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the other hand in the *A gayanus/D ovalifolium* plots a slight legume dominance occurred under a heavy grazing pressure (Figure 7)

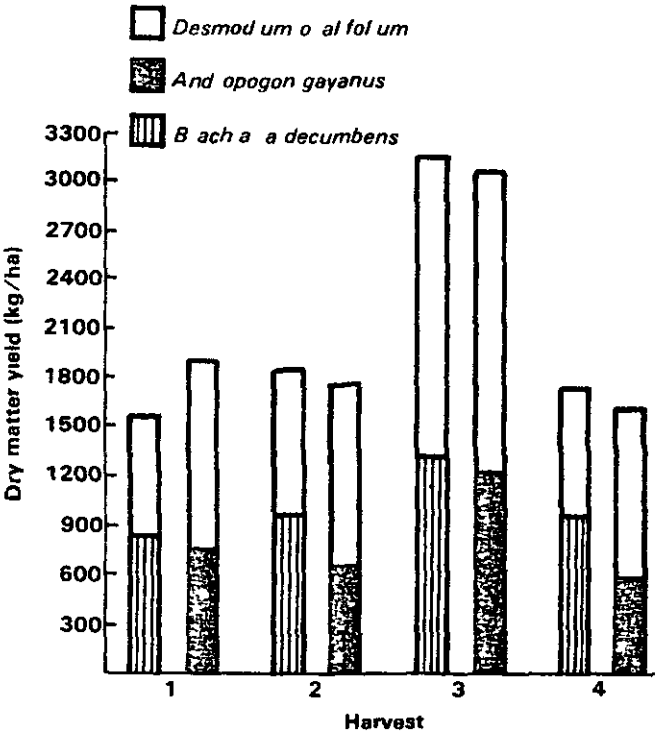
D ovalifolium 350 is apparently a moderately palatable species well accepted by grazing animals during the dry season The aim of a current selection program is to identify genotypes with better palatability voluntary intake and digestibility within the *D ovalifolium/heterocarpon* complex

Zornia sp

Many of the *Zornia* accessions in CIAT s collection are affected by a fungal disease caused by *Sphaceloma zorniae* Although plants have in some cases recovered from severe attacks of this fungus disease resistance is a major selection objective of a recently established screening project Disease resistance seems to be more frequent in Brazilian *Zornia* species

Work with this species includes grazing trials and mixtures with *A gayanus* of 10 ecotypes

Emphasis in future work will be on the systematic evaluation of all available introductions in order to select for better dry season performance and resistance to *Sphaceloma* scab



F gure 7 P esentat on y elds of *Desmod um o al folium* n associat on w th *And opogon gayanus* CIAT 621 and *Brachiaria decumbens* cv Bas lisk established n 1977 n the Llanos Orientales, Colomb a (Monthly harvests du ing the wet season 1979)

FORAGE AGRONOMY IN THE THERMIC SAVANNAS (CERRADO)

The objectives of this section are to (1) evaluate and select germplasm under Cerrado conditions for adaptation to acid soils persistence under grazing and resistance or tolerance to pests and diseases (2) evaluate the potential of the Cerrado for commercial seed production and (3) produce seed of selected germplasm to supply the evaluation programs at the Cerrado Center (Centro de Pesquisa Agropecuaria dos Cerrados CPAC)

Pasture Evaluation

Preliminary germplasm evaluation

In November 1978 352 legume introductions were planted in the two major soil types of the region i e red yellow latosol (Latosolo Vermelho Amarelo LVA) and dark red latosol (Latosolo Vermelho Escuro LVE) Some physical and chemical characteristics typical of these soils are found in Table 7 The LVA site was 100 m higher than that on the LVE on a more exposed plateau area On the LVE one replicate was sown with *Andropogon gayanus* for grazing to indicate whether any accessions were rejected by the animals Genera and number of accessions evaluated are listed in Table 8 Species of *Stylosanthes* accounted for almost 50 percent of the introductions and a total of 159 introductions originated in Brazil Emphasis has been placed on the genus *Stylosanthes* because previous experience has demonstrated its good adaptation to the acid infertile soils of the target area

Dry matter production of most accessions growing on the LVE was higher than that on the LVA.

