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Consultant Final Report
EMBRAPA/CIAT/IICA

PASTURE SPECIES EVALUATION

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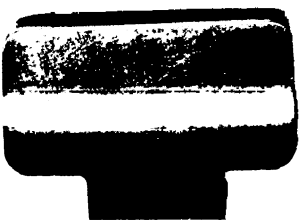

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Série Publicações Miscelâneas Nº A4/BR-89-058
ISSN-0534-0591

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Brasília, setembro de 1989

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA
EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA

Grof, Bela
Pasture species evaluation. Consultant final report EMBRAPA/CIAT/IICA/por Bela Grof.-Brasília:IICA/EMBRAPA,1989.
61 p. (IICA. Série Publicações Miscelâneas, A4/BR 89-058)
ISSN 0534-0591

1. Pastagem-Avaliação. I. Título. II. Série.

AGRIS F01
CDU 633.2

APRESENTAÇÃO

A reprodução e difusão dos Relatórios de Consultores, no âmbito restrito das Diretorias das Unidades do Sistema Nacional de Pesquisa Agropecuária, vinculado à EMBRAPA, tem como objetivo principal o de divulgar as atividades desenvolvidas pelos consultores e as opiniões e recomendações geradas sobre os problemas de interesse para a pesquisa agropecuária.

As atividades desta consultoria foram realizadas no âmbito do Projeto Colaborativo EMBRAPA/CIAT/IICA.

As opiniões dos consultores são inteiramente pessoais e não refletem, necessariamente, o ponto de vista do IICA ou da EMBRAPA. A coordenação dos Contratos IICA/EMBRAPA agradeceria receber comentários sobre estes relatórios.

Horacio H. Stagno
Coordenador Contratos IICA/EMBRAPA

Final report on pasture species evaluation studies conducted from 1985 to 1988. A collaborative project IICA/EMBRAPA/CIAT at the Centro de Pesquisa Agropecuaria dos Cerrados (CPAC) of EMBRAPA, Planaltina-DF, Brazil

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Acknowledgements

I wish to express my greatful appreciation to the directors of EMBRAPA/CPAC for providing the facilities to conduct the pasture species evaluation work described in this report. Thanks are due to colleagues in the Area Tecnica de Producao Animal with whom I have been associated during the past three years. Administrative support provided by directors and staff of IICA has been a great help and it is greatfully acknowledged. Special thanks go to Ms. Raquel Martins Silva and Engenheiros Marco Antonio de Souza and Andre Luis Schulz for their part in assisting me with the work in hand.

Evaluation of grass and legume species at the Cerrados Agricultural Research Center (CPAC) Planaltina-DF

Introduction

The Cerrados of Brazil occupy 203.7 million ha and constitute one of the largest areas of undeveloped land resources.

Although these ranges support about 40% (51 million) of the Brazilian cattle population (127 million), productivity is generally low. Poor nutritive value of native pastures and monospecific sown grass pastures is the principal cause of this low productivity, especially in the dry season when native grasslands often provide less than 60% of the animals' maintenance requirements. The introduction of improved forage grasses and the addition of a legume(s) to supply the much needed nitrogen (protein) to the associated grass and to the grazing system, is the most economical means of producing more beef and milk per unit area at lower cost.

Evaluation of forage species-a CIAT/EMBRAPA/IICA Collaborative Project-with the primary objective of identifying grasses and legumes adapted to Cerrados conditions and grazing utilization has been in progress at the Cerrados Agricultural Research Center (CPAC), Planaltina since 1978.

The experimental site is situated at lat. 15°C, 36'S, long. 47°, 42'W. Rainfall is 1580 mm/year with 90% falling from October to March inclusive. Average year-round temperature is 21°C. The soil is a well-drained, acid Oxisol (pH 4.5), P fixation and Al-saturation are high, it is deficient in P, K, Ca, Mg and trace elements.

During the past decade significant progress has been made in tropical pasture development at CPAC by exploiting

the naturally occurring species of legumes and exotic grasses through introduction and screening for desirable forage characteristics.

Since the initiation of the Collaborative Pasture Agronomy Program at CPAC some 2786 accessions, grasses and legumes have been evaluated. A total of 1099 accessions, 706 legumes and 393 grasses, have been evaluated during the 3 years under review.

Edaphically and environmentally adapted legumes and grasses that can grow at low levels of P and at high Al-saturation have already been identified for the Cerrados ecosystem.

During the initial phase of pasture species evaluation the emphasis was on the genus Stylosanthes. 60% of the legumes evaluated at CPAC prior to 1985 were accessions of Stylosanthes.

An achievement was the identification of anthracnose resistant genotypes of S. guianensis var. pauciflora and S. macrocephala. In addition to these species, two accessions of S. capitata were selected as 'key' species and included in a grazing productivity experiment.

Results of this and other grazing experiments conducted at CPAC indicate the need for a wider range of legumes with better stress and grazing tolerance. In case of Stylosanthes capitata, better anthracnose resistance is needed.

Low seed yields, lack of persistence in grazed grass-legume associations handicap S. guianensis var. pauciflora, while S. macrocephala has a short season of growth and it is not adapted to the higher rainfall regions of the northern Cerrados.

A broader range of genetic material of 'key' species and new introductions of legumes and grasses have been evaluated during the past three years. A collecting mission of CIAT to East and Central Africa lead Dr. Gerhard Keller-Grein realized new accessions of Brachiaria. Accessions of legumes and grasses evaluated during the period under review are listed in Tables 1 and 2.

Twenty-four accessions of forage species, 7 grasses and 17 legumes were selected for advanced testing.

Selections for the well-drained Cerrados:

C. brachypodum (1)
C. brasilianum hybrid (1)
Brachiaria brizantha (3)
B. decumbens (1)
P. maximum (1)

For the varzeas:

Arachis pintoi (2)
Desmodium ovalifolium (8)
Pueraria phaseoloides (4)
Paspalum conspersum (1)
Paspalum sp. aff. P. plicatulum (1)

Recently, pasture species evaluation was expanded in the varzea where accessions of Paspalum, Hemarthria and Axonopus have been tested, in the first instance, in a small-plot clipping experiment. Legume accessions selected from the collection of Arachis pintoi, Desmodium ovalifolium and Pueraria phaseoloides were included in a Category III type of experiment. These legumes were combined in association with Paspalum sp. aff. P. plicatulum, P. conspersum (syn. P. regnellii) and Brachiaria dictyoneura.

Two other Category III grazing experiments were initiated; one consists of 5 Brachiaria spp. each with Centrosema brasilianum, S. guianensis hybrids, S. guianensis var. vulgaris, an ecotype, locally referred to as 'Mineirao' and, S. capitata hybrid no. 56. Another experiment of this type contains, 'Mineirao' and four hybrids of C. pubescens x C. macrocarpum.

Preliminary evaluation of grasses

Since 1978 priority has been given to the evaluation of legumes at CPAC due to the major role adapted legumes can play in pasture improvement. In recent years emphasis has been given to the evaluation of species and accessions of Paspalum and Brachiaria. Species of Paspalum are particularly well-adapted to poorly drained conditions and Brachiaria spp. have great economic significance in the acid soil regions of Cerrados and cleared forest areas of Brazil. The susceptibility of the widely grown B. decumbens, B. humidicola and B. ruziziensis to spittlebug make it necessary to concentrate on the search of resistant accessions adapted to a wide range of ecological situations.

Brachiaria spp.

Some 343 accessions representing 12 species of Brachiaria have been evaluated in a small plot experiment at CPAC. 52% of the collection established as spaced plants were ecotypes of B. brizantha, by far, the most variable and promising species in the collection.

The collection was evaluated over two season, for dry-matter yield, and its seasonal distribution, growth habit, number of days to seed maturity, seed yield, regrowth following defoliation, and damage by spittlebug (Deois flavopicta). Cluster analysis was applied to the data matrix. The data matrix of these agronomic attributes was truncated at the seven-group level.

Dry-matter yields - overall

Annual dry matter yields for the seven clusters ranged from 10.2 to 22.4 t/ha/year and were the highest for clusters 3, 4 and 1, that is, 22.4, 22.2 and 17.1 t/ha per year, respectively (Table 3).

These 3 clusters contain 123 accessions, of which 105 (85.4%) are ecotypes of B. brizantha and they are all erect or semierect plants. In the 'second best' cluster (4), 89% of all accessions displayed erect/semierect growth habit. 11% and 5% in cluster 4 and 1 are stoloniferous, respectively.

In the cluster (3) containing only B. brizantha, 60% of the accessions are late flowering, that is, flowering began at the end of March or later.

Total dry-matter yields sorted into the remaining four clusters in declining order: 6 > 2 > 5 > 7, that is, 14.0, 12.7, 10.8 and 10.2 DM t/ha per year, respectively. These clusters contain the majority of accessions of B. decumbens, B. humidicola, and B. ruziziensis including the commercial cultivars of B. decumbens and B. humidicola. In addition to lower DM yields, accessions of these four clusters showed poor adaptive characteristics. Cluster 7 (the lowest yielding group) showed the highest incidence (94%) of spittlebug damage. Note, that only one accession of B. brizantha is located in cluster 7.

