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SUMMARY

48 introduced forages were evaluated over three years on acid-soil sites. Evaluation was on smallholder farms, which resulted in more realistic and relevant selection. Five grass and two legume species were selected as being broadly adapted and high yielding, and were distributed directly to farmers. The grasses were *A. gayanus* cv. Planaltina, *B. decumbens* cv. Basilisk, *B. brizantha* cv. Marandu, *B. humidicola* CIAT 6369 and *P. maximum* cv. Riversdale, and the legumes, *C. pubescens* CIAT 15160 and *S. guianensis* cv. Pucallpa (CIAT 184). A further six grasses and six legumes were identified which yielded well at some sites, but which require further testing before distribution.

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INTRODUCTION

The South-east Asian Forage Seeds Project (FSP) was a project funded by the Australian International Development Assistance Bureau (AIDAB). It was jointly administered by Centro Internacional de Agricultura Tropical (CIAT, Colombia) and Australian Tropical Forages Genetic Resource Centre (ATFGRC), CSIRO Division of Tropical Crops and Pastures.

The Project duration was 3 years, from January 1992 to December 1994. The broad aims were to introduce new forage germplasm, evaluate and select adapted lines and extend the adapted lines to smallholder farmers in four countries in South-east Asia - Indonesia, Malaysia, Philippines and Thailand. This publication reports on the project results from one area where the FSP was active, Kalimantan in Indonesia.

There were few options available to smallholders in Kalimantan. Forages available were the high input grasses king grass (*Pennisetum purpureum* x *P. glaucum*), Napier grass (*P. purpureum*) and splendida setaria (*Setaria sphacelata* var. *splendida*), a local centro (*Centrosema pubescens*), the shrub legumes leucaena (*Leucaena leucocaphala*) and gliricidia (*Gliricidia sepium*) and a range of native grasses including alang-alang (blady grass, *Imperata cylindrica*) and *Paspalum conjugatum*. There are large areas of blady grass in Kalimantan; this grass is favoured by the annual burning of large tracts of land each dry season. There were limited areas of improved pastures in Kalimantan. In 1991, there was a total of 105.5 ha of improved pastures in East Kalimantan, predominantly king grass, *Setaria* and *Brachiaria decumbens*, most of which was on Government Stations (Anon 1991). Through a "forage intensification program", almost 10 million Napier and king grass cuttings were distributed by Government agencies to smallholders in Central, South and East Kalimantan over the period 1990-94. Many of these cuttings failed to establish because of the acid soils or the farmers' limited knowledge of forage management.

Farm size ranged from 0.5 to 2 ha. Most of the forages were grown in, between or adjacent to cropping areas and were used for cut and carry, but some were grazed.

Before this project was conducted, pasture introduction into Kalimantan had been limited to the testing of some commercial pasture cultivars such as Basilisk signal grass (*Brachiaria decumbens*) and Cook stylo (*Stylosanthes guianensis*) from Australia on Government Research Stations. There had been limited distribution of these forages to farmers.

This publication reports the results of introduction and evaluation of a range of forages at nine acid-soil sites in Kalimantan.

MATERIALS AND METHODS

The details of the 9 sites selected to represent the major soil types in Kalimantan are presented in Appendix 1. The location of the sites and major adjacent towns or cities are shown in Figure 1. Soil chemical analysis results from 5 sites are in Appendix 2. Three of the sites were on farmers' fields, with the other six sites at Government Veterinary Clinics or a Government Station. At Loa Janan Horticultural Station, the plots were managed and the forages used by a farmer who worked there. This was different from most previous projects, where evaluations were carried out on Government or University Research Stations.

The soils at the sites (Appendices 1 and 2) are acid and infertile, with high levels of exchangeable aluminium. Most pasture or crop species are poorly adapted to such soils. Soil fertility (N, P, K, S) and plant productivity are low in the natural state. Some of the sites had adequate levels of some nutrients because of previous land use and the addition of manure to the plots. Rainfall data for selected locations in Kalimantan is presented in Appendix 3.

The climate is humid equatorial tropical (Watts 1955). Rainfall is relatively uniform across the provinces in Kalimantan, averaging over 150mm per month and 2000mm per year (Appendix 3), with an average 18 rain days per month at Samarinda (Appendix 3). Mean minimum and maximum temperatures are 22.8°C and 33.0°C at Banjamarsin and 24.0°C and 30.0°C at Balikpapan (Sukanto 1969). Evapotranspiration at Balikpapan averages 60-70mm per month and 800mm annually (Papadakis 1961). While in general, December to April are the wettest months and July to October are the driest months, in a particular year the wettest or driest month can be one of 7 or 8 months, and it is not unusual to have a dry month or a series of dry months in the January to May period.

The majority of the accessions were introduced as two sets during early 1992 (Appendix 4). The first set consisted of 15 accessions which were sown at 6 sites together with 5 or 6 local controls, while the second set of 17 accessions was also sown at 6 sites with one local control. Both sets of introductions were sown at 3 sites. A limited number of other accessions were introduced in later years. The forages selected were mainly productive, commercial pasture cultivars either in Australia (Set 1, from ATFGRC, CSIRO) or South America (Set 2, from CIAT).

At each site, each set of lines was to be established in a randomised complete block design with two replications. Plot size was 4m x 5m.

Sowing rates were 5kg ha^{-1} for the grasses, 10kg ha^{-1} for the small seeded legumes, and 30kg ha^{-1} for the large seeded legumes. The introductions and the local controls were sown or planted into cultivated, weed-free seedbeds.

The legume seeds were to be tested for germination, and hot water treated if there was more than 60% hard seed. Legumes were to be inoculated with appropriate root nodule bacteria (RNB).

The first set of accessions was sown in the January-March period of 1992 while the second set was sown in April-May.

Fertilisers to be applied at establishment were triple superphosphate at 150kg ha^{-1}, muriate of potash as 100kg ha^{-1}. Urea at 100kg ha^{-1} was to be applied twice to the grasses only, at establishment and at 2 months after establishment.

Establishment counts were to be carried out 3-4 weeks after sowing in two 0.5m x 0.5m quadrats per plot.

The plots were to be monitored each month after sowing. Records were to be made of legume nodulation, growth, yield, appearance, colour, pests and diseases, flowering, seed production and acceptance by cattle.

As the FSP forage consultant could visit the site only two or three times each year, the laying out of the plots, cultural treatments, sowing and observations were to be carried out by local co-operators at each of the sites.

