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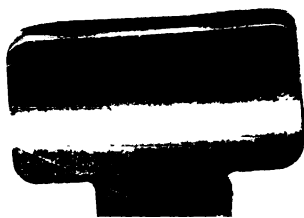
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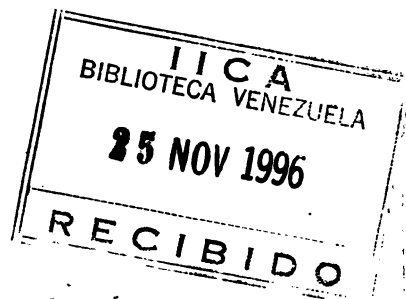
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Consultant Final Report  
IICA/EMBRAPA-PROCENSUL II

FORAGE IMPROVEMENTS  
1986 AND 1987 CONSULTANCIES

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IICA/EMBRAPA-PROCENSUL II

Edward Mark Hutton

Brasília, outubro 1987

INSTITUTO INTERAMERICANO DE COOPERAÇÃO PARA A AGRICULTURA  
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## APRESENTAÇÃO

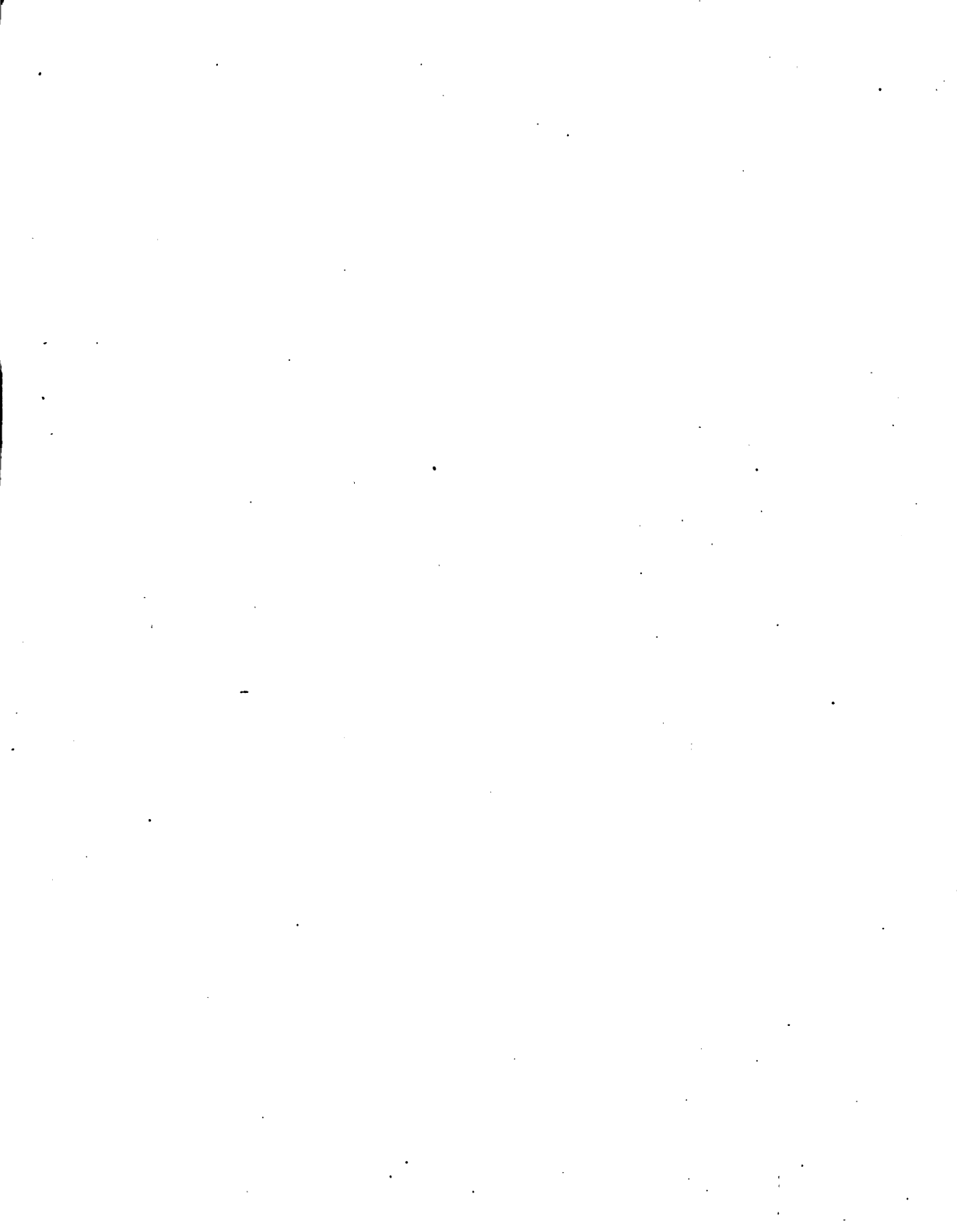
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As atividades de consultoria são realizadas no âmbito do Projeto de Desenvolvimento da Pesquisa Agropecuária e Difusão de Tecnologia na Região Centro-Sul do Brasil-PROCENSUL II, financiado parcialmente pelo Banco Interamericano de Desenvolvimento-BID e a EMBRAPA conforme os contratos de Empréstimo 139/IC-BR e 760/SF-BR, assinados em 14 de março de 1985 entre o Governo brasileiro e o BID.