Dry-matter yields - wet season

The bulk of the dry matter yield was produced during the wet season. Highest DM yields in two wet seasons were recorded for clusters 2, 3 and 1, which produced 21, 18, and 16 ha, respectively. Up to 95% of the accessions were B. brizantha in the three clusters with the highest DM yields

(Table 4). Furthermore, 87%, 95% and 89% of the accessions in these three clusters were unaffected by spittlebug.

DM yields: dry season

78 accessions of B. brizantha or 61% of the 127 accessions of this species included in the experiment were sorted into clusters (3, 1, and 4) with DM yields of 5.3, 3.7, and 2.9 t/ha. Cluster 3 with the highest (5.3 t/ha) yield contains 24 accessions. Of these, 18 or 75% are B. brizantha and the remaining five are the best-yielding accessions of B.decumbens, including CIAT 16488.

In cluster (6) with the lowest dry matter yield, 50% of the accessions are B. humidicola and the rest of the accessions are B. ruziziensis and B. decumbens. These were badly hit by spittlebug in the wet season and recovery was slow or nil during the dry season. The poor performance of B. humidicola during the dry season has already been recorded at CPAC (Tables 5 and 6).

Seed yield

Days to seed maturity (counted from January 1) ranged from 75 to 185 days (Table 7). Some of the latest flowering accessions failed to produce seed. Seed yields also showed a wide range of variability among accessions, and ranged from 4 to 155 kg/ha.

Frequency of cutting trial

In the follow-up small plot experiment, 24 accessions of Brachiaria were compared using cv. Marandu as the control. Several accessions of Brachiaria brizantha and 1 accession of B. decumbens (CIAT 16488) produced high yields of dry matter when cut at 3, 6, 9 and 12 weeks intervals and

outyielded cv. Marandu. The relative growth rate* and recovery after defoliation of several of these accessions were superior to that of Marandu.

In general, crop growth rate** (CGR) peaked at the 6 and 9 wks. cutting interval and one accession of B. decumbens CIAT 16488 was considerably better than Marandu. High RGR and rapid recovery was recorded in several selected accessions 3 wks after defoliation. These accessions were B. brizantha CIAT 16315, 16306, 16301, 16467 and B. decumbens CIAT 16488 (Figs 1 and 2).

Preliminary agronomic evaluation of the Brachiaria spp. collection has been completed and three accessions of B. brizantha and one accession of B. decumbens have been selected for Category III type of evaluation, that is, under grazing and in association with legumes. These selected accessions represent distinct growth forms with specific agronomic characteristics. For example, CIAT accession 26110 is a 'Marandu-type' but it has shown significantly better recovery after defoliation during the dry season and it has a higher relative growth rate than cv. Marandu. It appears,

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* The relative growth rate (RGR), defined as the increase of plant material per unit of material present per unit of time, was calculated from the formula

$$RGR = \frac{d}{dt}(\log_e kg/ha)$$

** Crop growth rate (CGR), defined as the increase of plant material per unit of time, was calculated using the formula

$$CGR = \frac{dW}{dt}$$ where W = total dry-matter in kg/ha

that it requires better soil fertility or higher rate of fertilizer application for best performance. CIAT 16315 is a less productive type of B. brizantha with excellent performance during the dry season. It is a short growth form, tolerant of drought and it is a good seed producer. CIAT 16306 is one of the tall, erect types, this accession also showed good recovery following defoliation during the dry season. The ability of these different growth forms to combine in association with legumes e.g. S. capitata and C. brasilianum is of particular interest. This aspect is being investigated in a small-scale grazing experiment on the Chapadao.

Cluster analysis of numerical data of relatively few, well-chosen agronomic attributes sorted the Brachiaria collection into similar agromorphological groups. The superiority of accessions of B. brrizantha became quite obvious.

Paspalum spp.

Paspalum is a predominantly American genus. It contains approximately 250 species most of which are good grazing grasses and several of them are adapted to wet situations. It is estimated that there are 30 million ha of hydromorphic soils in Brazil and 12 million ha of these varzea lands are situated in the Cerrados. Most of the c. 160 species of this genus occurring in Brazil are well-accepted by cattle. Several species such as P. guenoarum and P. plicatulum possess antibiosis that effectively reduced survival and fecundity of adult spittlebugs and killed nymphs of the insect feeding on these species.

In a small plot, cutting experiment established on a low humic gley soil at CPAC, 8 accessions of Paspalum sp. aff. P. plicatulum were compared with seven other grasses.

These accessions were selected from 43 wet-land grass species collected by Dr. J.F.M. Valls, Curator of Gramineae, CENARGEN.

Two agro-morphological groups of this species form were distinguished: late flowering, broad-leafed genotypes with high yield capacity, IVDMD and nutrient values; early flowering, narrow leafed types with low yield capacity and generally low nutritive values.

The highest total annual and dry season herbage yields were produced by Paspalum sp. aff. P. plicatulum BRA accessions 009661, 003913 and 009610. These accessions produced dry matter yields ranging from 25.7 to 28.6 t ha^{-1} (Table 8). The same accessions were the most productive in the dry season (Table 9).

Significant intraspecies variability was recorded in IVDMD among accessions of P. sp. aff. P. plicatulum. In the wet season, IVDMD values for accessions of this species ranged from 33.4% to 57.3%. BRA accessions 003913, 009661, and 009610 selected on the basis of several desirable agronomic characteristics were in the top range of IVDMD values: 55.56%, 54.91%, and 54.83%. In the dry season, IVDMD values were the highest, 51.9% and 51.7%, for two of the selected BRA accessions, 009610 and 003913, respectively (Table 10). Crude protein contents of the selections were above maintenance level in the wet season, while P content of the forage was marginal. Both values were below or at maintenance level at the end of the dry season (Table 11). The first selection, BRA 009610, showed somewhat more stable IVDMD values on a year-round basis than the other two selections, also it had a slightly higher CP content at the end of the dry season. Accession BRA 009610 has been established for basic seed multiplication in the 1987/88 wet season.

Mean yields of cleaned seed for accessions of P. sp. aff. P. plicatulum ranged from 214 to 918 kg/ha.

The species and ecotypes of Paspalum included in this experiment were free of foliar diseases and insect pests, including spittlebug. The long growth season, high DM yields, and nutrient contents of selected accessions of P. sp. aff. P. plicatulum in a seasonally flooded situation are of considerable economic significance. These accessions can provide an adequate diet for the maintenance of adult cattle by filling the 'nutritional gap' regularly occurring in the well-drained savannas during the dry season.

Panicum maximum

Dr. E.M. Hutton selected three lines from hybrid progenies of sexual P. maximum for evaluation. One of these accessions, a drought tolerant type of intermediate growth habit, CPAC 3148, is showing good promise in small plot experiments and in regional trials 'B' established at Lucas do Rio Verde, Canarana and Rondonopolis, MT, in the 1500 to 2000 mm rainfall region.

Preliminary evaluation of legumes

CPAC has assembled and studied a wide range of accessions of Stylosanthes species with emphasis on S. guianensis var. pauciflora, S. capitata, S. guianensis var. vulgaris and S. macrocephala.

173 accessions of Stylosanthes have been evaluated during the period 1985-88. Anthracnose continued to be a problem in Stylosanthes accessions. Infestation was relatively low in the year of establishment. Twenty-seven percent of the accessions under observation were free of the

disease, less than one percent of the accessions were killed and the rest was slightly or moderately affected.

Anthracnose caused severe damage in the 1987/88 season, the pathogen destroyed a stand of 1.2 ha of S. capitata CIAT 1097. This accession showed field resistance to anthracnose in the grazing trial established in 1983.

S. guianensis var. pauciflora

127 accessions of the "tardio" group have been evaluated prior to 1985 and an additional 64 accessions were tested since, totalling 191 accessions of this species form. Selection of accessions with an early flowering habit and improved seed production continued.

Main attributes of the tardio group

- most accessions are very well-adapted to the soils and climate of the region;
- excellent tolerance to drought and they are not defoliated in the dry season;
- high degree of resistance to anthracnose.

Deficiencies

- low inherent capacity to produce seed;
- lack of persistence in grass-legume associations;
- poor regeneration from self-sown seed;
- unstable resistance to anthracnose and stemborer in the northern Cerrados.

Past experience with CIAT 2243 (cv. Bandeirante) indicated that the low inherent capacity of this species form to produce commercially acceptable seed yields can not be improved upon by agronomic manipulation, including

irrigation and high rate of fertilizer application. Seed yield of this accession with irrigation until peak flowering produced 34 kg of pure seed per ha as against 24 kg/ha without irrigation.

Although seed production of six accessions of 'tardios' varied considerably in 1988, only one accession (CIAT 2542) produced good seed yields. These accessions were hand harvested during the second week of September and fallen seed was collected on a plastic sheet placed under the plants. Pure seed yields were as follows:

CIAT accession	Pure seed yield kg/ha		
	from plant	under plant	total
2542	127.0	48.8	175.8
10417	68.3	10.4	78.7
10484	68.1	9.9	78.0
2017	33.8	9.9	43.7
2974	23.2	13.2	36.4
2983	5.6	8.6	14.2

The aim of a recently developed project is to select superior genotypes from hybrid derivatives of a series of crosses of S. guianensis pauciflora x vulgaris and vulgaris x vulgaris. Fifty hybrid lines, products of the breeding program conducted by Dr. J.W. Miles in Colombia, were established for evaluation in a space-planted nursery in four randomized blocks in 1986/87. The hybrids were classified on the basis of flowering date, vigor, anthracnose resistance and seed yield. Early and mid- season lines were considered those which were in the 'full seedhead stage' or at least began flowering at the end of

March. Seeds of these lines reached maturity in June/July (Table 12).