RESULTS AND DISCUSSION

At most of the sites, the trials were not conducted precisely as scheduled. Some treatments were either added or subtracted from the experimental plan. The monthly observations were not carried out and reported as planned except at Pangkalan Lada where 13 months of observations were carried out from February 1992. The results consist mainly of the observations recorded by the Project Agronomists during their regular visits. Some problems occurred with the identification of accessions where more than one line of a species was sown. These were mostly resolved. The confusion was the result of co-operators not being aware of the identification numbers and using seed lot numbers as the identification number rather than the correct CPI or CIAT number.

Establishment was good at Kanamit and Pangkalan Lada in Central Kalimantan, and at Plei Hari in South Kalimantan. In East Kalimantan, dry conditions following sowing led to poor establishment of the grasses sown in the first set of accessions, although the legumes and the second set of accessions had good establishment. The exception to this was at Teluk Dalam where the sowings were poorly executed and it was reported that only five accessions established, these being Cavalcade, Glenn, Lee, Maldonado and the local centro control. Teluk Dalam was abandoned following an inspection at the site in May 1992. At that time, there were a few plants each of Amarillo, Cavalcade and Maldonado present. Establishment and yield ratings for the other 8 sites are presented in Appendices 5-7.

During the three years of the trials, a number of pest and disease problems were observed on a range of the introductions including birds and rats eating seed, grasshoppers, powdery

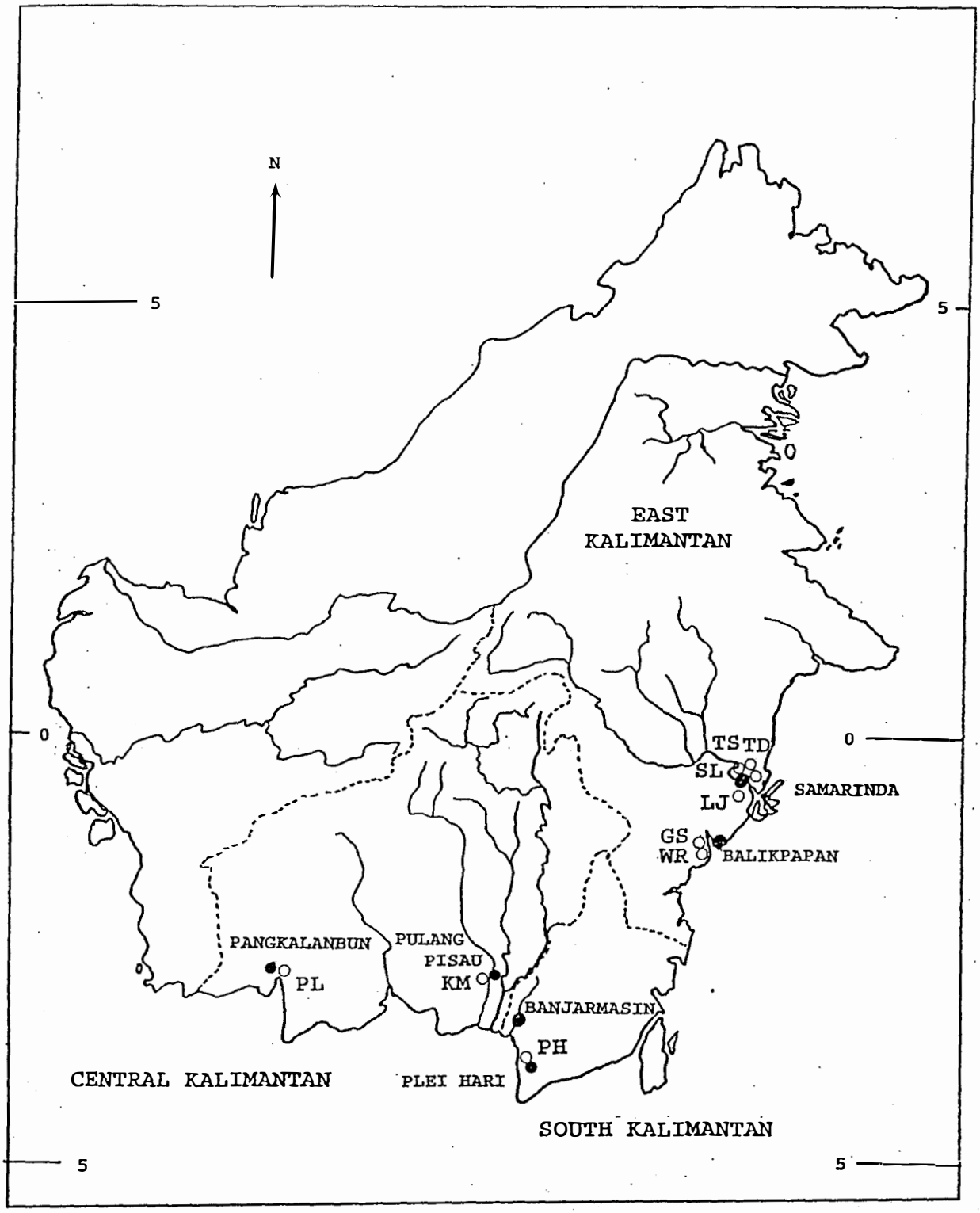

Figure 1. Location of the forage evaluation sites and adjacent cities and towns in Kalimantan, Indonesia (● Cities and Towns, ○ Sites)

mildew (*Aeschynomene* spp.), rhizoctonia leaf blight (twining legumes), anthracnose (*Stylosanthes* spp.), bean fly, damping off, mealy bugs, leaf disease and insect leaf damage. Uncontrolled grazing by cattle was a problem at one site. These problems only prevented a reasonable evaluation at Teluk Dalam, the one site which was abandoned during the first year.

Although there were problems with the establishment of some of the grasses in East Kalimantan, the majority of the accessions established well enough at one or more sites for them to indicate their potential or otherwise. Accessions which exhibited good or excellent yield after the establishment period at one or more of the sites are listed in Appendix 8, together with specific comments on their performance.

Five grasses and two legumes performed well over a range of sites. The grasses were *A. gayanus* cv. Planaltina, *B. decumbens* cv. Basilisk, *B. brizantha* cv. Marandu, *B. humidicola* CIAT 6369 and *P. maximum* cv. Riversdale, and the legumes, *C. pubescens* CIAT 15160 and *S. guianensis* cv. Pucallpa (CIAT 184). These were selected for distribution to farmers in Kalimantan during the 1993-94 wet season. Because of a shortage of seed and vegetative planting material, seed of the Australian commercial cultivars *A. gayanus* cv. Kent and *B. humidicola* cv. Tully was also distributed to farmers. The processes of extension of the forages to smallholders are reported by Ibrahim (1994) and Winarno (1994).