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 agradecerá receber comentários sobre estes relatórios.

Horacio H. Stagno  
Coordenador Contratos IICA/EMBRAPA





FINAL REPORT OF WORK DONE BY DR. E.M. HUTTON UNDER

AN EMBRAPA - IICA CONTRACT FOR THE PERIOD OF MAY

12, 1983 - MAY 12, 1986



Type of work done at CPAC as a Consultant in Forage Improvement.

It involved improvement of the three legumes Centrosema, Leucaena and Stylosanthes capitata and the grass Panicum maximum for adaptation to the cerrados of central Brazil.

My collaborator was F. Beni de Sousa.

1. Centrosema

C. pubescens has been an important pasture legume in Brazil but lost favor due to lack of persistence, especially in acid soils and under low fertilizer inputs. It has considerable potential in high quality pastures grown in rotation with a cropping phase if acid-soil tolerant, disease resistant, stoloniferous and prolific seeding varieties are developed.

To achieve this aim, 89  $F_3$ ,  $F_4$  and  $F_5$  populations from crosses between ecotypes of C. pubescens and C. macrocarpum or Centrosema Species were developed when at CIAT, Colombia. These were seeded together with 13 parents at CPAC November 1982 and selections for adaptation were planted successively in November 1983 and November 1984. The November 1982 and November 1983 plantings were under low fertility conditions on freshly prepared cerrado with fertilizer applications per ha of 200 kg single superphosphate, 200 kg dolomite, 100 kg KCl, 20 kg FTE BR 12 and seed inoculation with rhizobium. This allowed selection for low fertility and acid-soil tolerance as stress was placed on P, Ca and Mg uptake. A serious outbreak of the leaf disease Phoma sorghina (identified by Dr. Luiz Nasser of CPAC) in the relatively cool 1983-84 wet season made possible in March 1984 the selection for seed collection of Phoma resistant plants in the populations.

In the November 1984 seeding of 80  $F_5$ ,  $F_6$  and  $F_7$  selections and parents (5m plots, 3 rows 1m apart) the fertilizer application gave adequate minerals for selection of their dry matter and seed production under higher fertility conditions. The fertilizer applied per ha was 400 kg single superphosphate, 1 ton dolomite, 100 kg KCl, 20 kg FTE BR 12, subsoil pH remained at 4.7. The minerals supplied

were probably similar to those remaining after a cropping phase of soybean, maize, etc. In the 1983-4, 1984-5 and 1985-6 wet seasons Ronaldo P. de Andrade grew the most promising *Centrosema* hybrids for seed production and regional trials. All the promising hybrids which total 8, originate from the one cross viz *C. pubescens* 5052 X *C. macrocarpum* 5062. Each is a composite of lines from an original  $F_2$  selection, so there is scope for further selection in the composites or among the lines of the composites.