There is an inverse relationship between early maturation of seeds and retention of leaves during the dry season. Several of the mid-season and late flowering (April-May) hybrids possess the desirable characteristic of retaining green leaves throughout the dry season. The agronomic value of these genotypes largely depends on their capacity to produce seed yields better than those of cv. Bandeirante. At the same time, they must have a high degree of resistance to anthracnose. Apparently, there is a certain loss of disease resistance in the hybrids. The following lines combined some of these desirable characteristics:

16 - 8 (CIAT 15 x 1539)
24 - 23 (CIAT 1639 x 1633)
24 - 22 (CIAT 1122 x 1539)

A late flowering F_5 hybrid, 16-4 (CIAT 1808 x 1062) has excellent forage characteristics and it is somewhat earlier flowering than cv. Bandeirante (Table 13).

Anthracnose caused only minor damage in these selected materials while one of the controls, S. guianensis CIAT 136, was moderately affected by anthracnose.

Stylosanthes capitata

Unquestionably, this species has the best adaptation to the poor fertility acid-soil Cerrados.

296 accessions have been evaluated at CPAC, and all showed good adaptation to climate and soil. In the preliminary evaluation trials Brazilian accessions CIAT 1019 and 1097 were selected on overall performance for advanced

testing. Initially, these accessions have shown resistance to anthracnose and were included in the first grazing productivity (Category 4 or Stage 3) experiment conducted from May, 1983 to 1987. A relatively high population of these two S. capitata accessions was maintained in association with A. gayanus for the duration of the experiment. A slight advantage in terms of animal liveweight gain was recorded for CIAT accession 1097.

A major limitation to S. capitata is anthracnose. However, substantial intraspecific variation and resistance occurs in this character.

Because of the cyclic incidence of severe attacks of anthracnose it is imperative to carry out anthracnose screening over several seasons and inoculation with a broad spectrum of physiological races of the pathogen. A collaborative project with Plant Patology, CPAC was initiated in the second semester of 1988.

In a glass-house experiment 27 accessions, including susceptible controls are being tested using artificial inoculation. Resistant material will be further tested in field trials (Table 14).

In addition to S. capitata CIAT 1097 which is an early flowering accession, hybrid lines were selected from the plant breeding project of Dr. E.M. Hutton for evaluation. The hybrids, nos. 56 and 111, are early and late flowering types, respectively, the difference in seed maturation is up to 8 weeks. They were found to be superior to CIAT 1097 with respect to vigor and anthracnose resistance. Both hybrids are currently under seed multiplication. Most early flowering accessions of S. capitata are defoliated when their seeds mature. Consequently, late flowering habit with retention of leaves long into the dry season is an important criterion in the selection of suitable ecotypes of this

species. The following accessions were selected for late flowering and retention of leaves: CIAT 2320, CIAT 2353, CIAT 2546.

S. guianensis var. vulgaris CIAT 2950

Attributes of Stylosanthes guianensis var. vulgaris - 'Mineirao', CIAT 2950.

- well adapted to soils and climate of the Cerrados;
- resistant to anthracnose in the Central Plateau region and in Mato Grosso. However, it is susceptible to anthracnose in the northern Cerrados, in the Boa Vista, Macapa and Amapa Savannas.
- excellent establishment vigor;
- compatible with Andropogon gayanus and Panicum maximum (hybrid no. CPAC 2148);
- superior drought tolerance;
- first to recover after the opening rains;
- a major deficiency of this ecotype is poor seed production;

This accession has been included in two small-scale grazing trials. In one experiment, it is being evaluated in association with five Brachiaria spp. representing distinct growth forms. 'Mineirao' significantly ($P < 0.01$) outyielded S. capitata no. 56, C. brasilianum CIAT 5234 and S. guianensis hybrids during the dry season following heavy grazing. 'Mineirao' also performed well in association with Andropogon gayanus and Panicum maximum. It has persisted well in a protein bank and there was no loss of stand under this type of intermittent grazing.

In a small-scale grazing experiment 'Mineirao' showed excellent establishment vigor in association with

erect growth forms of Brachiaria brizantha, such as CIAT 16280.

Stylosanthes macrocephala

Promising accessions in the CIAT germplasm collection show resistance to anthracnose and stemborer at least in the Central Plateau region and in Mato Grosso. In the northern Cerrados, stand losses up to 75% occurred due to these problems. 150 accessions have been evaluated at CPAC; the promising accessions selected earlier are CIAT 2133 (BRA 008419), CIAT 10007 (BRA 0022781) and CIAT 10009 (BRA 0022837). These have been included in regional trials conducted in Mato Grosso and, CIAT 10007 has shown the best vigor.

There are distinct growth forms among the thirty-three new accessions of S. macrocephala introduced in 1985/86. For example, accession CIAT 10010 (BRA 0022965) is a very prostrate type. All accessions are prolific seed producers and the majority of accessions flower in February or early March and these are completely defoliated by the onset of the dry season. This is a major disadvantage of the species and in this respect there is no ecotypical variability among the accessions evaluated. CIAT 1430 (BRA 0028967) has shown better vigor than the control cv. Pioneiro CIAT 1281 (BRA 003697).

Centrosema spp.

C. brasilianum

At present, this is the most promising species for Cerrados conditions. CIAT 5234 (BRA 012297) persisted in association with Andropogon gayanus for three years under a heavy intermittent system of grazing. It was somewhat less

successful in association with B. brizantha cv. Marandu. It has excellent drought tolerance and it is a prolific seed producer. Hand harvested small plots yielded the equivalent of 850 kg/ha cleaned seed.

A major constraint for the species on the dark-red latosol site is little leaf mycoplasma (LLM). Practically all accessions of C. brasilianum were affected to some extent by LLM. The disease has severely reduced dry matter production and in most cases prevents seed setting. This problem is affecting only a small number of plants in the new experiments established on the Chapadao. Rhizoctonia attacks the plant during the wet season but it is not a serious problem under regular grazing.

C. macrocarpum

In addition to the 58 accessions tested earlier 130 accessions were included in the recent testing program. C. macrocarpum accessions were noted for good resistance to foliar diseases. All showed excellent adaptation to climate and soil conditions. Vegetative vigor and tolerance to drought were also good. A major problem with this legume is lack of flowering and seed set at CPAC and this applies to all 188 accessions evaluated. The presence of Cercospora, Anthracnose, Rhizoctonia and the Phoma/Phomopsis complex of pathogens were recorded. A virus condition also affects most accessions. But the incidence of diseases was low.

Selections from a breeding program initiated by Dr. E.M. Hutton produced hybrids of C. pubescens x C. macrocarpum which show resistarce to Phoma/Phomopsis and produce high seed yields as well. Four F_8 lines have been included in a Category III type grazing evaluation trial, each hybrid was established in association with A. gayanus and Panicum maximum.

Evaluation of 188 accessions of C. macrocarpum has now been concluded. The findings indicate that, in the collection evaluated to date, no suitable ecotype exists for the Planalto region of Central Brazil.

C. acutifolium

51 accessions of this species, introduced from Colombia, Venezuela and Central Brazil have been evaluated. In general, the species is well adapted to soil and environmental conditions. Excellent disease resistance but late flowering and poor seed production was recorded in accessions such as CIAT 5287, introduced from the Colombian Llanos. Several accessions of this species are highly susceptible to Phoma/Phomopsis.

One accession of C. acutifolium, (CIAT 15531) originally selected at CNPGC, Campo Grande, showed good performance, that is, resistance to foliar diseases and remained green throughout the dry season. Flowering and seed production occurs late in the season and it is moderate.

C. tetragonolobum and C. brasilianum hybrids

In view of the good forage potential of C. brasilianum and the related C. tetragonolobum, 38 and 11 new accessions have been evaluated, respectively, in 1987/88.

Establishment yield and early vigor of 6 accesssions of C. tetragonolobum were particularly good. DM yield of these accessions ranged from 2381 to 2437 kg ha^{-1} six months after establishment. All accessions of C. tetragorolobum exhibited resistance to pests and diseases. Only one accession (CIAT 15838) of this promising species is early flowering at CPAC. However, few of the flowers produced pods and most of them were distorted and empty.

A bulked-up population of the hybrid C. brasilianum (5234 x 5224) and selections from the F_2 population were planted on the Chapadao in December 1987. Selection 108 outyielded all other accessions including the control CIAT 5234 (Table 15).

The bulk population (F_3) of the hybrid, C. brasilianum, C. acutifolium CIAT 15531 and C. brachypodum CIAT 5850 are also under seed multiplication.