The selected forages, except for Riversdale which generally did not establish on the farmers' fields, all performed well. There were no obvious differences in performance between Planaltina and Kent or CIAT 6369 and Tully.

Of the other forages introduced and evaluated, there are some species or lines which had limited testing (sites and/or years) or some other limitation, and which should be evaluated further. These are the grass species *B. ruziziensis, Digitaria milanjiana, D. swynnertonii, P. maximum* cv. Thai Purple Guinea, *Paspalum atratum* and *P. guenoarum*, and the legumes *Arachis glabrata, Centrosema acutifolium, C. macrocarpum, Chamaechrista rotundifolia, Desmodium heterophyllum* and *D. ovalifolium.*

Digitaria swynnertonii grew well at the most acid site, Waru, and at Kanamit, where the pH was 4.5. It was not selected for immediate distribution because of doubts about its palatability. This needs to be clarified. *Flemingia macrophylla*, a native of South-east Asia, was widely adapted, but is not palatable to cattle, which limits its appeal. Goats, however, readily consume this species. The only legume which showed appreciable growth at Waru was a native *Desmodium heterophyllum*. *Centrosema acutifolium* and *C. macrocarpum* grew well at a number of sites but did not produce viable seed in Kalimantan. *Digitaria milanjiana* may require a higher fertility regime than that used in this study.

All of the forages listed were selected as being suitable for use as perennials for cut and carry or for grazing. The legumes *Aeschynomene americana, Centrosema pascuorum* and *Macroptilium gracile* all had excellent early growth, competitive ability and yield, but did not persist. They may have

potential as ley pastures or pioneer forages.

Conclusions

This evaluation over three years of 48 introduced forages allowed the selection of five grasses and two legumes which could be distributed directly to farmers in Kalimantan, and six grasses and seven legumes which should be tested more extensively before distribution.

Evaluation of the forages on smallholder farms made the performance of the forages more relevant to farmers. The introduced forages performed better than the local forages under sub-optimal management.

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At Kanamit:	Ir Tiswanda, Dr Rudjito, Dr M. Taufiq, Mr S. Hasim
At Plei Hari:	Ir Hardiato
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Appendix 1 - Site Details of introduction sites in Kalimantan, Indonesia

Format and Codes Used

Site Name -	As provided by co-operators
Site Code -	Used in this publication
Latitude -	°S latitude
Province -	CK = Central Kalimantan (Propinsi Kalimantan Tengah) SK = South Kalimantan (Propinsi Kalimantan Selantan) EK = East Kalimantan (Propinsi Kalimantan Timur)
Soil Surface pH -	Measured with a soil pH test kit from Inoculo Laboratories
Topography -	Of site
General Description -	Of vegetation type etc
Closest City or Town -	Closest of note

Site Name	Site Code	Latitude & Province	Soil Type	Surface & Soil pH	Topography	General Description/Closest Town or City
Kanamit Pankoh III Klinic	KM	3,CK	Organic Black Loam	4.5	Flat	*Imperata* grassland at Klinic; Pulang Pisau
Pangkalan Lada Klinic	PL	2.5, CK	Podzolic	4.5 - 6.0	Flat	*Imperata* grassland at Klinic; Pangkalanbun
Guneung Seteleng	GS	2, EK	Podzol	4.5 - 5.5	Moderate slope, terraced	Weedy fallow on a farm; Balikpapan
Loa Janan Horticulture Station	LJ	1, EK	Red Loam	4.5 - 5.5	Gentle slope	*Imperata* grassland at Horticulture Station; Samarinda
Sungai Lantung	SL	0.5, EK	Podzolic	5.5 - 6.0	Steep slope	*Imperata* grassland on a farm; Samarinda
Talang Sari	TS	0.5, EK	Eroded Podzolic?	4.5	Steep slope	*Imperata* grassland on a farm; Samarinda
Teluk Dalam Klinic	TD	0.5, EK	Black Cracking Clay	6.0 - 6.5	Flat	Low grassland, seasonally waterlogged; Samarinda
Waru Klinic	WR	2, EK	Sand	3.5 - 4.0	Flat	Low grassland, seasonally flooded and waterlogged; Balikpapan
Pelei Hari UPT Station	PH	4, SK	Red-brown clay loam	4.5 - 5.5	Gentle slope	*Imperata* grassland; Plei Hari

Appendix 2 - Chemical characteristics of the surface soils from 5 sites in Kalimantan

Analysis Methods	
pH:	20:100, Soil: H_2O
Electrical conductivity (EC):	20:100, Soil: H_2O
Organic Carbon (Org C):	Walkley & Black
Total N (N):	Kjeldahl Digest
Nitrate/Nitrogen (NO_3N) extractable:	20:100, Soil: H_2O
Phosphorus extractible (Bic P):	1:100, Soil: 0.5m $NaHCO_3$ Colwell
Sulphur extractible ($S0_4$ S):	20:100, Soil: 0.5M $CaHPO_4$
Calcium (Ca):	5:100, Soil: 1M NH_4CI @ pH 7.0
Magnesium (Mg):	5:100, Soil: 1M NH_4CI @ pH 7.0
Potassium (K):	5:100, Soil: 1M NH_4CI @ pH 7.0
Aluminium extractable (A1):	8:80, Soil: 1M KCI
Copper extractable (Cu):	25:50, Soil: 0.005M DTPA
Zinc extactable (Zn):	25:50, Soil: 0.005M DTPA
Manganese extractable (Mn):	25:50, Soil: 0.005M DTPA
Boron extractable (B):	10:20, Soil: Hot 0.001M $CaC1_2$

Chemical characteristics of the soils from five sites in Kalimantan.

Site	pH	EC	Org C	Tot N	NO_3 N	BiC P	SO_4 S	Ca	Mg	K	Ex Al	Cu	Zn	Mn	B
		ms/ cm	%	%	ppm	ppm	ppm	meq %	meq %	meq %	meq %	ppm	ppm	ppm	ppm
Kanamit	4.3	0.091	12.6	0.56	14	-	-	1.10	0.56	0.17	8.3	0.4	0.2	0	0.3
Pangkalan Lada	5.1	0.022	2.5	0.14	2	12	23	1.60	0.60	0.12	1.3	0.6	0.5	3	0.5
Loa Janan	4.8	0.055	2.4	0.19	7	58	32	2.70	1.60	0.51	2.6	0.8	0.7	9	0.7
Sungai Lantung	5.2	0.016	1.6	0.11	2	6	14	4.7	1.50	0.37	4.9	0.7	2.0	32	0.3
Plei Hari	5.1	0.023	2.3	0.16	8	11	44	1.3	0.96	0.14	1.6	0.7	0.3	16	0.6

Appendix 3 - Rainfall data for Kalimantan

A Mean monthly and total rainfall at 5 locations in Kalimantan

B Monthly and annual rainfall at Samarinda 1978-1991

C Monthly and annual number of rain days at Samarinda 1978-1991

D Monthly and annual ranges of number of rain days at Samarinda 1978-1991.