The work has shown that it is possible to breed *C. pubescens* - like hybrids from crosses with *C. macrocarpum* combining acid-soil tolerance, disease resistance, stoloniferous development, high dry matter and seed yield. Previously (Hutton 1985 Trop. Agric. 62: 273-280) it was shown that acid-soil tolerance was due to efficient Ca absorption by roots in competition with exchangeable Al in the subsoil, so stimulating deep rooting and vigorous top growth. At CPAC, foliar analysis of the parents in the November 1982 seeding confirmed this finding, the Ca absorption of the *C. macrocarpum* lines being 30% greater than that of *C. pubescens*. The fertilizer additions in all the seeding from 1982-1984 did not change the pH and exchangeable Al and Ca in the subsoil below 30 cms. The roots of the promising hybrids in the 1984 seeding have been traced to a depth of 2 m at the end of the second wet season.

## 2. Leucaena

The leguminous tree *L. leucocephala*, principally the variety Cunningham, is increasing in importance in Brazil because of its high feeding value, persistence, and freedom from disease and most insects. Large areas (some hundreds of ha) are being seeded on the better soils, especially in the states of São Paulo and Mato Grosso. It is being used as a "protein bank", often with closely spaced double rows 4m apart and interplanting with *P. maximum* or a similar grass. Interplanting with legumes like *S. capitata*, *S. guianensis* and *Zornia latifolia* could also be considered, as well as a cropping phase which might require distances up to 8m between the double rows for machinery movement. Problems occur mainly in establishment from weed competition, leaf cutter ants, etc., and in management if grazing in the wet season is insufficient to

regulate the height for dry season use. Establishment problems and costs can be reduced by sowing with a crop like maize or rice. The toxicity problems in cattle associated with mimosine - DHP (3-hydroxy-4 pyridone) do not seem to occur in Brazil, so the rumenal bacteria for degradation of these compounds probably occur in the cattle population. However it is urgent, in view of the increasing Leucaena areas, to define the exact situation based on techniques now available in published papers.

When Cunningham is grown in acid soil with pHs around 5 or less, as occur extensively in the cerrados and Amazonia, growth and persistence are often poor. It has been shown at CPAC (Hutton and de Sousa in press) that the poor growth and restricted rooting of Cunningham (given adequate fertilizer) was from inhibition of Ca and Mg uptake caused by imbalance of exchangeable Al and Ca in the subsoil. The subsoil of the cerrados are generally very low in exchangeable Ca which increases the problems in varieties like Cunningham. Even when subsoil Ca is supplied by gesso ( $\text{CaSO}_4$ ) application, there is only a small growth stimulation. Cunningham does not have the genetic capacity to absorb and transport sufficient Ca in competition with Al for vigorous meristematic growth of stem and root tips. Changes in subsoil pH and imbalances of exchangeable Al and Ca are difficult to influence with dolomite, except after a number of years of crop cultivation. With gesso, the subsoil Ca status is improved, but there is little change in the low pH and high exchangeable Al.

For acid soils it is apparent that Cunningham Leucaena needs replacing with acid-soil tolerant lines as with C. pubescens. A source of acid-soil tolerance in Leucaena was found in L. diversifolia (Hutton 1984 PABS 19: 263-274) and L. leucocephala - L. diversifolia crosses have given promising acid-soil tolerant hybrids (Hutton and de Sousa 1985 Leucaena Res. Repts. 6: 17-19, Hutton 1985 Procs. XV Int<sup>l</sup> Grass<sup>ld</sup> Congress in press). As with the C. pubescens - C. macrocarpum hybrids, the roots of the adapted Leucaena hybrids are able to absorb subsoil Ca in competition with Al resulting in deep rooting and vigorous top growth.