Desmodium ovalifolium

This vigorous, stoloniferous perennial is best adapted to regions with 2000 mmm or more rainfall and with a short dry season. It lacks vigor in dryland areas of the Brazilian Cerrados where the length of dry season is more than two months. However, the species is promising in the Cerrados in low-lying areas subject to periods of flooding. At CPAC it was found to be susceptible to root-knot nematodes. Considerable variation was observed among accessions in this respect. The number of root-knot nematodes (Meloidogyne) ranged from nil to 13,725 per 5 g of roots. A final selection for resistance to root-knot nematodes and little leaf mycoplasma was carried out among the 70 accessions of D. ovalifolium established nearly four years ago. 23% of the accessions were severely affected by these diseases and were dead or almost so at the time of observation. On the basis of tolerance to root-knot nematodes and vegetative vigor, 8 accessions were selected for seed multiplication and continuing evaluation (Table 16). Four accessions are under grazing in the Category 3 experiment established in the varzea at CPAC.

Significant ecotypical variability was observed in seed production among accessions tested in the varzea. The range was from 0,6 kg to 440 kg ha^{-1}. Higher seed yields were

obtained from accessions in which peak flowering occurred before June (Table 17).

Selected accessions are currently evaluated under grazing in association with B. dictyoneura and two accessions of Paspalum sp. aff. P. plicatulum (Table 18).

Pueraria spp.

Some 47 accessions from 3 species have been evaluated in the varzea at CPAC. Four selections have been included in a grazing evaluation trial. These selections have grown vigorously during the six months of wet season but appear to be intolerant of low temperatures (< 15°C) and made no regrowth during the cool-dry season eventhough moisture in the varzea was non-limiting. Apparently, the species is out of its normal tropical environment on the Planalto.

The accessions under seed multiplication are: CIAT 17283, 17300, 7182 and 17320. These are early flowering, heavy seeders.

Arachis pintoi

Accessions of A. pintoi showed good adaptation to seasonally water-logged situations. Initially, 9 accessions and the control (CIAT 17434) had been evaluated. Four accessions, including 3 local selections and the control were established in a Category 3 experiment. Two accessions, CIAT 18748 and CIAT 18750, showed superior establishment vigor and nodulation in the year of establishment. An important feature of these accessions is high seed production. Seed yields in excess of 1 t ha^{-1} have been recorded in two consecutive seasons from these accessions under supplementary irigation.

Evaluation of grass-legume associations under grazing

Varzea

A small-scale grazing experiment was established in the varzea in May, 1987. This trial comprises four selected accessions of each of the following legumes A. pintoi (CIAT 18748, 18749, 18750 and 17434), D. ovalifolium (CIAT 13085, 13110, 13137 and 13289), and Pueraria phaseoloides (CIAT 7182, 8042, 17300, and 17320). These legumes were planted in association with the following grasses: A. pintoi - B. dictyoneura CIAT 6133, A. pintoi - Paspalum sp. aff. P. plicatulum - BRA 008486, D. ovalifolium - P. sp. aff. P. plicatulum BRA 008486, D. ovalifolium - B. dictyoneura CIAT 6133, P. phaseoloides - Paspalum conspersum (syn. P. regnellii)BRA 000159, P. phaseoloides - P. sp. aff. P. plicatulum BRA 001449. Two stocking rate treatments were superimposed on the experiment.

In this situation, accessions of A. pintoi and D. ovalifolium performed best. These legumes formed productive associations with B. dictyoneura and P. sp. aff. P. plicatulum. Dry matter yield accumulated at the end of the wet season was significantly ($P < 0.05$) higher for P. sp. aff. P. plicatulum than that of B. dictyoneura. Yield difference between P. sp. aff. P. plicatulum and P. conspersum at the end of wet season was not significant but regrowth produced by P. conspersum during the rainless period of July - August was higher. Apparently, this grass has better tolerance to low night temperatures (10 - 15^{o}C) than the other grasses in the experiment. (Table 19).

Accumulated DM yield and regrowth during the rainless period was significantly higher ($P < 0.01$) for A. pintoi CIAT 18750 thar for three other accessions of this species in the experiment. A. pintoi proved to be the most palatable and D. ovalifolium the least palatable species. Two

accessions of A. pintoi, CIAT 18750 and 18748 which originated from the Central Plateau, were found to be more resistant to fungal diseases (Cercospora, Colletotrichum, and Synchytrium) and spider mite, also they nodulated better than the control accession (CIAT 17434) introduced from the Brazilian Atlantic coast (Table 20).

Legume compatibility with Brachiaria spp.

This small-scale grazing trial was established on red-yellow latosol and consists of 5 Brachiaria spp. accessions of distinct growth habit, ranging from a prostrate, decumbent type to erect and semierect growth forms, with cv. Marandu as control. Each grass was established with four legumes. A stocking rate of 1.7 an/ha was superimposed on these pastures. Grazing started at the end of the wet season and grazing intervals of six weeks to be employed during the coming wet season. Presentation dry-matter yields were significantly ($P < 0.01$) higher for S. guianensis 'Mineirao' than those of S. capitata, C. brasilianum and S. guianensis hybrids. On the basis of total (grass + legume) dry-matter yield, associations containing 'Mineirao' and S. capitata were better than those of C. brasilianum and S. guianensis hybrids. As regard to compatibility of pasture components it is too early to draw conclusions.

Centrosema/Stylosanthes with A. gayanus and P. maximum

Four Centrosema hybrids and S. guianensis 'Mineirao' were combined in association with Andropogon gayanus or Panicum maximum (CPAC 3148). These plots are grazed at 6-weeks intervals and high and low stocking rates are superimposed on these associations. Grazing of the experiment started in 1987/88 and legume population is satisfactory in all treatments.

Regional Trials

The multilocational trials proved to be of great success determining the range of adaptation of species selected at CPAC and complemented the species selection work conducted at HQ. The set of new selections listed before should be included in future RT's.

Seven regional trials type "B" have been established in the Cerrados during the 1987/88 season. These regional trials include a new set of selected species such as S. capitata hybrid, C. brasilianum CIAT 5234, accessions of C. acutifolium, Panicum maximum hybrids, Paspalum conspersum, and P. sp. aff. P. plicatulum. One regional trial was established on varzea land in Mato Grosso. The two species of Paspalum and Desmodium heterocarpon are the outstanding species for this situation. Three hybrid lines of S. guianensis were included at one site in Mato Grosso. C. brasilianum is one of the most promising species for the well-drained Cerrados. Another promising accession is C. acutifolium CIAT 15331.

The "Southern Cone" - Paraguay

The summer growing legumes such as, Leucaena, C. acutifolium, C. pubescens x C. acutifolium hybrids are promising on the better soils. The Centrosema accessions were practically free of foliar diseases in this situation. C. macrocarpum, D. ovalifolium, and S. capitata were killed by frost (- 3°C). This ecosystem is not well catered for by our existing germplasm collection and new introductions of subtropical species are needed for evaluation. The winter growing species Lotononis and Lespedeza are promising. East African clovers were introduced for evaluation.

Bolivia

The CIAT germplasm is more applicable to the Santa Cruz area and a regional trial 'B' was established at the Saavedra experimental station. Another collaborating institution in Bolivia, the Universidad Tecnica de Beni was supplied with planting material from CPAC stock. Species adapted to water-logged situations such as Desmodium heterophyllum, D. ovalifolium, and Paspalum spp. will be tested at UTB. Fifteen hybrid lines of B. guianensis and selected accessions of Brachiaria spp. were also added to the list of new accessions.

Conclusions and Recommendations

Germplasm evaluation at CPAC and its future needs

As described in the report, a wide range of potentially useful forage species have been assembled and studied at CPAC. It is of paramount importance to evaluate the selected accessions as soon as it is practically feasible.

There is a tremendous public interest in improved forage species in Brazil. Therefore, a concentrated and reinforced effort should be made to evaluate and release species adapted to the various niches in the Cerrados ecosystem.

There are species on the list of promising accessions that could be released at an early date. For example, Paspalum conspersum has a number of desirable agronomic characteristics that would qualify the species for an early commercial release for varzea conditions. Although grazing productivity data will not be available for several years, its resistance to spittlebug, high palatability and nutritive values are sufficient reasons for its release.

The Stage 2 type of experiments presently employed are based on the Jones and Jones-Hutton design is highly suitable to evaluate simultaneously several accessions of the same legume in association with grasses This type of experiment is an excellent forerunner of field scale grazing productivity experiments. The major advantage is the low cost of maintenance and up-keep of this experiment and it requires minimum supervision. Since plot size is small (e.g. 400 and 800 m^2) particular care must be taken to obtain a uniform establishment of all treatments. Because of the cyclic growth of pasture species in the six months wet and six months dry regions of the Cerrados, a seasonal change of stocking rate has to be incorporated in the design of the experiment.

Is the available legume germplasm sufficient?

The supply of native legume germplasm is far from being exhausted. The need for adapted legumes is greater now, since the deficiencies of existing material are well known. The objectives of plant collecting missions can be well defined as well as the areas of collection sites. In areas where a particular species is endemic, the saturation technique may be applied, that is, a group of collectors should spend as much time as it is required to thoroughly comb the area for the particular species, ecotype in demand.