Sources of Data

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A,B,C,D Departemen Perhubungan, Badan Meteorologi Dan Geofisika, Balai Witayah III, Stasion Meteorologi Temindung Samarinda.

Rainfall for three locations in Kalimantan (mm)

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
A. Mean monthly and total rainfall (mm)													
Banjamarsin	302	264	315	214	160	141	104	112	138	131	233	279	2383
Balikpapan	186	170	248	219	220	265	258	246	195	154	194	242	2597
Samarinda	186	153	170	193	230	157	136	110	124	138	204	229	2021
B. Monthly rainfall range at Samarinda 1978-1991 (mm)													
	24-349	3-278	72-282	54-304	94-431	58-269	9-329	12-279	28-220	48-238	93-299	144-295	1463-2614
C. Mean monthly and total rain days at Samarinda 1978-1991													
	18	17	17	19	23	19	18	15	16	18	20	21	220
D. Monthly range of rain days at Samarinda 1978-1991													
	7-25	1-26	1-29	6-26	16-28	11-24	4-25	8-28	6-22	9-25	10-26	13-27	143-259

Appendix 4 - List of accessions sown or planted at each site in Kalimantan, and wet season of sowing.

Format and Codes Used

Species -	Alphabetically listed by genus and species within genus, Part A. Grasses, Part B. Legumes
Accession Identification-	Cultivar names are presented, numbers are Australian (CPI), Brazilian (BRA) or Colombian (CIAT) identification numbers.
Wet Season sown/planted -	91/2 = 1991/1992

Name	Identification	Site								
		KM	PL	GS	LJ	SL	TS	TD	WR	PH
A. Grasses										
Andropogon gayanus	Planaltina (CIAT 621)	91/2	91/2	91/2	91/2	-	91/2	-	93/4	91/2
Brachiaria brizantha	Marandu (CIAT 6780)	91/2	91/2	91/2	91/2	-	91/2	-	93/4	91/2
B. decumbens	Basilisk (CIAT 606) Local (Basilisk?)	91/2	91/2	91/2	91/2	-	91/2	-	- 91/2	91/2
B. dictyoneura	Llaneiro (CIAT 6133,CPI 59610)	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
B. humidicola	CIAT 6369 (BRA 370) Tully	91/2 -	91/2 93/4	91/2	91/2	-	91/2	-	93/4	91/2
B. ruziziensis	Thai ruzi (Kennedy?)	-	92/3	-	-	-	-	-	-	-
Chloris gayana	Callide	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Digitaria milanjiana	CPI 41192	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
D. swynnertonil	CPI 59749	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Euclaena mexicana	Local	-	91/2	-	-	-	-	-	-	-
Panicum maximum	Makueni Riversdale Thai purple (TD58)	91/2 91/2 -	91/2 91/2 92/3	- - -	91/2 91/2 -	91/2 91/2 -	- - -	91/2 91/2 -	91/2 91/2 -	- - -

Name	Identification	Site								
		KM	PL	GS	LJ	SL	TS	TD	WR	PH
Paspalum atratum	BRA 9610	-	-	-	93/4	-	-	-	93/4	93/4
P. conjugatum	Local	91/2	-	-	-	-	-	-	91/2	-
P. guenoarum	BRA 3824	-	-	-	93/4	-	-	-	93/4	93/4
P. malacophyllum	CPI 27690	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Pennisetum purpureum	Local Napier grass	91/2	91/2	-	-	-	-	-	-	-
P. purpureum x P. glaucum	Local King grass	91/2	91/2	92/3	93/4	-	92/3	-	91/2	-
Setaria sphacelata var. *splendida*	CPI 15899 (?)	91/2	91/2	-	-	-	-	-	91/2	-
B. Legumes										
Aeschynomone americana	Glenn	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
	Lee	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Arachis glabrata	CPI 93469	-	-	-	-	-	-	-	-	92/3
	CPI 93490	-	-	-	-	-	-	-	-	92/3
A. pintoi	Amarillo	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Cajanus cajan	CIAT 18700	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
Calliandra calothyrsus		-	-	-	93/4	93/4	-	-	93/4	-
Calopogonium mucunoides	Local	91/2	-	-	-	-	-	-	91/2	-

Name	Identification	Site								
		KM	PL	GS	LJ	SL	TS	TD	WR	PH
Centrosema acutifolium	CIAT 5277	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
C. macrocarpum	CIAT 5452	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
	CIAT 15014	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
	CIAT 15047	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
C. pascuorum	Cavalcade	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
C. pubescens	CIAT 438	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
	CIAT 15160	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
	Local									
C. schiedeanum	Belalto	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Chamaecrista rotundifolia	Wynn	91/2	91/2	-	-	-	-	-	91/2	-
Codariocalyx gyroides	CIAT 3001	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
Cratylia argentea	CIAT 18516	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
Desmodium heterophyllum	Johnstone (CIAT 349)	-	-	-	93/4	-	-	-	93/4	93/4
D. ovalifolium	CIAT 13089	-	-	-	93/4	-	-	-	93/4	93/4
D. velutinum	CIAT 13220	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
Flemingia macrophylla	CIAT 17403	91/2	91/2	91/2	91/2	-	91/2	-	-	91/2
	Local	-	91/2	-	-	-	-	-	-	-
Leucaena diversifolia	Bogor	-	-	-	91/2	-	-	-	-	-

Name	Identification	Site								
		KM	**PL**	**GS**	**LJ**	**SL**	**TS**	**TD**	**WR**	**PH**
Macroptilium gracile	Maldonado	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
Stylosanthes capitata	Capica (CIAT 10280)	-	-	-	93/4	-	-	-	93/4	93/4
S. guianensis	Cook	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
	Graham	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
	Thai Graham	-	92/3	-	-	-	-	-	-	-
	Pucallpa (CIAT 184)	91/2	91/2	91/2	91/2	-	91/2	-	-	-
	SSD-12	-	-	-	93/4	-	-	-	93/4	93/4
S. hamata	Verano	91/2	91/2	-	91/2	91/2	-	91/2	91/2	-
	Thai Verano	-	92/3	-	-	-	-	-	-	-

Appendix 5 - Establishment and Yield Ratings of Introductions at two sites in Central Kalimantan

Format and Codes Used

Establishment (ES)	N = not sown at site X = did not establish, not recorded P = poor establishment F = fair G = good E = excellent
Yield Ratings	Dates as month at observations - = not sown or planted at the site at the time P = poor growth/yield F = fair G = good E = excellent
Species	Alphabetically listed by genus and species within genus, Part A. Grasses, Part B. Legumes
Accession Identification	Cultivar names are presented, numbers are Australian (CPI), Brazilian (BRA) or Colombian (CIAT) identification numbers.

