13130, 13132, 13133, 13134, 13137, 13139, 13302, 13307
0.42 - 0.48	3608, 3652, 13096, 13099, 13102, 13105, 13111, 13115, 13138, 13140, 13289, 13305, 13306, 13370, 13371
0.57	13110

H. *D. ovalifolium* accessions in % of tannins groups:

21.1 - 23.0	3666, 3778, 13110
25.1 - 28.0	3780, 3784, 3788, 13109, 13111, 13122, 13289, 13370, 13371
28.8 - 31.1	3607, 3652, 3673, 13030, 13082, 13085, 13086, 13089, 13097, 13105, 13112, 13113, 13123, 13128, 13130, 13134, 13305, 13306, 13307
31.4 - 34.5	350, 3608, 3663, 3668, 3674, 3781, 3793, 3794, 13081, 13083, 13088, 13090, 13091, 13092, 13093, 13094, 13095, 13096, 13098, 13099, 13100, 13101, 13102, 13103, 13104, 13106, 13107, 13108, 13115, 13116, 13117, 13120, 13125, 13136, 13400
34.8 - 38.2	3776, 13087, 13114, 13118, 13124, 13127, 13131, 13133, 13135, 13137, 13138, 13139
39.5 - 43.0	13121, 13126, 13129, 13132, 13140, 13302

I. *D. ovalifolium* accessions in palatability index groups:

0.10 - 0.57	350, 3784, 3793, 13081, 13087, 13091, 13123, 13129, 13134, 13137, 13138, 13140
0.61 - 0.86	3663, 3674, 3776, 3778, 3781, 3794, 13095, 13096, 13099, 13102, 13104, 13106, 13108, 13112, 13114, 13116, 13117, 13118, 13120, 13122, 13124, 13126, 13133, 13136, 13302
0.90 - 1.23	3608, 3666, 13030, 13085, 13089, 13090, 13092, 13093, 13098, 13100, 13101, 13103, 13107, 13111, 13115, 13121, 13127, 13130, 13131, 13132, 13139, 13306, 13307, 13370, 13400
1.27 - 1.55	3607, 3652, 3673, 3780, 3788, 13082, 13088, 13094, 13097, 13109, 13110, 13125, 13128, 13135
1.60 - 1.92	3668, 13083, 13086, 13105, 13113, 13289, 13371
2.37	13305