At CPAC, the Leucaena lines were seeded (plots 10 m, three ROWS 1 m apart) November 1982 after rhizobium inoculation on freshly

4

prepared cerrado given per ha (as in the Centrosema) - 200 kg single superphosphate, 200 kg dolomite, 100 kg KCl, 20 kg FTE BR 12. The fertilizer treatment did not change the subsoil pH 4.7 - or exchangeable Al and Ca. It thus gave selection pressure among lines for efficient root absorption of Ca, P and Mg from the subsoil. There were 83 hybrid lines (developed at CIAT) mainly from L. leucocephala - L. diversifolia hand crosses, a few from L. leucocephala - L. shannoni and L. leucocephala - L. esculenta, and some from natural crosses, apparently of L. leucocephala - L. diversifolia. Also there were 4 L. leucocephala varieties and 13 varieties of the *Leucaena* species, especially L. diversifolia. By August 1983 persistence among the lines was at a low level due to Ca deficiency, as shown by death of root and stem tips. Persistence was 58% in the lines from hand and natural crosses, 23% in those of *Leucaena* species, nil in 3 L. leucocephala varieties (including Cunningham), but 36% in the fourth L. leucocephala. This has proved to be a natural cross with L. diversifolia.

*Leucaena* trees at CPAC took 16-18 months to produce seed, so the selections from the 1982 planting could only be seeded two years later in November 1984. Larger seeded selections had larger leaflets and better forage production, and usually had higher chromosome numbers (78-104). Small seed in L. leucocephala (104 chroms) x L. diversifolia (52 chroms) indicated reversion to L. diversifolia. In L. leucocephala (104) x L. diversifolia (104) small seed was more common and was associated with fine leaflets and tall wood types.

In November 1984, 95 vigorous persistent selections were seeded in 5 m plots with two rows 2 m apart. Per ha fertilization was - 400kg single superphosphate, 1 ton each of gesso and dolomite, 200 kg KCl, 20 kg FTE BR 12. Below 50 cm, soil pH remained at 4.8; there was some reduction of exchangeable Al and some increase in exchangeable Ca. Almost half the lines planted were F<sub>3</sub> populations from L. leucocephala x L. diversifolia (52 chroms). The rest included Cunningham control, large-leaflet selections from the promising natural L. leucocephala - L. diversifolia cross, F<sub>2,3</sub> of both L. leucocephala (104) x L. diversifolia (52) and L. leucocephala (104) x L. diversifolia (104).

Plant establishment per row in the 1984-5 season averaged 38% and in one third of the rows it was more than 50%. During the wet season the less vigorous, less acid-soil tolerant trees were eliminated giving an average of 10 trees per row for the final evaluation. After 15 months, Cunningham trees were 110 - 120 cm high, those of the promising natural cross and the best  $F_3$  selections 200 - 240 cm, while the most vigorous wood types with fine leaflets from the crosses were 3 m or more high. Tall trees are not desirable for forage but can be controlled by grazing. Tallness is important for selection of deep-rooting, acid-soil tolerant phenotypes and for seed production. The percentage of vigorous large-leaflet forage types was 90% in the selections of the promising natural cross, 25% in the  $F_2$  L. leucocephala (104) x L. diversifolia (52), but almost nil in the  $F_2$  L. leucocephala (104) x L. diversifolia (104). Most of the large  $F_3$  population was large leaflet forage types, but only 5% were vigorous and acid soil tolerant, with some lines giving over 50% desirable trees. It is apparent that acid-soil tolerance can be transferred to the  $F_3$ , and no doubt to the  $F_4$  when populations are approaching stability of the desirable characters.

The cytology of the *Leucaena* crosses is being studied by Dr. Maria Teresa Schifino of the Agronomy Department of the University of Rio Grande do Sul at Porto Alegre. She is defining the relation between mitotic and meiotic chromosomes, also meiotic behaviour in the crosses. This work is an essential basis for the development of stable, vigorous, acid-soil tolerant hybrids for forage.

#### Need for further work on the *Leucaena* project

Due to slow "turn-around" of populations, it has not been possible to investigate in detail populations of the crosses at the  $F_4$  stage. This is essential to reach a high level of stability for the important characters, including acid-soil tolerance. Fortunately the selections of the promising natural L. leucocephala - L. diversifolia cross have almost reached stability so seed of these should soon be available.