Different sowings or plantings of the same line are indicated by year at planting in brackets (92).

Name/Identification	Kanamit							Pangkalan Lada															
	ES	2/92	4/92	5/92	8/93	10/93	1/94	ES	2/92	4/92	5/92	6/92	7/92	8/92	9/92	10/92	11/92	12/92	1/93	2/93	8/93	10/93	1/94	7/94
A. Grasses																								
Andropogon gayanus Planaltina	G	-	-		E	E	E	E	-	-	G	E	E	E	E	E	E		G	G	E	E	E	G
Brachiaria brizantha Marandu	G	-	-		E	E	E	E	-	-	E	E	E	E	E	E	E		G	G	E	E	G	G
B. decumbens Basilisk	G	-	-		E	G	G	G	-	-	G	E	E	E	E	E	E		G	G		G	G	G
B. dictyoneura Llanero	G	-	-		G	G	G	G	-	-	G	E	E	E	E	E	E	G	G	G		G	G	G
B. humidicola	G	-	-		E	G	G	E	-	-	G	E	E	E	E	E	E	G	G	G	G	G	F	G
CIAT 6369	N	-						F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	F	F
Tully																								
B. ruziziensis Thai	N	-						P	-	-	-	-	-	-	-	-	G	G	G	G		G	G	G
Chloris gayana Callide	F			P				F		F	F	F	F	E	F	P			F	F		P		
Digitaria milanjiana CPI 41192	F	P		G	G	F		G		E	E	F	F	E	G	G	G			G		F	F	
Digitaria swynnertonii CPI 59749	G	P	F	E	G	G		G		E	E	F	F	G	G	G	G			G	G	G	G	G
Euclaena mexicana Local	N							G		E	G	G	G		G	G	G	G	G	G		P		

Name/Identification	Kanamit							Pangkalan Lada															
	ES	2/92	4/92	5/92	8/93	10/93	1/94	ES	2/92	4/92	5/92	6/92	7/92	8/92	9/92	10/92	11/92	12/92	1/93	2/93	8/93	10/93	1/94	7/94
Arachis pintoi Amarillo	F	F						P	P	F	F	F	F	F	F	P	P	P	P	P	F	P		
Cajanus cajan CIAT 18700	P	-	-			P		F	-	-	E	E	E	E	E	E	E		G	G	G	E	G	F
Calopogonium mucunoides Local	F	F		G				N																
Centrosema acutifolium CIAT 5277	G	-	-		G	G		F	-	-	F	G	G	G	G	G			G	G	E	G	G	F
C. macrocarpum CIAT 5452	G	-	-			E	G	F	-	-	F	F	F	F	F	F	F	F	F	F		G	E	F
CIAT 15014	G	-	-			G	G	G	-	-	F	G	F	F	F	F	F	F	F	F		G	G	G
CIAT 15047	G	-	-		G	E	E	P	-	-	G	G	G	G	G	G	G	G	G	G	E	E	E	G
C. pascuorum Cavalcade	F	G		G				F	G	E	E	F	F	E	F									
C. pubescens CIAT 438	G	-	-		G	G	G	F	-	-	F	F	F	F	F	F	F	F	F	F		F	G	G
CIAT 15160	G	-	-		E	E	E	P	-	-	F	F	F	F	F	F	F	F	F	F	G	E	G	G
C. schiedeanum Belalto	F	F		P		F		F	G	E	G	G	G	E	G	G	G	G	G	G	G	G	G	F
Chamaecrista rotundifolia Wynn	F	F		E		F		P													G	F	F	F
Codariocalyx gyroides CIAT 3001	X	-	-					E	-	-	G	E	E	E	E	E		F		F				

Name/Identification	Kanamit							Pangkalan Lada															
	ES	2/92	4/94	5/92	8/93	10/93	1/94	ES	2/92	4/92	5/92	6/92	7/92	8/92	9/92	10/92	11/92	12/92	1/93	2/93	8/93	10/93	1/94	7/94
Cratylia argentea																								
CIAT 18156	X	-	-					P	-	-	P	P	P	P	P	P	P	P	P	P		P		
Desmodium velutinum																								
CIAT 13220	P	-	-			P		P	-	-	-	F	F	F	F	F	G	F	F	F		G	F	
Flemingia macrophylla																								
CIAT 17403	E	-	-	-	E	E		G	-	-	-	G	G	G	G	G	G	F	F	F	G	E	E	E
Local	N							F		G	G	G	G		G	G	G	G	G	G		G	G	G
Macroptilium gracile								E	G															
Maldonado	F	G	G	E		F		F	G	E	E	F	F	E	G	F	F	F	F	F	F	F	P	P
Stylosanthes guianensis																								
Cook	F	P		P		F		E	-	E	E	G	G	E	G	G			G	G	G	E	E	E
Graham	F	F		P		P		E	G	E	E	E	G	E	G	G	G				G	G	F	
Thai Graham	N							E	-	-	-	-	-	-	-	-	G	G	G	G			G	F
Pucallpa	E	-	-		E	G	E	E	-	-	G	E	E	E	E	E	E	G	G	G	E		G	F
S. hamata																								
Verano	F							F													F		F	
Thai Verano	N							G	-	-	-	-	-	-	-	-	G	G	G	G		F	P	P
S. scabra	N																						F	

Appendix 6 - Establishment and growth ratings of introductions at five sites in East Kalimantan

Format and Codes Used

Species	Alphabetically listed by genus and species within genus, Part A. Grasses, Part B. Legumes.
Identification	Cultivar names are presented, numbers are Australian (CPI), Brazilian (BRA) or Colombian (CIAT) identification numbers.
Establishment (ES)	N = not sown at site X = did not establish, not recorded P = poor establishment F = fair G = good E = excellent
Growth ratings	Dates as month at observations - = not sown or planted at the site at the time P = poor growth/yield F = fair G = good E = excellent

Different sowings or plantings of the same line are indicated by year of planting in brackets (92).