Table 7 Physical and chemical characteristics of the profile of the Dark Red Latosol (LVE) and the Red Yellow Latosol (LVA) at the Cerrado Center

Soil	Depth (cm)	Texture	pH in water	Exchangeable cations Al (meq/100 g)	Ca+Mg (meq/100 g)	K (meq/100 g)	Al sat (%)
LVE	0 10	Clayey	4 9	1 9	0 4	0 10	79
	10 35	Clayey	4 8	2 0	0 2	0 05	89
	35 70	Clayey	4 9	1 6	0 2	0 03	88
	70 150	Clayey	5 0	1 5	0 2	0 01	88
LVA	0 20	Sandy clay loam	5 0	0 4	0 05	0 06	7
	20 40	Sandy clay loam	4 9	0 07	0 03	0 03	50
	100 120	Sandy clay loam	5 6	0 01	0 03	0 01	07

Source CPAC Annual Report 1976

Table 8 Legume germplasm under preliminary evaluation at the Cerrado Center

Legume species	No of accessions
Stylosanthes guianensis	58
S guianensis (tardio)	12
S capitata	27
S viscosa	14
S humilis	14
S bracteata	4
S hamata	4
S ingrata	1
Total	134
Other genera	
Zornia	49
Desmodium	30
Leucaena	18
Centrosema	18
Aeschynomene	16
Galactia	14
Calopogonium	13
Macroptilium/Vigna	11
Pueraria	3
Soemmeringia	2
Teramnus	2
Total	176

Differences in dry matter yield between the two sites ranged from 2% for *Zornia* spp to 65% for accessions of *S capitata*

Stylosanthes was again confirmed as the most promising genus On the basis of dry matter production regrowth potential dry season greenness seed production potential and tolerance to pests and diseases 40 introductions of this genus have been selected for further evaluation (Table 9) Selected introductions of *S guianensis* were almost exclusively represented by the tardío type a distinctive fine stemmed viscous late flowering form which has shown excellent tolerance to anthracnose over a four year period Accessions of *S scabra* have shown good adaptation to both soil types and low anthracnose susceptibility None of the introductions of *S bracteata* were better than the control CIAT 1582 Accessions of *S humilis* and *S hamata* have shown a high susceptibility to anthracnose

New introductions of *Calopogonium* and *Galactia* species were no more productive than the Brazilian commercial varieties In addition accessions of *Galactia* gave low seed production *Aeschynomene* species showed high susceptibility to anthracnose while species of *Teramnus Desmodium Pueraria Vigna Soemmeringia* and *Centrosema* grew relatively poorly

Table 9 Promising accessions of four Stylosanthes species selected for further evaluation on the two major soil types of the Cerrado

Species	CIAT accession number	Origin	Adaptation to soil type		Season of flowering[2]		
			LVE	LVA	Early	Mid	Late
S. guianensis	2243[1]	Dist. to Federal	+	+			+
	2244[1]	Goias	+				+
	2203[1]	Goia	+	+			+
	1262[1]	Matto Grosso	+	+			+
	2245[1]	Piau	+				+
	2247[1]	Bahia	+	+		+	
	1059[1]	Bahia	+	+			+
	1062[1]	Bahia	+	+			+
	1095[1]	Bahia		+			+
	1175	Colombia	+	+		+	
	1280[1]	Maranhao		+			+
	1534[1]	Venezuela		+			+
	1633[1]	Goia	+	+			+
S. capitata	2246	Piau	+				+
	1686	Matto Grosso	+	+		+	
	1728	Matto Grosso	+	+			+
	1943	Minas Gerais	+	+			+
S. baia	1009	Bahia	+	+		+	
	1047	Bahia	+	+		+	
	1050	Bahia	+			+	
	1064	Bahia	+	+		+	
	1710	Matto Grosso	+			+	
	1773	Matto Grosso	+		+		
	2299	Goia	+			+	
	2300	Maranhao	+				+
	2301	Maranhao		+			+
	2302	Piau	+	+		+	
	2303	Probably Brazil	+	+		+	
	2304	Probably Bazil	+		+		
	2305	Probably Bazil	+			+	
	2306	Probably Bazil	+	+		+	
	2307	Pernambuco	+	+		+	
	2308	Bahia	+			+	
	2309	Probably Brazil	+	+		+	
S. viscosa	1094	Bahia	+			+	
	1132	Belize		+		+	
	1547	Venezuela	+			+	
	1638	Sao Paulo	+	+		+	
	1783	Matto Grosso	+	+		+	
	1790	Matto Grosso	+			+	

1 Tardio types
2 Early December January Mid February March Late April or later

Introductions of *Zornia* species principally *Z latifolia* from the Colombian Llanos were more vigorous than the control CIAT 728 However all accessions showed severe leaf shedding at the end of the wet season Furthermore at the end of the dry season regrowth in almost all introductions was severely damaged by insects and approximately 50 percent of the accessions were suffering from a virus disease These

virus/fungal/insect complex symptoms were also recorded on native *Zornia* species Therefore systematic screening of accessions of this species for resistance to this complex is advisable