Stylosanthes guianensis

Although species and ecotypes of Stylosanthes which are edaphically well-adapted to Cerrados conditions have already been selected several of these have major deficiencies as pasture species. For example, the "tardio" group (S. guianensis var. pauciflora) and the promising ecotype of S. guianensis var. vulgaris, "Mineirao", are inherently poor producers of seed. While a large collection of S. guianensis var pauciflora is available and many accessions have been evaluated: only one accession (CIAT 2950) of the "Mineirao" type has desirable agronomic features. This is a clear cut case where more germplasm is required for agronomical evaluation.

S. guianensis hybrids

The current evaluation program of 50 hybrid lines should be carried out to a logical conclusion. The primary objective of the project is to identify early or mid-season flowering lines with retention of leaves during the dry season, stable anthracnose resistance and commercially acceptable seed yields.

A hybridization project using var. pauciflora and "Mineirao" type S. guianensis as parents is worth consider-

ing with the aim to produce a new set of hybrids which may recombine the desirable agronomic features listed above.

S. capitata

Resistance to a broad spectrum of physiological races of anthracnose is the principal objective of current and continuing selection. Accessions and/or hybrids of S. capitata which prove to be resistant in planthouse and field tests to be included in regional trials for evaluation in a wide range of ecological situations. This project should have a high priority.

After the completion of a series of anthracnose tests in the planthouse and under field conditions, resistant accessions should be tested under grazing (Stage II) in association with erect growth forms of Brachiaria and A. gayanus.

Centrosema brasilianum

At present, C. brasilianum is the most successful legume species selected at CPAC. It is adapted to acid, infertile Cerrados soils in the Central-West and in Mato Grosso.

It is compatible with vigorous grasses such as A. gayanus and it is an excellent seed producer. The accession tested (CIAT 5234) is moderately palatable, but it is well-accepted by cattle during the dry season. A major constraint to the wider use of C. brasilianum at present is little-leaf mycoplasma (LLM). The disease is localized at the moment in the old introductory nursery on LVE soil and there is little evidence of LLM on the Chapadao where a small scale grazing experiment was established 3 years ago, also new accessions and a field scale grazing experiment were planted at the same site during the current season. The

available accessions are agronomically successful and there is no immediate need to increase the germplasm base. It is, however, rather urgent to identify the vector(s) spreading LLM. It would be useful to know whether or not it is a native insect and, if so, why is the area of infestation restricted to the old legume nursery.

C. acutifolium

In the 1500 mm rainfall regions of the Cerrados, an ecotype of C. acutifolium from Mato Grosso, is doing better than the high rainfall types originating from the Colombian Llanos and Venezuela. To date, only a relatively small number of accessions of this species have been examined and, while the selected accession, (CIAT 15331) is disease resistant, its seed production is only moderate. More accessions of the Mato Grosso type should be obtained for evaluation at CPAC.

Arachis pintoi

A small number of accessions (9) is available of this species. Because of the good promise shown by two accessions in the varzea more material is needed for evaluation. These selected accessions originated from the Planalto region, one is from Formosa, the other one was collected in the Federal District. Accessions of this and other species adapted to well-drained Cerrados and sandy soils would be desirable. Specific Rhizobium cultures are needed for A. pintoi especially when sexual seed is used for establishement.

Paspalum spp.

Native grasses, particularly the genus Paspalum, deserve a lot more attention. The Pantanal should have a high priority for collecting Paspalum spp. Accessions of P. regnellii and P. plicatulum are among the best for varzea

conditions at CPAC. Collecting missions should work along the Amazon basin as well in search of tropical forms of promising species, such as P. plicatulum, P. coryphaeum, P. secans, P. maritimum etc.

Late-flowering, broad-leafed accessions of Paspalum sp. aff. P. plicatulum were identified as a promising group of native grasses adapted to seasonally flooded soils (varzea). Accessions of this species form tested at CPAC are free of pests and diseases of major consequence and are, resistant to spittle bug, because of antibiosis. Of the three selected accessions, BRA 003913, 009661 and 009610, the latter has already been established for multiplication of basic seed.

. Brachiaria spp.

A major part of CIAT's Brachiaria collection, some 343 accessions from 12 species has been evaluated.

Analyses showed that 85% of the best yielding accessions were B. brizantha. A high percentage of the B. brizantha accessions were undamaged by spittlebug. It was possible to select accessions with high performance for advanced testing in sward and in association with legumes.

Three accessions of B. brizantha and one tentative selection of B. decumbens are on the list of promising accessions. The respective BRA/CIAT numbers are: B. brizantha BRA 003361 (CIAT 16306), 003441 (16315), 004308 (26110), B. decumbens 004391 (16488).

While in the past season, spittlebug infestation was light, in the early part of the wet season of 1988-89, a very severe attack was observed. At the time of writing results are being compiled. These data will be of considerable help in selecting suitable accessions of Brachiaria.

Several hundred new introductions of Brachiaria spp. are in CIAT's germplasm bank and these to be obtained and evaluated as soon as it is possible. Accessions of B. brizantha should have a high priority in the evaluation program.

List of publications since 1985.

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acid-soil savannas of the Brazilian Central Plateau. Submitted for publication to the XVIth International Grasslands Congress.

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Table 1.

Legume germplasm under preliminary evaluation (Cat. I, II & III) 1985/88, at CPAC, Brazil

Species	No. of accessions	Total
Arachis pintoi	6	6
Centrosema acutifolium	51	
C. arenarium	5	
C. bifidum	1	
C. brasilianum	88	
C. brachypodum	1	
C. capitatum	1	
C. macrocarpum	130	
C. pascuorum	17	
C. pubescens	9	
C. pubescens x *C. macrocarpum*	5	
C. rotundifolium	2	
C. sp.	3	
C. tetragonolobum	11	
C. vexillatum	1	325
Desmodium canum	1	
D. heterocarpum	3	
D. heterophyllum	20	
D. ovalifolium	70	
D. strigillosum	6	
D. velutinum	1	101
Periandra coccinea	1	1
Pueraria lobata	3	
P. phaseoloides	36	
P. sp.	8	47
Stylosanthes capitata	76	
S. guianensis var. *pauciflora*	64	
S. guianensis var. *vulgaris*	2	
S. guianensis hibrido	50	
S. macrocephala	33	225
Tadehagi sp.	1	1
Total		706

Table 2.

Grass germplasm evaluated at CPAC from 1985 to 1988		
Species	Number of accessions	Total
1. *Brachiaria brizantha*	169	
2. *B. decumbens*	40	
3. *B. ruziziensis*	14	
4. *B. humidicola*	48	
5. *B. jubata*	35	
6. *B. serrata*	3	
7. *B. dictyoneura*	13	
8. *B. leucocrantha*	2	
9. *B. bovonei*	6	
10. *B. subulifolia*	4	
11. *B. platynota*	3	
12. *B. nigropedata*	1	
13. *B.* sp.	5	343
1. *Paspalum* sp. aff. *P. plicatulum*	19	
2. *P. plicatulum*	1	
3. *P. urvillei*	2	
4. *P. pauciciliatum*	1	
5. *P. modestum*	2	
6. *P. oteroi*	1	
7. *P. indecorum*	1	
8. *P. pumilum*	1	
9. *P. lividum*	2	
10. *P. proliferum*	1	
11. *P. notatum*	2	
12. *P. conspersum*	1	
13. *Paspalum* sp. aff. *P. virgatum*	1	
14. *P.* sp	2	37
1. *Penisetum* sp	1	1
1. *Panicum maximum*	5	5
1. *Andropogon gayanus*	2	2
1. *Hemarthria altissima*	2	2
1. *Axonopus complanatus*	1	
2. *Axonopus repens*	1	
3. *Axonopus araujoi*	1	3
Total		393

Table 3.

Classification of 238 accessions from 13 species of *Brachiaria* on the basis of five parameters.

Cluster	No. of accessions (% total)	DM yield t ha^{-1}year^{-1}	Growth habit	Flowering time	Regrowth	Spittlebug damage score
1	57 (23.95%)	17.12	3(50,9%) - 2(43-9%)	2(94.7%)	3(73.8%)	0(86%)
2	14 (5.88%)	12.67	2(85,8%)	2(85,8%)	4(49,8%) - 3(42,7%)	0(71.4%) - 1(25,5%)
3	30 (12.61%)	22.40	2(50%) - 3(50%)	3(60%) - 2(40%)	3(73,3%) - 4(20%)	0(100%)
4	36 (15,13%)	22.22	3(52,8%) - 2(36,1%)	3(88,9%)	4(69,6%) - 3(19,5%) 5(11,2%)	0(97,2%)
5	25 (10,50%)	10.80	2(68%) - 3(24%)	3(92%)	3(60%) - 2(32%)	0(80%) - 1(20%)
6	60 (25,21%)	14.03	5(100%)	3(98,3%)	3(73.8%) - 4(18,4%)	0(91,6%)
7	16 (6,72%)	10,20	5(87,5%)	3(87,6%)	3(56%) - 2(44%)	1(83,7%)
Total	238	X: 15.63				

Growth habit: 2 - erect; 3 - semi-erect; 4 - stoloniferous

Flowering time: 1 - early; 2 - mid-season; 3 - late

Regrowth: 1-5 (min. - max.)