It is hoped that EMBRAPA-CPAC will support my return for shorter periods for a few years so that I can use my experience for further selection of promising lines for CPAC. With this in mind, long rows were seeded in November 1985 at CPAC with 58 lines representing the most promising *Leucaena* material from the 1982 and 1984 plantings. The long rows give larger numbers of plants and more scope for selection.

### 3. Comments on Stylosanthes species

S. guianensis was sold commercially in Brazil for some years until devastated by anthracnose. This problem has been overcome with the selection of anthracnose resistant varieties. At the same time, anthracnose resistant varieties of S. macrocephala, S. capitata, S. vulgaris, etc. have been developed, but commercialization of these has not occurred as yet. It is necessary to find, as with the other legumes, where they fit into the farming system to rekindle farmer interest. The *Stylosanthes* species have a number of advantages, including a low P requirement for satisfactory growth. They could be planted with a number of crops, and grow almost as a "weed" but enhancing the feeding value of stubble and the soil fertility. Also they could increase the feeding value of degenerated Brachiaria decumbens pastures. Whether they really fit in as associates of tall tropical grasses like Andropogon gayanus and P. maximum in a rotation after a cropping phase is doubtful. Their most important role appears to be increasing the protein content of native pastures by drilling in the seed lightly with 50 kg or less of single superphosphate among the trees and in rows about 2 m or more apart.

#### Stylosanthes capitata

S. capitata was chosen for improvement by breeding because of its free seeding habit, good seedling regeneration, good field resistance to anthracnose in a number of ecotypes, and good feeding value.

Among the crosses made at CIAT, 1019 x 1097 and 1019 x 1078 were chosen for intensive selection as the parents involved had shown



potential at CPAC, especially 1019 and 1097. The aim was to develop new hybrids with high production of dry matter and seed, drought resistance, field resistance to anthracnose and stem borer, and active seedling regeneration. At Carimagua 2000 F<sub>2</sub> plants of each cross (with parental controls) were transplanted into the field at 1.5 m x 1.5 m with a low fertilizer input (per ha 10 kg P, 18 kg K, 22 kg S, 11 kg Mg, 47 kg Ca, minor elements). When established the area was oversown with A. gyanus. In the second wet season heavy periodic grazing of the S. capitata - A. gyanus mixture made it possible to select 87 superior F<sub>2</sub> plants of the first cross and 61 of the second. The F<sub>3</sub> lines of these were established at Carimagua and from the populations plants with superior yield of dry matter and seed and drought resistance were selected. An F<sub>4</sub> generation was also planted and selected at Carimagua, and F<sub>5</sub> seed of 10 of the most promising selections (8 of the first cross, 2 of the second) were sent to CPAC in 1982 for evaluation.

At CPAC preliminary trials and seed increase plots indicated the superiority of the hybrid 1019 - 1097 no 56. A replicated plot trial (plots 10 m x 2 m, 4 rows) of all the hybrids and control was sown November 1984. No fertilizer was applied, the area being fertilized per ha 18 months before with 200 kg single superphosphate, 200 kg dolomite, 100 kg KCl, 20 kg FTE BR 12 for Centrosema hybrids planted with guandu. Down the profile to 1 m, pH was low, exchangeable Al high, and exchangeable Ca and P low, so the hybrids were grown under mineral stress.

In the cuts of May 1985 and of Feb and May 1986, the highest yielding Hybrid 56 gave an overall mean of 4812kg per ha of dry matter per harvest. This was 1.3 to 1.4 times that of Capica and 2-3 times that of 1019 and 1097. Seed production from the two outside rows of each plot showed that in June 1985 Hybrid 56 had the best yield, it being equivalent to over 500 kg/ha and more than double that of the controls.

The results demonstrate the value of breeding from adapted ecotypes to create variability capable of giving a genetic advance when selection has well defined objectives.