Of the browse legumes *Desmodium (= Codariocalyx) gyroides* CIAT 3001 has shown good adaptation to both LVE and LVA soil types The plants were readily consumed by cattle and the accession has been selected for further evaluation Severe leaf virus symptoms have been observed in the other woody *Desmodium* species Accessions of *Leucaena leucocephala* have been relatively slow to establish

Anthracnose was the major disease problem Its incidence in species of *Stylosanthes* and *Aeschynomene* was however lower at the LVA site than at the LVE site It is not clear whether this difference is a consequence of climatic unsuitability (e g lower humidity because of a continuous drying wind) at the LVA site or a presently low level of inoculum resulting from a lack of native legumes and no previous intensive experimentation

No stemborer (*Caloptilia* sp) or serious budworm (*Stegasta* sp) problems have yet been encountered Severe attacks by leafcutting ants (not specifically a pasture pest) during establishment were controlled by the application of methyl bromide gas to the nests

Agronomic evaluation

In December 1978 two separate trials were established one to evaluate legumes and the other grasses Germplasm used in these trials included commercial cultivars (controls) accessions from Category II at CPAC and experimental lines from Category IV at CIAT (Table 10)

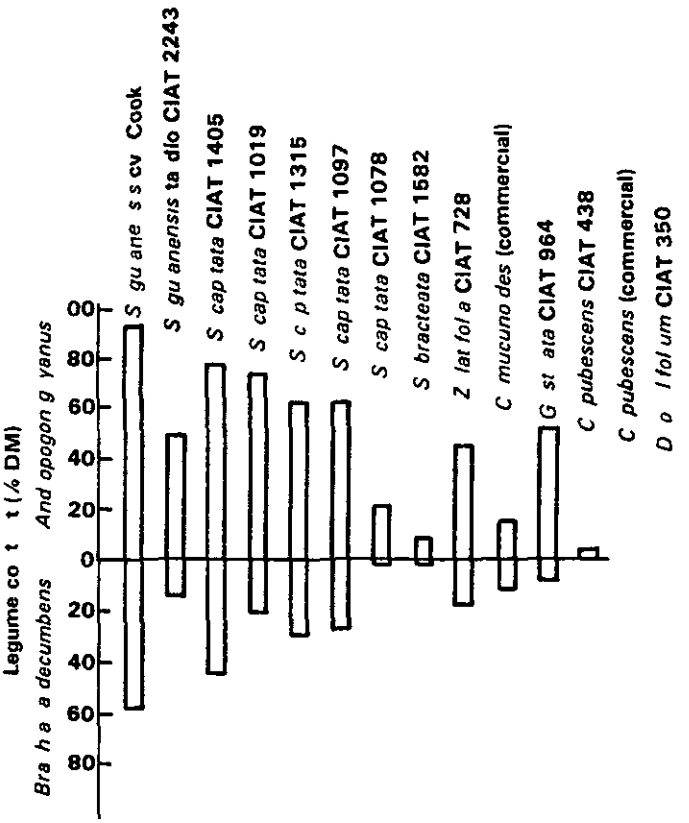
Table 10 Legume and grass entries under agronomic evaluation at the Cerrado Center 1978 79

Legume [1]	Grass [2]
Stylosanthes guianensis cv Cook	Andropogon gayanus CIAT 621
S guianensis tardio CIAT 2243	Brachiaria ruziziensis (commercial)
S pitata CIAT 1405	B decumbens cv Basilisk
S capitata CIAT 1019	B humidicola (commercial)
S capitata CIAT 1315	Panicum maximum cv Guinezinho
S capitata CIAT 1097	
S capitata CIAT 1078	
S bracteata CIAT 1582	
Zornia latifolia CIAT 728	
Calopogonium mucunoides (commercial)	
Calopogonium stratum CIAT 964	
Desmodium ovalifolium CIAT 350	
Centrosema pubescens (commercial)	
Centrosema pubescens CIAT 438	

1 Sown with Andropogon gayanus CIAT 621 and Brachiaria decumbens cv Basilisk
2 Sown with Calopogonium mucunoides (commercial) and Stylosanthes guianensis cv Cook

Grazing was withheld this season to allow the plants to establish satisfactorily In May 1979 at the end of the wet season the legume plots were sampled The legume content (Figure 8) of the *A gayanus* plot was more than twice that of the *Brachiaria decumbens* plots confirming the greater compatibility of the erect species *A gayanus* The two *Centrosema* accessions had almost disappeared from all plots *Desmodium ovalifolium* was present but below the height of sampling (15 cm) The grass evaluation trial was not sampled this season