Spittlebug: 0-5 (no spittlebug - major damage (dead plant)

Table 4. **Dry-matter yield of 244 accessions of *Brachiaria* spp. in the wet season (4 harvests) CPAC, Planaltina**

Cluster	No. of accessions (% of total)	DM yield t/ha	*B. brizantha* No. and % per cluster
1	70(29.41%)	16.43	64(91.4%)
2	42(17.65%)	21.24	29(69.0%)
3	20(8.40%)	18.11	19(95.0%)
4	14(5.88%)	11.80	7(50.0%)
5	15(6.30%)	6.49	5(33.0%)
6	63(26.47%)	13.25	2(3.17%)
7	14(5.88%)	9.22	1(7.14%)

Table 5. Dry-matter yield of 244 accessions of *Brachiaria* spp. in the dry season CPAC, Planaltina

Cluster	No. of accessions (% of total)	DM yield t/ha	*B. brizantha* No. and % per cluster
1	44(18%)	3.69	40(90.9%)
2	38(16%)	1.96	28(73.7%)
3	24(10%)	5.34	18(75.0%)
4	28(11%)	2.86	20(71.4%)
5	34(14%)	2.74	19(55.9%)
6	56(23%)	1.58	1(1.79%)
7	20(8%)	2.26	0

Table 6. **A cluster of accessions of *Brachiaria brizantha* and *B. decumbens* with the highest DM yield in two dry seasons CPAC, Planaltina**

CIAT accession No.			
B. brizantha			
16113	16119	16121	16168
16288	16307	16308	16457
16458	16467	16473	16483
16487	16459	16827	16829
16830	16110	cv. Marandú	
B. decumbens			
16488	16498	16499	16500
26181			

Table 7.

Seed yield (g/plant) of accessions from 11 species of *Brachiaria*. Cerrados Agricultural Research Center, Planaltina-DF., Brasil.

Species		Seed yield Range or Mean g plant^{-1}	Number of days to maturity Range or Mean
1. *B. brizantha*	(145)*	0.45 - 55.87	75 - 185
2. *B. decumbens*	(40)	0.13 - 18-65	77 - 127
3. *B. humidicola*	(34)	0.39 - 26.00	77 - 130
4. *B. ruziziensis*	(15)	11.30 - 36.19	87 - 133
5. *B. jubata*	(27)	0.60 - 36.42	83 - 174
6. *B. serrata*	(1)	38.80	139.7
7. *B. bovonei*	(3)	0.81 - 392	76 - 98.3
8. *B. dictyoneura*	(1)	2.43	89.5
9. *B. subulifolia*	(2)	0.30 - 1.65	81 - 89
10. *B. platynota*	(1)	1.00	123
11. *B. nigropedata*	(1)	0.81	82
Control *B. brizantha* cv. Marandu		25.3	121

* Number of accessions per species.

Table 8.

Dry matter yields (t ha^{-1} year^{-1}) of 15 grass accessions in a várzea at the Cerrados Agricultural Research Center, near Brasilia

Species	BRA N°+	Dry matter yields ton ha^{-1} year^{-1}
Paspalum sp. aff. *P. plicatulum*	003913	28.6 a*
P. sp. aff. *plicatulum*	009661	25.9 a b
P. sp. aff. *plicatulum*	009610	25.7 a b
P. sp. aff. *plicatulum*	009628	24.2 a bc
P. sp. aff. *plicatulum*	009431	19.8 bcd
P. sp. aff. *plicatulum*	003638	19.2 bcd
Paspalum urvillei	010685	18.4 cd
P. urvillei	007323	18.3 cd
P. sp. aff. *plicatulum*	008486	17.7 cd
P. sp. aff. *plicatulum*	009407	16.9 d
Hemarthria altissima	-	16.1 d
Paspalum oteroi	003905	6.9 e
P. pauciciliatum	003891	3.5 e
P. modestum	006203	2.0 e
Axonopus complanatus	-	1.8 e

* Mean values followed by a different letter are significantly ($P < 0.05$) different (Duncan's multiple range test).

+ Accession number of Centro Nacional de Recursos Genéticos, Brasília.

Table 9. **Dry-matter yield produced by 15 wet-land grasses during the dry season (May - June) Várzea, CPAC, Planaltina**

BRA	Species	DM yield kg/ha
009661	*Paspalum* sp. aff. *P. plicatulum*	2301.1a*
003913	*P.* sp. aff. *P. plicatulum*	2259.0a*
009610	*P.* sp. aff. *P. plicatulum*	2034.7a
010685	*P. urvillei*	1950.4a
007323	*P. urvillei*	1388.6 b
009407	*Paspalum* sp. aff. *P. plicatulum*	1220.2 bc
003638	*P.* sp. aff. *P. plicatulum*	1024.2 bc
008486	*P.* sp. aff. *P. plicatulum*	963.2 bcd
006203	*P. modestum*	959.3 bcd
009431	*Paspalum* sp. aff. *P. plicatulum*	889.2 cd
—	*Hemarthria altissima*	786.0 cde
009628	*Paspalum* sp. aff. *P. plicatulum*	762.4 cde
003905	*P. oteroi*	755.6 de
003891	*P. pauciciliatum*	507.8 e
—	*Axonopus complanatus*	381.9 e

* Means followed by a different letter are significantly different ($P<0.05$) according to Duncan's Multiple Range Test.

Table 10. **Seasonal changes in IVDMD values of 15 wet-land grasses Várzea, CPAC, Planaltina**

Species and BRA accessions No.	Seasons		
	Wet	End of Wet	End of dry
	(IVDMD%)		
P. sp. aff. *P. plicatulum*			
008486	57.27 a *	49.11 abcde	43.85 bcd
003913	55.56 ab	59.98 a	51.69 a
009661	54.91 ab	55.87 ab	44.43 abcd
009610	54.83 ab	51.77 abc	51.88 a
009431	54.41 ab	50.51 abcd	46.61 abc
003638	52.51 abc	45.16 def	46.66 abc
009407	46.27 cd	41.10 ab	36.80 de
009628	33.43 e	40.12	32.23 e
P. urvillei			
007323	48.26 bcd	46.72 cde	49.02 abc
010685	42.79 d	50.61 abcd	45.73 abc
Hemarthria altissima	47.42 cd	53.10 ab	51.49 ab
P. modestum			
006203	48.87 bcd	48.89 bcde	41.86 cd
P. oteroi			
003905	47.29 cd	44.14 ef	43.45 cd
Axonopus complanatus	35.51 e	44.33 ef	42.16 cd
P. pauciliatum	42.83 d	44.65 ef	42.10 cd

* Mean values followed by a different letter are significantly ($P < 0.05$) according to Duncan's Multiple Range Test.

Table 11. **Chemical composition of selected accessions of *P.* sp. aff. *P. plicatulum* Várzea, CPAC**

P. sp. aff. *plicatulum*	CP	P	K	Ca	Mg
			%		
			wet season		
1.	7.5	0.15	1.51	0.63	0.55
2.	7.4	0.13	0.85	0.58	0.66
3.	7.5	0.14	1.03	0.63	0.65
			end of wet season		
1.	6.5	0.19	1.21	1.14	1.04
2.	8.6	0.17	0.93	1.16	0.98
3.	7.4	0.16	0.90	1.01	1.06
			end of dry season		
1.	6.1	0.12	0.87	1.23	0.55
2.	5.2	0.11	1.0	1.10	0.44
3.	5.1	0.09	0.54	1.09	0.62

1. BRA 009610; 2 = 009661; 3 = 003913

Table 12. Early and mid-season flowering *S. guianensis* hybrids selected from the F_4 generation

Parental lines CIAT nos.	Breeder's No.	Type of cross	Origin
15 x 1539	6-2	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	6-4	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	6-6	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	7-2	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	7-7	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	16-8	vulgaris x vulgaris	Bolivia; Venezuela
15 x 1539	28-23	vulgaris x vulgaris	Bolivia; Venezuela
1122 x 1539	24-22	vulgaris x vulgaris	Colombia; Venezuela
1639 x 1633	24-23	vulgaris x pauciflora	Brazil

Table 13. F_3, F_4 and F_5 progenies of *S. guianensis* hybrids selected for drought tolerance and retention of leaves in the fry season

Breeder's No.	Parental accessions CIAT No.	Type of cross
45-4 F_3	1808 x 10136	*pauciflora* x *pauciflora*
44-3 F_3	unknown	—
1-8 F_3	10136 x 2031	*pauciflora* x *pauciflora*
5-7 F_3	10136 x 2031	*pauciflora* x *pauciflora*
16-4 F_5	1808 x 1062	*pauciflora* x *pauciflora*
47-3 F_3	10136 x 1062	*pauciflora* x *pauciflora*
2-4 F_3	unknown	—
46-2 F_3	unknown	—
17-10 F_4	15 x 1539	*vulgaris* x *vulgaris*

Table 14. Accessions of Stylosanthes capitata resistant to anthracnose. Selected at CPAC 1978-88.