#### 4. Panicum maximum

P. maximum is one of the highest quality grasses and the main deficiency of current cultivars is lack of tolerance to acid soils of low fertility common in the cerrados. Breeding work was commenced on it at CIAT because of its future importance as a companion grass for Centrosema and Leucaena. Also the selection methods for acid-soil tolerance among the hybrid P. maximum populations were the same as for the Centrosema and Leucaena programs. A sexual P. maximum selection was obtained from Tifton, Georgia, U.S.A. and this was used as the female parent in a number of crosses with a range of the most promising introductions. Only a small percentage of the seedlings survived the acid-soil tolerance test conducted in trays of oxisol in the glasshouse.

These were eventually transferred vegetatively to Carimagua where 6 promising vigorous plants were selected in the acid-soil using a low fertilizer input. Material from these was planted at CPAC in November 1982. All these have proved to be apomictic.

After sufficient seed increase of these 6 hybrid lines, it was possible to sow a replicated trial (Plots 10 m x 2 m, 3 rows) at CPAC in November 1984 under the same conditions as those of the S. capitata trial viz low pH and nutrient levels in the soil. When established, the trial was given 100 kg urea per ha as N levels were low. In the 1984-5 wet season the centre row of each plot was harvested for yield, and during the 1985-6 wet season three centre-row harvests were made. After each harvest all remaining rows were cut.

The 4 harvests showed that Hybrid 35-37 was consistently the highest yielder giving an overall mean of 2800 kg per ha of dry matter per harvest. This was 1.3 times that of 50-51 and 1.4 to 1.5 times that of 38-55 and Makueni, but 3.2 times that of Colonião. The rest of the hybrids gave lower dry matter yields than the three most promising ones discussed. With Colonião, the soil acidity and low fertility conditions caused death of many seedlings soon after establishment, and yield has been depressed throughout the experimental period.

The P. maximum hybridization program has demonstrated the possibilities of releasing a wide range of variability from varieties through the use of several sexual types in this normally apomictic species. There is considerable scope to continue this work with the object of selecting for other attributes that may be found lacking in the lines that have been assembled. Through the use of this method, the need for repeated expensive African field collections of P. maximum is greatly reduced.

#### SUMMARY AND RECOMMENDATIONS

1. As indicated, the work has produced hybrid lines with promise for the cerrados in Centrosema, Leucaena, S. capitata and P. maximum. Seed of these is being increased, but more seed is needed to evaluate their performance under grazing and in regional trials. Work with Leucaena has been the slowest because of the two year interval between generations. As a result more selection work in the Leucaena populations is required, as discussed.
2. Pasture legume sales in Brazil are disappointingly low, because in spite of all the work done, there are very few dependable legumes available to the farmer. He has had many failures in the past, especially in acid soil which cover 68% of Brazil. For economic reasons, the farmer does not usually put fertilizer in pastures, and legumes in particular need some inputs of P fertilizer.
3. A new orientation is needed in the pasture program, especially in legumes. The important questions to be answered are, where do the legumes fit into the farming system, and how should they be evaluated for this? A more realistic approach is needed if farmer interest in legumes is to be recaptured and commercial seed production of legumes developed on an increasing scale. The era of conventional large-scale, well-fertilized legume-grass experiments under grazing seems to be past, although there is some justification of these for milk production.

4. There are definite niches for legumes including growth in rotation with a cropping sequence, growth with crops, upgrading degraded B. decumbens pastures, "protein banks" for native pastures and - incorporation in native pastures which will cover extensive areas for a considerable time. Different legumes are needed for each of the various niches. J. Zobey has already made a commendable start on some of these aspects.

CPAC has done exemplary work on assembling a number of promising legumes with the necessary acid-soil tolerance and disease resistance, and with various degrees of persistence and compatibility with grasses under grazing. It is urgent to evaluate all these various legumes relative to their future place in the farming system.