Introductions of *Stylosanthes* were observed for the incidence of anthracnose All accessions of *S capitata* and *S guianensis* showed disease symptoms but they were not severe Of special interest was the reaction of *S guianensis* tardio CIAT 2243 In the seedling stage plants showed symptoms but then recovered com pletely This has been noted previously and obser vations made over the subsequent four years showed that after the establishment year plants were no longer attacked by the fungus This appears to be correlated with the increased viscosity of leaf and stem surfaces



F gure 8 Legume co tent Category III plots planted n mixt res w th *Andropogon gayanus* o *B ach a decumbens at the Ce rado c nter* (Late ra ny se son cutting at 15 cm he ght)

of the plants after the seedling stage Screening was started for selecting resistant ecotypes as well as to understand the nature of the mechanisms of resistance including the hypothesis about the viscous substances

Seed Production

Many areas of the Cerrado would appear to be climatically suitable for pasture seed production To confirm this an experiment was established in December 1978 with nine promising legume accessions and four promising grass accessions Results are shown in Table 11 Excellent establish ment was noted in all cases with the exception of *Stylosanthes capitata* CIAT 1078 which was slower than the other accessions No flowers were produced this season by *Desmodium ovalifolium* or *Pueraria phaseoloides* this may be related to latitude of the site

Seed yields were particularly low in *S capitata* CIAT 1078 and *S bracteata* CIAT 1582 *S capitata* CIAT 1405 and CIAT 1315 as well as *S hamata* CIAT 147 gave excellent seed yields

Production data for the grass accessions are shown in Table 12 *B humidicola* (commercial) was relatively slow to establish and produced little seed this season Production of seed in the other three grasses was similar The pattern of inflorescence production in the four grasses is shown in Figure 9 *B decumbens* cv Basilisk and *P maximum* cv Petrie Green Panic as occurs with most tropical grasses produced in florescences over a long period of time with con siderable variation in maturity between and within inflorescences Furthermore with successive cycles of inflorescence production the percentage of fertile tillers declined dramatically Seed yields in the second and third harvests were correspondingly reduced On the other hand more than 83 percent of all in florescences produced by *A gayanus* CIAT 621 appeared within a week of initial heading date with a relatively small increase thereafter

Severe anthracnose infestation was observed in *S capitata* CIAT 1405 and large areas of dead plants were noted High mortality of plants was also found in the plots of *S capitata* CIAT 1315 Although anthracnose lesions were present on the leaves of the latter the cause of plant death in *S capitata* CIAT 1315 is yet to be determined Grasses were disease free except for the presence of *Ustilago* sp on some seeds of *P*

Tabl 11 Plant em r$_{e}$ nce and d p od ct on data for l gum ce ion at tne C r do C

Legum a c on	Plant eme gen at 50 days (plants/m^2)	Date f t flowe ing	Dat ha ve t	D y m t product on (kg/ha)	Pu s d p odu t on (kg/ha)
Zorn a l t fol a CIAT 728	50	5 3 79	29 5 79	1283	175
Stylo nt es cap tata CIAT 1405	74	8 4 79	11 6 79	3200	199
S ap t ta CIAT 1315	60	11 4 79	8 6 79	2761	150
S cap tata CIAT 1078	14	28 3 79	6-7 79	566	31
S br t ata CIAT 1582	30	6 4 79	13-6 79	608	17
S ha ata CIAT 147	38	20 2 79	31 5 79	403o	322
S gu a en ta d o CIAT 2243	54	1 6 79	4 9 79	5271	42
D smod um oval fol um CIAT 350	94	1			
Pu a a phaseolo des CIAT 9900	24	1			