	CPAC	BRA	CIAT
		Accession Nos.	
1	706	005886	1097*
2	704	007251	1019*
3	2826	014401	2546
4	2829	014532	2553
5	2700	035220	16
6	2831	014281	2536
7	2836	015113	2320
8	2821	035173	2353
9	2837	014362	2543
10	2841	014397	2545
11	2839	014443	2548
12	2683	029050	10398
13	2699	035211	12
14	1925		Hybr. 56
15			Hybr. 111 L
16			Hybr. 111 G
17			9 G
18	1594	013935	2502
19	1608		2829
20	1597	014117	2521
21	2825	035548	15
22	2844	031160	1682
23	2823	001881	1328
24	650		1405*
25	662		136*
26	Lago Norte		
27	Barra do Garca - MT		

* Control

Table 15. Dry matter yields (kg ha^{-1}) of 18 accessions of Centrosema spp. produced during the wet season. Chapadao, CPAC, Planaltina.

108	C. brasilianum	sel. F_3 (5234 x 5224)			5225.1	a*	
5234	C. "				3758.4	b	
	C. brasilianum	F_3 (5234 x 5224)		Bulk sel.	3594.7	b	
2013	C. "	"	"	"	3183.1	b c	
205	C. "	"	"	"	3142.8	b c d	
203	C. "	"	"	"	2870.8	b c d e	
106	C. "	"	"	"	2847.5	b c d e	
309	C. "	"	"	"	2505.5	b c d e f	
104	C. "	"	"	"	2222.4	b c d e f g	
1015	C. "	"	"	"	2157.1	c d e f g	
15531	C. acutifolium				1843.5	d e f g h	
15899	C. "				1695.5	e f g h	
15398	C. brasilianum				1657.1	e f g h	
15533	C. acutifolium				1489.7	f g h	
5850	C. brachypodum				1401.2	f g h	
15387	C. brasilianum				1089.8	g h	
15530	C. acutifolium				1045.1	g h	
15525	C. brasilianum				653.8	h	

* Mean values followed by a different letter are significantly (P 0.05) different (Duncan's multiple range test).

Table 16.

Number of nematodes on roots of *Desmodium ovalifolium* accessions Várzea, CPAC

Desmodium ovalifolium CIAT accession no.	Nematodes	
	Meloidogyne	Pratylenchus
	Number per 5 g of roots	
3652	0	57
3663*	7	223
3666*	3	319
3673	0	200
3776	0	243
13081*	10	1053
13087*	128	103
13089*	25	192
13103*	3	120
13104*	7	846
13114*	25	638
13117	0	228
13120	0	125
13125	0	404
13129	0	419
13131	0	374
13132*	6	256
13136	0	57

* Accessions selected for general vigour.

Table 17.

Seed yield of *Desmodium ovalifolium* accessions Várzea, CPAC, Brazil

CIAT accession	Cleaned seed yield kg ha^{-1}	CIAT accession	Cleaned seed yield kg ha^{-1}
13130	440,00	13101	24,57
13129	252,14	13097	24,14
13081	198,14	13085	21,14
13082	144,76	13092	20,38
13131	129,71	3788	20,24
13103	119,43	13302	17,33
13137	115,81	3780	16,76
13098	109,57	3784	16,19
13083	108,14	13114	15,86
13099	98,57	13105	15,57
13124	82,86	13089	10,29
13088	69,71	13113	10,29
13117	66,67	13115	10,29
13120	64,38	3668	9,91
13132	63,00	13133	9,29
13122	61,14	3776	7,05
3781	55,62	13289	6,86
13139	55,43	13136	3,81
13110	53,43	13091	3,43
3666	49,91	13125	3,43
13087	40,57	*13119	3,14
13111	37,52	13095	2,48
13128	35,00	13109	2,29
13104	33,71	3663	0,76
13126	31,05	13135	0,57
13166	29,05	3674	0,19
3673	28,19	3778	0,19
13086	25,71	-	-

Table 18. Selected accessions of D. ovalifolium

CIAT accession nos.	BRA
13081	008362
13983	008192
13085	008389
13097	007935
13098	007943
13099	007951
13105	008010
13114	008281

Table 19. Accumulated dry-matter yield (April 6 - July 7) of grasses in association with legumes. Varzea, CPAC.

Species	DM kg/ha
Paspalum sp. aff. P. plicatulum CPAC 3232	512.60 a*
Brachiaria dictyoneura CIAT 6133	374.39 b
Paspalum conspersum	631.94 a
Paspalum sp. aff. P. plicatulum CPAC 3241	552.05 a

* $P < 0.05$

Table 20. Accumulated dry-matter yield (April 6 - July 7) of four accessions of A. pintoi grown in association with Brachiaria dictyoneura CIAT 6133 or Paspalum sp. aff. P. plicatulum CPAC 3232 (BRA 001490). Varzea, CPAC, Planaltina.

A. pintoi Accession No.	DM kg/ha
CIAT 18750	450.98 a**
CIAT 17434	170.07 b
CIAT 18749	165.99 b
CIAT 18748	137.75 b

** P < 0.01

Fig. 1 Mean Crop Growth Rate (kg/ha/week) of B. brizantha cv. MARANDU vs. B. brizantha CIAT 16301 - CIAT 16473 - CIAT 16549 and B. decumbens CIAT 16488

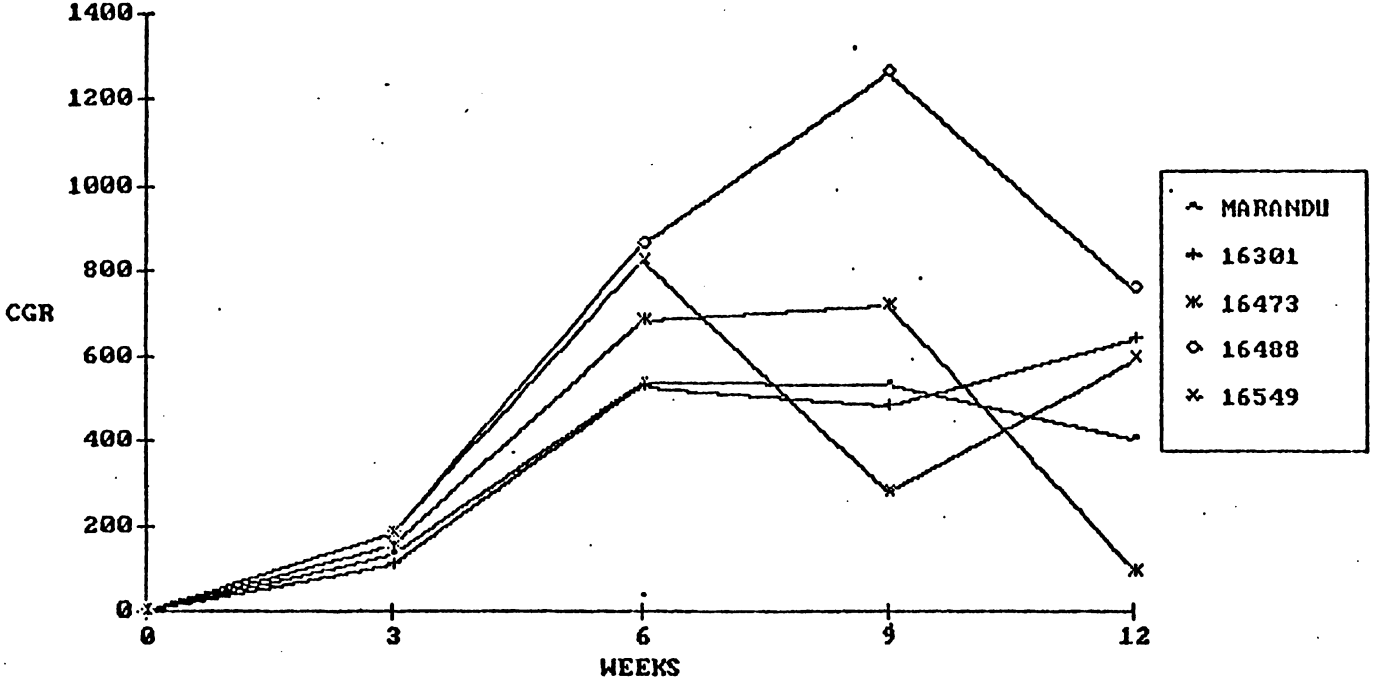
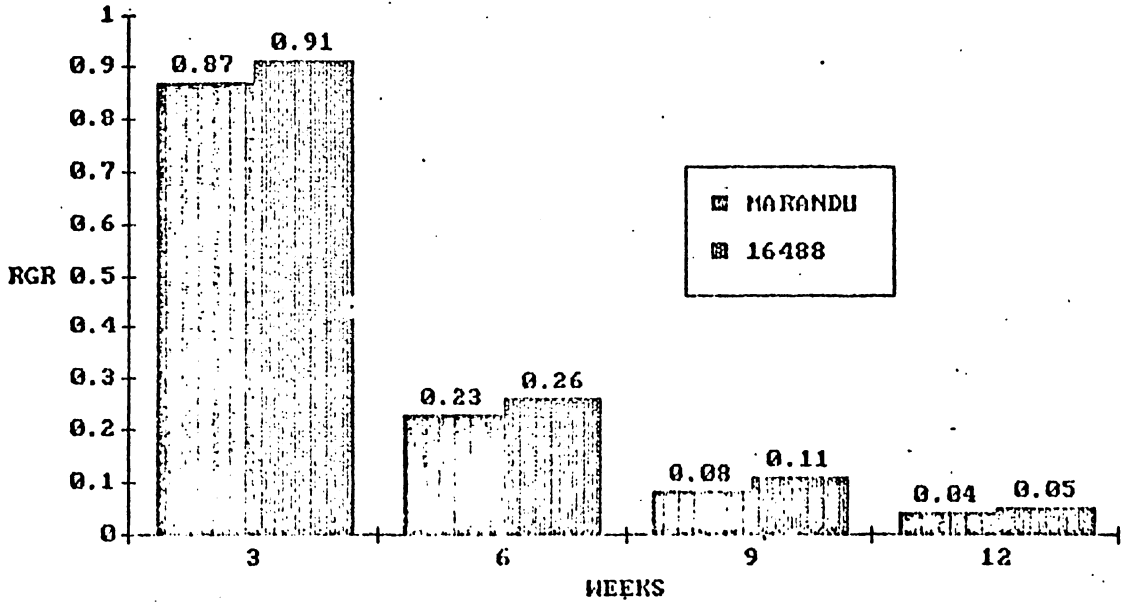