- a. After a cropping sequence, legumes like Centrosema mixed with grasses similar to P. maximum would give a high quality pasture mixture growing on the residual crop fertilizer. There is considerable scope for investigating levels of residual crop fertilizer and its use by pastures. It is possible that the pasture mixture would establish satisfactorily by sowing with the last crop in the sequence eg maize. A pasture phase after cropping increases organic matter and N and helps to reduce the increasing soil erosion problem in the cerrados.
- b. Legumes need evaluation in association with the principal crops - rice, maize, sorghum, cassava, soybean. Herbicides could cause problems for the legume in the first four, while shading could be a problem in soybean. Stubbles integrated with legumes become valuable off-season pastures. Some years ago at Katherine, Northern Territory, Australia I observed Townsville stylo growing very well with sorghum. Non-twining legumes are probably preferable, such as S. capitata, Zornia latifolia and S. guianensis but a free-seeding habit as in the first two is an advantage. Centrosema could be considered, as evidenced by the case (cited to me) of a Cuiabá farmer who regularly sows Centrosema with his soybean crops.
- c. Leucaena is the best legume for "protein banks" because of its persistence, but other less persistent legumes, including S. guianensis (shown by Zobey) have a definite place. With

Leucaena there is an urgent need to develop the new acid-soil tolerant hybrids as soon as possible.

Leucaena "protein banks" can be flexible with relatively close row spacing or with wider row spacing to accommodate crops and machinery. The cropping phase can be followed later by a high quality grass which could be mixed with a suitable legume. Intercropping Leucaena is an ongoing practice in Africa ("alley cropping") with the crop fertilizer maintaining the Leucaena vigor. This system is also used at the EMBRAPA rice-bean centre near Goiania. Establishment of Leucaena with crops like maize reduces costs and is very efficient.

- d. In view of the importance of native pastures, the improvement of their protein content by means other than "protein banks" is an urgent problem. Many hilly areas will remain in native pasture almost indefinitely. The *Stylosanthes* species, because of their low P and mineral requirements, are ideally suited to shallow drilling into native pastures with minimum amounts of single superphosphate (< 50 kg/ha) or with essential minerals supplied by seed pelleting. The seed could be drilled into the pasture without removal of the trees, as has been done in Australia with *S. hamata*. Free seeding species like *S. capitata*, *S. macrocephala*, etc. have the advantage over poorer seeders like *S. guianensis*. All *Stylosanthes* introductions with promise should be evaluated in the native pasture situation. These studies should include evaluation of yield, persistence, seedling regeneration, legume spread, stimulation of native grasses and other pasture components. When overall soil fertility is raised with time, inclusion of better quality grasses like *Melinis minutiflora* could be considered. I have seen instances of native Brazilian cerrado invaded naturally by *M. minutiflora*.
- e. Degenerated *B. decumbens* pastures in "gently rolling" country will probably be cropped in future but will no doubt remain where planted on hilly country. Wherever they are, degenerated *B. decumbens* could be upgraded with *Stylosanthes* species, as already shown at CPAC by A. Barcellos with *S. guianensis*. Free seeding species, including *S. capitata* and *S. macrocephala*,

could be maintained for longer periods than S. guianensis in degenerated B. decumbens. A low P input is needed with the Stylosanthes at planting. When the degenerated B. decumbens regains vigor, Stylosanthes are likely to be eliminated by competition. Whether the new free seeding types of Desmodium ovalifolium or the creeping Arachis pintoi have a place in B. decumbens pastures in the cerrados is an interesting question.

The varzeas, some 10% of the cerrados, are an important resource. The grazing experiments planned with the legumes and grasses assembled need a concentrated effort. It is possible that A. pintoi or D. ovalifolium in combination with grasses like B. dictyoneura or Paspalum plicatulum will be productive and persistent.

5. The role of Stage 2 small-scale experiments fertilized and periodically grazed in the legume-grass evaluation process needs thought. At relatively low cost these define in 2-3 year the attributes of legumes (and some grasses) including yield potential, persistence and palatability, compatibility with grasses, regeneration from seed, etc. This information would predict likely legume performance with a grass in rotation with a cropping phase. It would also predict legume performance in sown-fertilized pastures for dairy cattle; this information would be useful for beef cattle pastures should beef prices ever escalate sufficiently. After visiting Brazilian fazendas for some 15 years, progressive farmers use legume grass pastures in rotation with crops, adding small amounts of fertilizer only when needed for pasture maintenance.

The stage 2 evaluation is not a good indicator of legume performance in native pastures and degraded B. decumbens.