Name/ Identification	Guneung Setelang				Loa Janan						Sungai Lantung					Talang Sari				Waru						
	ES	8/93	10/93	8/94	ES	6/93	8/93	10/93	1/94	8/94	ES	5/92	8/93	10/93	8/94	ES	8/93	10/93	8/94	ES	4/92	6/92	8/93	10/93	1/94	8/94
A. Grasses																										
Andropogon gayanus																										
Planaltina (92)	G	G	G		G	-	E	F	G	G	N					G	E	E	E	N						
(93)	N				N						N					N				F				P	G	G
(94)	G	-	-	G	N						N					N				N						
Brachiaria brizantha																										
Marandu (92)	G	E	G		G	-	E	F	G	E	N					G	G	F	F							
(93)	N				N						N					N				F				P	G	G
(94)	G	-	-	G	N						F	-	-	-	F	N				N						
B. decumbens																										
Basilisk (92)	G	G	F		G	-	G	F	G	G	N					G	G	G	F							
(94)	G	-	-	G							N															
Local																				G	G			G	G	G
B. dictyoneura																										
Llanero (92)	F		F		X						N					X				N						
(94)	G	-	-	G							N					N				N						
B. humidicola																										
CIAT 6369 (92)	G	G	F		G	-	G	F	G	F	N					G	G	F	F	N						
(93)	N										N					N				G	-	-		P	G	G
(94)	G	-	-	F							F	-	-	-	F	N				N						
Chloris gayana Callide	N				X						X					N				X						
Digitaria milanjiana CPI 41192	N				P		G	F	F	F	P	F	E	F	G	N				P		P		F		

Name/ Identification	Guneung Setelang				Loa Janan						Sungai Lantung					Talang Sari				Waru						
	ES	8/93	10/93	8/94	ES	6/93	8/93	10/93	1/94	8/94	ES	5/92	8/93	10/93	8/94	ES	8/93	10/93	8/94	ES	4/92	6/92	8/93	10/93	1/94	8/94
D. swynnertonii CPI 59749	N				X						P	F	E	F	G	N				F		F	G	F	G	G
P. maximum																										
Makueni	N				P			P			P	F		F		N				P		F				
Riversdale	N				G	E	E	F	G	G	P	F	E	F	G	N				F		F	G	G	G	G
Paspalum atratum BRA 9610	N				G	-	-	-	F	F	N					N				P	-	-	-	-	P	
P. conjugatum Local	N				N						N					N				G		F		F	G	F
P. guenoarum BRA3824	N				G	-	-	-	F	F	N					N				P	-	-	-	-	F	
P. malacophyllum CPI 27690	N				X						X					N				P				P		
P. purpureum x P. glaucum																										
Local King grass (92)	G	-	F								N					G		F	F	N	G	F		G	F	G
(93)	N				G	-	-	-	-	F	N					N				N						
(94)																										
Setaria sphacelata var. *splendida* CPI 15899	N				N						N					N				G	G	F		P	F	F
B. Legumes																										
Aeschnomene americana	N				G		E	G	F	F	G	E	E	F	F	N				F						
Glenn	N				G		E				G	G	G	P	F	N				F						
Lee																										

Name/ Identification	Guneung Setelang				Loa Janan						Sungai Lantung					Talang Sari				Waru						
	ES	8/93	10/93	8/94	ES	6/93	8/93	10/93	1/94	8/94	ES	5/92	8/93	10/93	8/94	ES	8/93	10/93	8/94	ES	4/92	6/92	8/93	10/93	1/94	8/94
Arachis pintoi																										
Amarillo (92a)	N				G	P	P			P	X															
(92b)	N										G	G	F	F	F	N				F						
(93)	N				X											N				N						
(94)	N				G					P						N				N						
Cajanus cajan																										
CIAT 18700	F	G	F		P			P			N					G		F	P	N						
Calliandra calothyrsus	N				F	-	-	-	P	P	N					N				P	-	-	-	-	P	
Calopogonium mucunoides																										
Local	N				N						N					N				F	G			P		P
Centrosema acutifolium																										
CIAT 5277	F		F		F	-	G	F		F	N					F		F	P	N						
C. macrocarpum																										
CIAT 5452	F		F		F	-	G	G	G	E	N					F	G	G	P	N						
CIAT 15014	F		F		F	-	G	F	F	G	N					F	E	G	G	N						
CIAT 15047 (92)	F		F		F	-	G	G	G	G	N					F	-	F	F	N						
(94)	F	-	-	F	N						N					N				N						
C. pascuorum																										
Cavalcade	N				G	G					G		G			N				F	G					
C. pubescens																										
CIAT 438	F		F		F			G	F	F	N					F		F	F	N						
CIAT 15160 (92)	G	G	G		F		E	G	G	E	N					F		P	F	N						
(94)	G	-	-	F	N						N					N				N						
Local								F		P	N					F	F	P		N						

Name/ Identification	Guneung Setelang				Loa Janan						Sungai Lantung					Talang Sari				Waru					
	ES	8/93	10/93	8/94	ES	6/93	8/93	10/93	1/94	8/94	ES	5/92	8/93	10/93	8/94	ES	8/93	10/93	8/94	ES	6/92	8/93	10/93	1/94	8/94
C. schiedeanum Belalto	N				G	F	G	F	G	G	G	P		F	F	N				F			P		
Chamaecrista rotundifolia Wynn	N										N					N				P	F	G	P	P	P
Codariocalyx gyroides CIAT 3001	X				G			G	E	E	N					F	P	P		N					
Cratylia argentea CIAT 18516	X				X						N					X				N					
Desmodium heterophyllum Johnstone	N				G	-	-	-	F	F	N					N				P	-	-	-	P	
D. ovalifolium CIAT 13089	N				F	-	-	-	F	F	N					N				F	-	-	-	F	P
D. velutinum CIAT 13220	X				X						N					N				N					
Flemingia macrophylla CIAT 17403	G	G	E	E	G		E	E	E	G	N					G	E	E	E	N					
Leucaena diversifolia	N				N						X					N				N					
Macroptilum gracile Maldonado	N				G	E	E	F	F	F	G	G	E	P	P	N				F	G		P	P	P

Name/ Identification	Guneung Setelang				Loa Janan						Sungai Lantung					Talang Sari				Waru					
	ES	8/93	10/93	8/94	ES	6/93	8/93	10/93	1/94	8/94	ES	5/92	8/93	10/93	8/94	ES	8/93	10/93	8/94	ES	6/92	8/93	10/93	1/94	8/94
Stylosanthes capitata Capica	N				P	-	-	-	F	F	N					N				F	-	-	-	F	P
S. guianensis																									
Cook	N				G	G	G	G	G	E	G	G	G	G	G	N				F					
Graham	N				G	G	G	F		F	G	G	G	F		N				F					
Pucallpa (92)	G	G	G		G		E	G	G	G	N					G	E	G	E	N					
(94)	G	-	-	F							N					N				N					
SSD-12	N				F	-	-	-	F	F	N					N				P	-	-	-	P	
S. hamata																									
Verano	N				G	F		P			G	F		P		N				F					