Fig. 2 Mean Relative Growth Rate (d/dt loge kg/ha) of B. brizantha cv. MARANDU vs. B. decumbens 16488



Programa II. Geração e Transferência de Tecnologia

O Programa de Geração e Transferência de Tecnologia é a resposta do IICA a dois aspectos fundamentais: (i) o reconhecimento, por parte dos países e da comunidade técnico-financeira internacional, da importância da tecnologia para o desenvolvimento produtivo do setor agropecuário; (ii) a convicção generalizada de que, para aproveitar plenamente o potencial da ciência e da tecnologia, é necessário que existam infra-estruturas institucionais capazes de desenvolver as respostas tecnológicas adequadas ás condições específicas de cada país, bem como um lineamento de políticas que promova e possibilite que tais infra-estruturas sejam incorporadas aos processos produtivos.

Nesse contexto, o Programa II visa a promover e apoiar as ações dos Estados membros destinadas a aprimorar a configuração de suas políticas tecnológicas, fortalecer a organização e administração de seus sistemas de geração e transferência de tecnologia e facilitar a transferência tecnológica internacional. Desse modo será possível fazer melhor aproveitamento de todos os recursos disponíveis e uma contribuição mais eficiente e efetiva para a solução dos problemas tecnológicos da produção agropecuária, num âmbito de igualdade na distribuição dos benefícios e de conservação dos recursos naturais.

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA

O Instituto Interamericano de Cooperação para a Agricultura (IICA) é o organismo especializado em agricultura do Sistema Interamericano. Suas origens datam de 7 outubro de 1942, quando o Conselho Diretor da União Pan-Americana aprovou a criação do Instituto Interamericano de Ciências Agrícolas.

Fundado como uma instituição de pesquisa agronômica e de ensino, de pós-graduação para os trópicos, o IICA, respondendo às mudanças e novas necessidades do Hemisfério, converteu-se progressivamente em um organismo de cooperação técnica e fortalecimento institucional no campo da agropecuária. Essas transformações foram reconhecidas oficialmente com a ratificação, em 8 de dezembro de 1980, de uma nova convenção, que estabeleceu como fins do IICA estimular, promover e apoiar os laços de cooperação entre seus 31 Estados membros para a obtenção do desenvolvimento agrícola e do bem-estar rural.

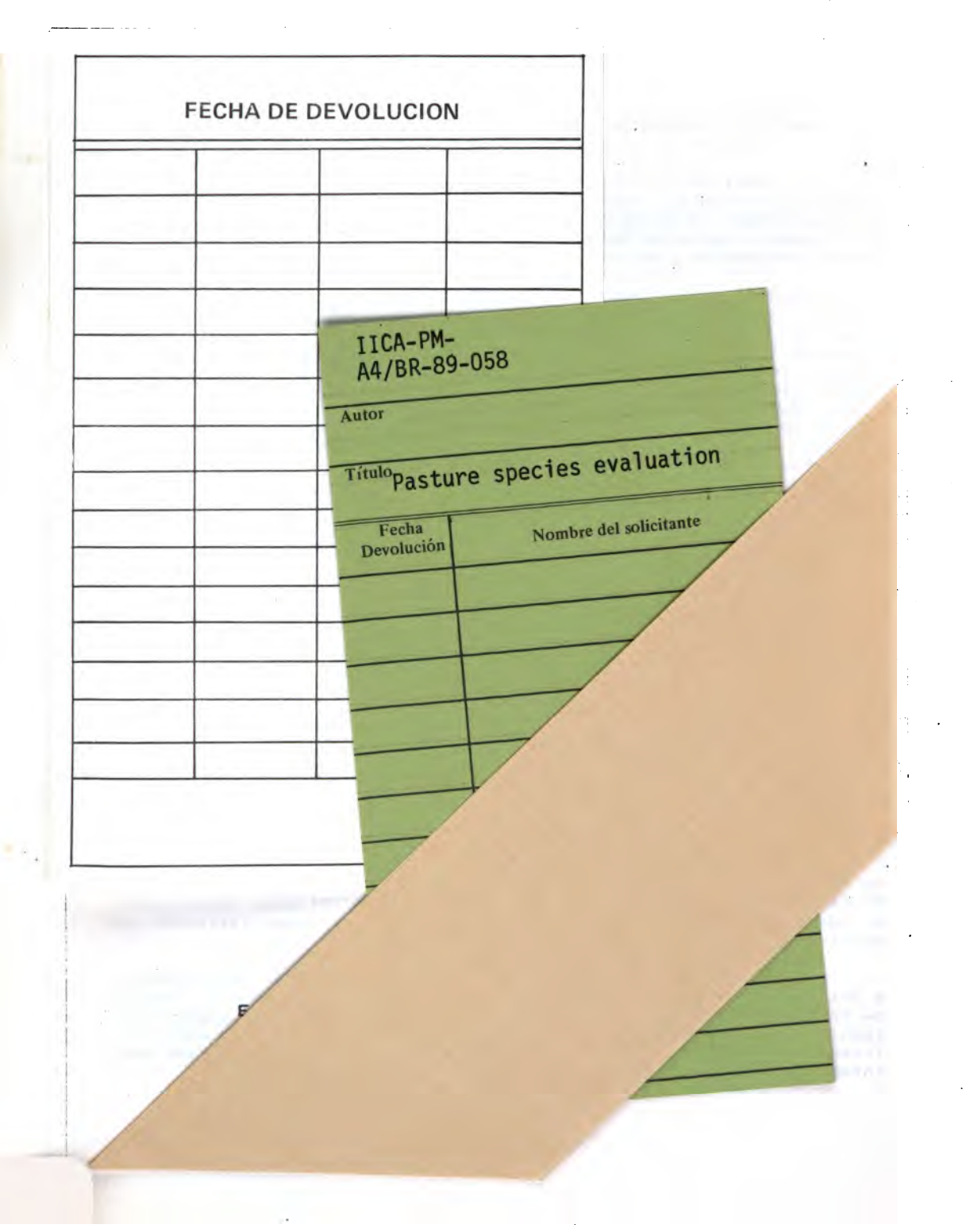
Com um mandato amplo e flexível e com uma estrutura que permite a participação direta dos Estados membros na Junta Interamericana de Agricultura e em seu Comitê Executivo, o IICA conta com ampla presença geográfica em todos os países membros para responder a suas necessidades de cooperação técnica.

As contribuições dos Estados membros e as relações que o IICA mantém com 12 Países Observadores, e com vários organismos internacionais, lhe permitem canalizar importantes recursos humanos e financeiros em prol do desenvolvimento agrícola do Hemisfério.

O Plano de Médio Prazo 1987-1991, documento normativo que assinala as prioridades do Instituto, enfatiza ações voltadas para a reativação do setor agropecuário como elemento central do crescimento econômico. Em vista disso, o Instituto atribui especial importância ao apoio e promoção de ações tendentes à modernização tecnológica do campo e ao fortalecimento dos processos de integração regional e sub-regional.

Para alcançar tais objetivos o IICA concentra suas atividades em cinco áreas fundamentais, a saber: Análise e Planejamento da Política Agrária; Geração e Transferência de Tecnologia; Organização e Administração para o Desenvolvimento Rural; Comercialização e Agroindústria, e Saúde Animal e Sanidade Vegetal.

Essas áreas de ação expressam, simultaneamente, as necessidades e prioridades determinadas pelos próprios Estados membros e o âmbito de trabalho em que o IICA concentra seus esforços e sua capacidade técnica, tanto sob o ponto de vista de seus recursos humanos e financeiros, como de sua relação com outros organismos internacionais.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Autor
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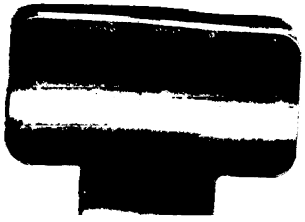
Fecha Devolución
Nombre del solicitante



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