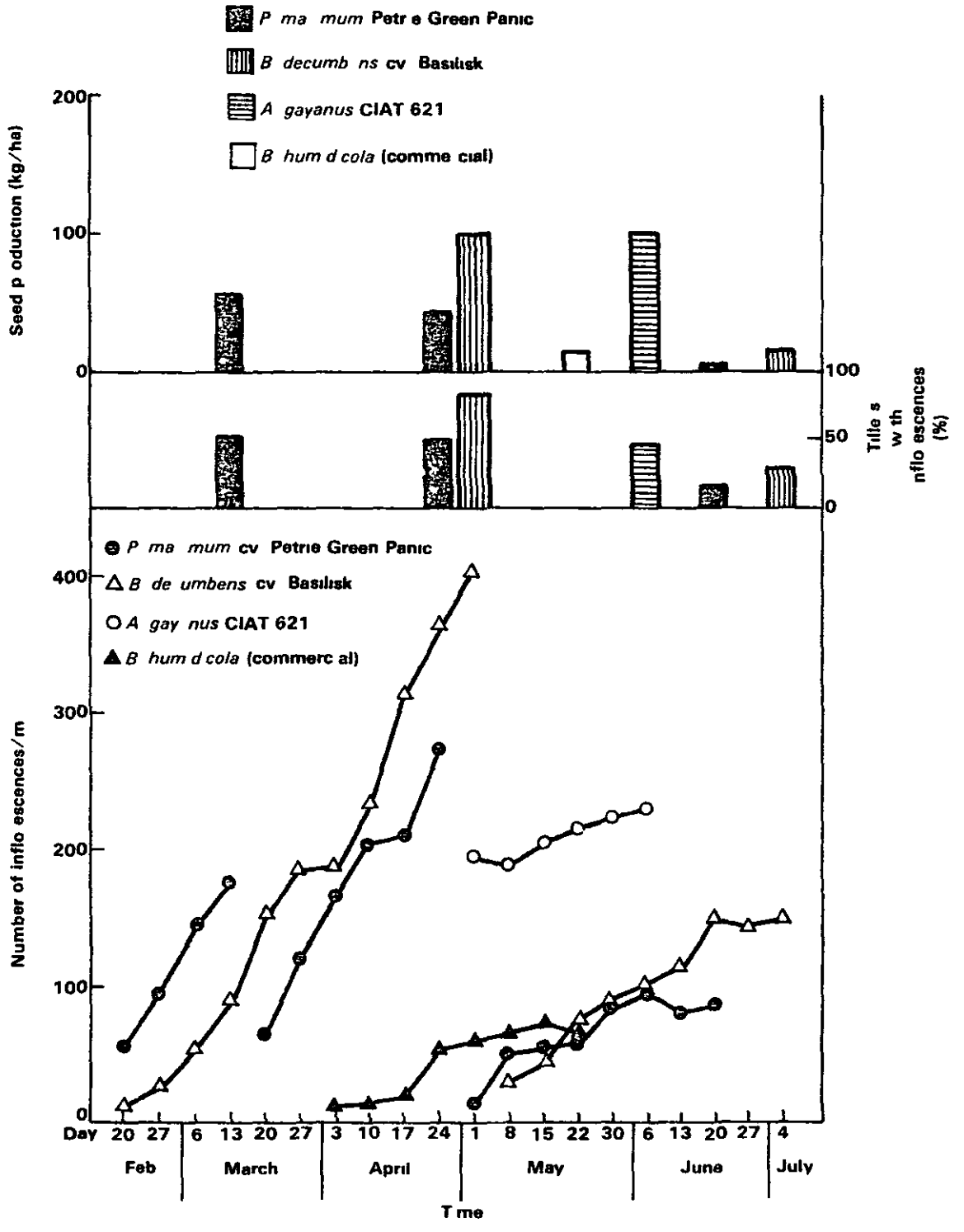
1 No flowe s produced

maximum A caterpillar (*Mocis latipes*) attack in *Panicum* and *Andropogon* was easily controlled by the application of a carbamate insecticide A mild out break of *Stegasta* sp was controlled with malathion

In addition to evaluating the potential of the region for commercial seed production another important function of the Program is to increase seed of promising lines to service successive stages of the evaluation program to provide seed for other research areas and ultimately the production of foundation seed of new cultivars Seed of legumes *D ovalifolium* CIAT 350 *Z latifolia* CIAT 728 *S capitata* CIAT 1315 *S capitata* CIAT 1097 *S guianensis* CIAT 1262 *S guianensis* CIAT 2247 *S scabra* cv Seca and *A gayanus* CIAT 621 is presently being increased

Table 12 Plant mergence and seed produ t on data fo grass acces on at th Cerrado Cent

Gra acc s on	Plant emergenc at 50 days (plant /m^2)	Date f st flowering	Dat ha v t	Dry matt produ t on (kg/ha)	Pu se d product on (kg/h)
B a h a a hum d cola commercial	16	22 3 79	23 79		12
B d umbens cv Bas lisk	20	20 2 79	2 5 79 4 7 79	6820	147 16
Pan cum max mum v P t e g en panic	24	13 2 79	12 3 79 27 4 79 22 6 79	6300	93 40 2
And opogon gayanu CIAT 621	32	27 4 79	7 6 79	8247	128



F gure 9 Pattern of flo escence nd seed prod ct on n four t op cal g asses at the Ce ado Center 1979