Appendix 7 - Establishment and growth ratings of introductions at 1 site in South Kalimantan: Plei Hari

Format Codes Used

Species -	Alphabetically listed by genus and species within genus, Part A. Grasses, Part B. Legumes
Line Identification-	Cultivar names are presented, numbers are Australian (CPI), Brazilian (BRA) or Colombian (CIAT) identification numbers.
Establishment (ES)	N = not sown at site X = did not establish, not recorded P = poor establishment F = fair G = good E = excellent
Growth ratings	Dates as month at observations - = not sown or planted at the site at the time P = poor growth/yield F = fair G = good E = excellent

Different sowings or plantings at the same line are indicated by year of planting in brackets (92).

Name/Identification		ES	5/92	8/93	10/93	8/94
A. Grasses						
Andropogon gayanus						
Planaltina	(92)	G	F	E	F	F
	(94)	G	-	-	-	G
Brachiaria brizantha						
Marundu	(92)	E	G		G	F
	(94)	G	-	-	-	G
B. decumbens						
Basilisk	(92)	G	F	G	P	F
	(94)	E	-	-	-	G
B. dictyoneura						
Llanero	(92)	F	F		F	F
	(94)	E	-	-	-	G
B. humidicola						
CIAT 6369	(92)	P	F	G	P	F
	(94)	P	-	-	-	G
Panicum maximum						
Local					G	
Paspalum atratum						
BRA 9610		E	-	-	-	E
P. guenoarum						
BRA 3824		E	-	-	-	G
Pennisetum purpureum x *P. glaucum*						
King Grass					F	
Setaria sphacelata var. *splendida*						
CPI 15899					F	
B. Legumes						
Arachia glabrata						
CPI 93469/93490	(92)	G	-	P	F	
	(94)	F	-	-	-	F
Cajanus cajan						
CIAT 18700		X				

Name/Identification		ES	5/92	8/93	10/93	8/94
Centrosema acutifolium						
CIAT 5277	(92)	F	F	G	F	F
	(94)	F	-	-	-	F
C. macrocarpum						
CIAT 5452	(92)	F	F	G	G	F
	(94)	G	-	-	-	G
CIAT 15014	(92)	F	F	G	G	F
	(94)	E	-	-	-	E
CIAT 15047	(92)	P		E	F	F
	(94)	F	-	-	-	F
C. pubescens						
CIAT 438	(92)	P	P		F	F
	(94)	F	-	-	-	F
CIAT 15160	(92)	F	P		F	F
	(94)	E	-	-	-	E
Codariocalyx gyroides						
CIAT 3001	(92)	F	F	G	E	F
	(94)	E	-	-	-	G
Cratylia argentea						
CIAT 18516	(92)	P	F	G	G	G
	(94)	G	-	-	-	G
Desmodium heterophyllum						
Johnstone		E	-	-	-	G
D. ovalifolium						
CIAT 13089		E	-	-	-	E
D. velutinum						
CIAT 13220		X	-	-	-	-
Flemingia macrophylla						
CIAT 17403	(92)	P	P	G	G	F
	(94)	E	-	-	-	E
Stylosanthes capitata						
Capica		F	-	-	-	F
S. guianensis						
Pucallpa	(92)	P	F	G	F	F
	(94)	E	-	-	-	G
SSD-12		F	-		-	F

Appendix 8 - Lines which had good or excellent yield ratings at Project Sites in Kalimantan

Format Codes Used

Species -	Alphabetically listed by genus and species within genus, Part A. Grasses, Part B. Legumes
Line Identification-	Cultivar names are presented, numbers are Australian (CPI), Brazilian (BRA) or Colombian (CIAT) identification numbers.
Wet Season sown/planted -	91/92 = 1991/1992
Sites -	Sites where yield ratings were good or excellent.
Comments-	Specific comments on the line.

Name/Identification	Sites	Comments
A. Grasses		
Andropopgon gayanus Planaltina	KM,PL,GS,LJ,TS,WR,PH	Productive and persistent at all sites, produced good quantities of viable seed. Similar in appearance to cv Kent. Preferred by cattle at KM. Well grazed by deer at PL. Excellent regrowth following cutting. Good survival and regrowth after buring at LJ.
Brachiaria brizantha Marandu	KM,PL,GS,LJ,TS,WR,PH	Productive and persistent at all sites, produces some viable seed. Well grazed at LJ. Good survival after burning at LJ.
B. decumbens Basilisk	KM,PL,GS,LJ,TS,WR,PH	Productive and persistent at all sites, but not a high yielding as Marandu. Liked by cattle at KM. Well grazed at LJ. Little seed set. Poor regrowth after burning at LJ.
B. dictyoneura Llanero	KM,PL,GS,PH	Productive and persistent, not as high yielding as Marandu. Good vegetative spread at PL, KM. Little seed set.
B. humidicola CIAT 6369	KM,PL,GS,TS,WR,PH	Productive and persistent, not as high yielding as Marandu. Generally green or dark green in colour. Good vegetative spread at KM,LJ,GS,TS. Preferred by cattle at KM. Extremely well grazed at LJ. Good survival and regrowth following burning at LJ.
B. ruziziensis Thai ruzi	PL	Good growth at PL, the only site sown. Well grazed by deer at PL.
Digitaria milanjiana CPI 41192	KM,PL,LJ,SL	Better growth in first 2 years, productivity declined with declining fertility. Liked by cattle at PL, KM and LJ. Well grazed at LJ. Vegetative spread at LJ and SL. Good survival after burning at LJ.
D. swynnertonii CPI 59749	KM,PL,SL,WR	Good growth on the two most acid sites at KM and WR. Accepted by cattle at Pl, and at KM. Spread by seed at KM. Extremely competitive with *Imperata* at PL. Good survival after burning at LJ.

Name/Identification	Sites	Comments
Euclaena mexicana	PL	Good growth at the only site planted, but died out in the second year. Liked by cattle at PL.
Panicum maximum		
Makueni	KM	Poor estabishment some sites. Liked by cattle at PL, grazed at SL. Well grazed at LJ.
Riversdale	KM,PL,LJ,SL,WR	Productive and persistent, often pale in appearance. Liked by cattle at PL 7/92, well grazed at SL and LJ. Good survival and regrowth following burning at LJ.
Thai purple	PL	Good growth at PL, the only site sown. Generally pale in appearance. Well grazed by deer.
Paspalum atratum		Only sown 3 sites, one site cut back three times which affected its performance.
BRA 9610	PH	
P. conjugatum	KM,PL,WR	Good yield and persistence but not as productive as the other local and introduced grasses. Liked by cattle at PL.
P. guenoarum	PH	Only sown 3 sites, one site cut back 3 times which affected its perfomrance.
BRA 3824		
Pennisetum purpureum	KM,PL	Only planted 2 sites. Extremely productive in the first year, but died out during the second year at PL when no fertilisers were applied. Preferred by cattle at PL .
P purpureum x *P. glaucum*	KM,PL,WR	Productive at some sites, particularly in the first year, but died out at PL during the second year when no fertilisers were applied. Showed good growth and persistence at the acid WR sites. Generally stemmy and looked pale. Liked by cattle at PL and KM.
King grass		
Setaria sphacelata	KM,PL,WR	Only planted 3 sites. Producitve early when well fertilised but died out at 2 sites when fertlisers were no longer applied. Invariably suffered from leaf disease. Liked by cattle at PL.
var. *splendida* CPI 15899		

Name/Identification	Sites	Comments
B. Legumes		
Aeschynomene americana Glenn	PL,LJ,SL	Extremely productive in first and second years. Stands thinned out and productivity declined in third year, although some plants spread and volunteered from seed at most sites. Not liked by cattle at PL. Grazed at SL.
Lee	PL,LJ,SL	Extremely productive in first and second years. Died out during second year at all but 1 site. Set little or no seed. Not liked by catle at PL. Grazed at SL.
Cajanus cajan CIAT 18700	PL,GS	Persistent only at PL.
Calopogonium mucunoides	KM,WR	Good growth in first year only at the two sites sown.
Centrosema acutifolium CIAT 5277	KM,PL,LJ,PH	Productive and persistent at the less acid sites but generally set little seed and did not spread. Fair survival and regrowth following burning at LJ.
C. macrocarpum CIAT 5452	KM,PL,LJ,TS,PH	Productive and persistent but set little seed and did not spread except at LJ. Cut material eaten by cows at TS. Good survival and regrowth after burning at LJ.
CIAT 15014	KM,PL,LJ,TS,PH	Productive and persistent but set little seed and did not spread. Cut material eaten by cows at TS. Good survival and regrowth following burning at LJ.
CIAT 15047	KM,PL,LJ,PH	Productive and persistent but set little seed and did not spread except at LJ. Cut material eaten by cows at TS. Good survival and regrowth following burning at LJ.
C. pascuorum Cavalcade	KM,PL,LJ,SL,WR	Productive in the first year but set little seed and did not re-establish. Accepted by cattle at PL.

Name/Identification	Sites	Comments
C. pubescens		
CIAT 438	KM,PL,LJ	Productive and persistent. More prodution than local centro. Vegetative spread at TS. Well grazed at LJ. Poor survival and regrowth after burning at LJ.
CIAT 15160	KM,PL,GS,LJ,PH	More productive than CIAT 438, persistent, good vegetative spread at KM, GS, TS aned LJ. Obvious nitrogen input for range of grasses at GS. Preferred by cattle at KM. Forms good mixtures with a range of grasses. Extremely competitive with *Imperata* at LJ. Well grazed by deer at PL. Good survival and regrowth following burning at LJ.
C. schiedeanum		
Belalto	PL,LJ	Productive and persistent at the two less acid sites. Good vegetative spread at LJ and PL. Liked by cattle at PL. Well grazed at SL, LJ by cattle and by deer at PL. Competitive with Imperata at LJ.
Chamaecrista rotundifolia		
Wynn	KM, PL, WR	Introduced as a contaminant in Maldonado seed. Productive in the first 2 years and persisted at 3 sites. Set seed and spread at KM, PL and WR. Not liked by cattle at KM.
Codariocalyx gyroides		
CIAT 3001	PL,LJ,PH	Productive but productivity declined in third year at 2 sites. Did not appear to set viable seed. Limited grazing by cattle at LJ. Killed by wild fire at LJ.
Cratylia argentea		
CIAT 18516	PH	Establishment, growth and seed production adequate at 1 site only. Well eaten by goats.
Desmodium heterophyllum		
Johnstone	PH	Productive at 1 of 3 sites sown.
Local	WR	This native line was the most persistent and productive legume at WR.
D. ovalifolium		
CIAT 13098	PH	Productive only at 1 of 3 sites sown.

Name/Identification	Sites	Comments
D. velutinum		
CIAT 13220	PL	Productive only at 1 site.
Flemingia macrophylla		
CIAT 17403	KM,PL,GS,LJ,TS,PH	Extremely productive and persistent. Sets viable seed. Can be planted from stem cuttings. Well eaten by goats at TS. Not grazed by cattle but they will eat it if stall fed at LJ and TS. Accepted by cattle at PL 7/92. Not liked by cattle at KM. Good survival and basal regrowth after burning at LJ.
Local	PL	Good growth and persistence at the only site sown. Not markedly different from CIAT 17403 in productivity at this site.
Macroptilium gracile		
Maldonado	KM,PL,LJ,WR	Extremely productive in the first year, but productivity declined after that. Some plants persisted at four of the sites. Seed set was poor. Liked by cattle at PL. Flowering is limited in this environment. Transfer at N to grasses obvious. Well grazed at LJ. Fair survival and regrowth following burning at LJ.
Stylosanthes guianensis		
Cook	PL,LJ,SL	Productive and persistent at 3 sites spread at LJ. Not liked by cattle at PL 7/92 and KM. Preferred by cattle at SL. Well grazed at LJ. Killed by wildfire at LJ.
Graham, Thai Graham	PL,LJ,SL	Productive for the first 2 years but productivity declined in the third year. Less productive than Cook and Pucallpa. Accepted by cattle at PL. Preferred by cattle at SL. Well grazed at LJ. Killed by wildfire at LJ.
Pucallpa	KM,PL,GS,LJ,TS,PH	Productive and persistent at all of the sites sown. A fire destroyed most at 1 plot at KM and recovery was slow. Most planted killed by wildfire at LJ. Not liked by cattle at KM. Can be planted by stem cuttings. Competitive with *Imperata* at LJ and TS.
S. hamata		
Thai Verano	PL	Productive during the first year at the only site sown. Productivity declined during the second year. Not as productive as the *S. guianensis* lines.