## CONCLUSION

All the points raised add up to the need for a change in the priorities of the pasture program with legume evaluation procedures. These should be orientated towards the farming systems in the cerrados. It is doubtful for example whether expending money and effort on large-scale fertilized grazing experiments are justified.

### 6. Grasses

Since grasses comprise 60% or more of pastures, whether in rotation with crops or in dairy-beef pastures, etc., they provide a high proportion of the diet. Thus their yield, quality and dry-season growth are important considerations. More work is now needed on the evaluation of the range of grasses available using virgin cerrado. A scientist should be allocated to this work. The stage 2 trials currently used could have as the principal aim a comparative detailed evaluation of the grasses. Instead of mixing with a legume, a N source as urea carefully controlled totalling about 100 kg/ha, and applied in 2-3 portions during the season after grazing would facilitate grass evaluation. Other fertilizers need careful control eg 200-400 kg/ha of single superphosphate.

Detailed information needed on the grasses include yield and dry season growth, quality and leaf-stem ratios, mineral analysis of top growth, persistence, etc. For quality and leaf-stem ratios, the bulk of growth necessary could be obtained at the peak of the season by a mowing instead of a grazing.

Grasses which should be compared include Andropogon gayanus, B. decumbens, B. brizantha (Marandu), B. dictyoneura (CIAT), B. ruziziensis, P. maximum (Best CPAC introd<sup>n</sup>, Makueni, hybrid 35-37, Tibiatão), Paspalum (best two at CPAC).

### 7. Legume and grass breeding

The work outlined on the Centrosema, Leucaena, S. capitata and P. maximum breeding could be followed with further crosses and selection for specific characters in a sequence of generations

over some 8 years. At this stage it is probably better to evaluate the new advanced bred lines now available.

With P. maximum, because of its quality and potential, consideration could be given to a scientist continuing the breeding work by crossing sexual P. maximum types with the promising varieties to release a large "pool" of variability. It is possible to further improve P. maximum for the cerrados in a number of characters by selection from such a "pool". These include tolerance to poor soil, yield and leaf-stem ratio, quick regrowth after grazing, dry season growth, etc. The initial populations after crossing contain a high proportion of apomicts so it is relatively easy to produce "fixed" lines rapidly.

CPAC has assembled and studied a large range of promising *Stylosanthes* species with emphasis on S. guianensis. An achievement is the selection of anthracnose resistant "tardio" types of S. guianensis. The main problems with these are low seed yield, poor seedling regeneration and lack of persistence. These deficiencies could be overcome with a properly based breeding program using single plant selection after crossing, especially in the  $F_2 - F_4$  generations. Parents for this program would need to include several of the best "tardios", an early free-seeding S. guianensis like Cook and if possible a persistent type, resistant to heavy grazing. It may be possible to obtain this last type through the cooperation of Dr. D.F. Cameron (CSIRO Brisbane) who spent a year at CPAC.

8. Some intensive investigations required in the legumes and grasses being developed at CPAC include

- a. Depth and extent of rooting.
- b. Relation between fertilizer application and mineral analysis of both the soil profile (to 1 m or more) and leaf, as well as yield over several years. This would involve more plant nutrition work.
- c. With respect to "b", the minor element status of Mo, Zn, Cu and Co and also of Mn in cerrado soils relative to the contents and growth of the pasture and crop plants growing on them has



lagged behind and badly needs increased attention. For example a minor element "frit" is usually used at planting without any real knowledge of the minor element requirements of the particular plant. Also the role of Mn as a toxic mineral or essential nutrient has never been properly defined. Among the macro nutrients, the role of S in pasture and crop plant nutrition is very important but not properly understood. Reference is often made to Al toxicity in cerrado soils, although the classical root symptoms of this are almost impossible to find in pasture and crop plants. Increasing evidence indicates that Ca deficiency (not a Ph change) in the root zone is the main problem.

All these aspects could be investigated without difficulty at CPAC if a modern ICP machine (Atomic Absorption Inductively Coupled Plasma) were installed under the CPAC - Japanese agreement. This would need the cooperation of a Japanese scientist skilled in this technique to train and collaborate with CPAC scientists.

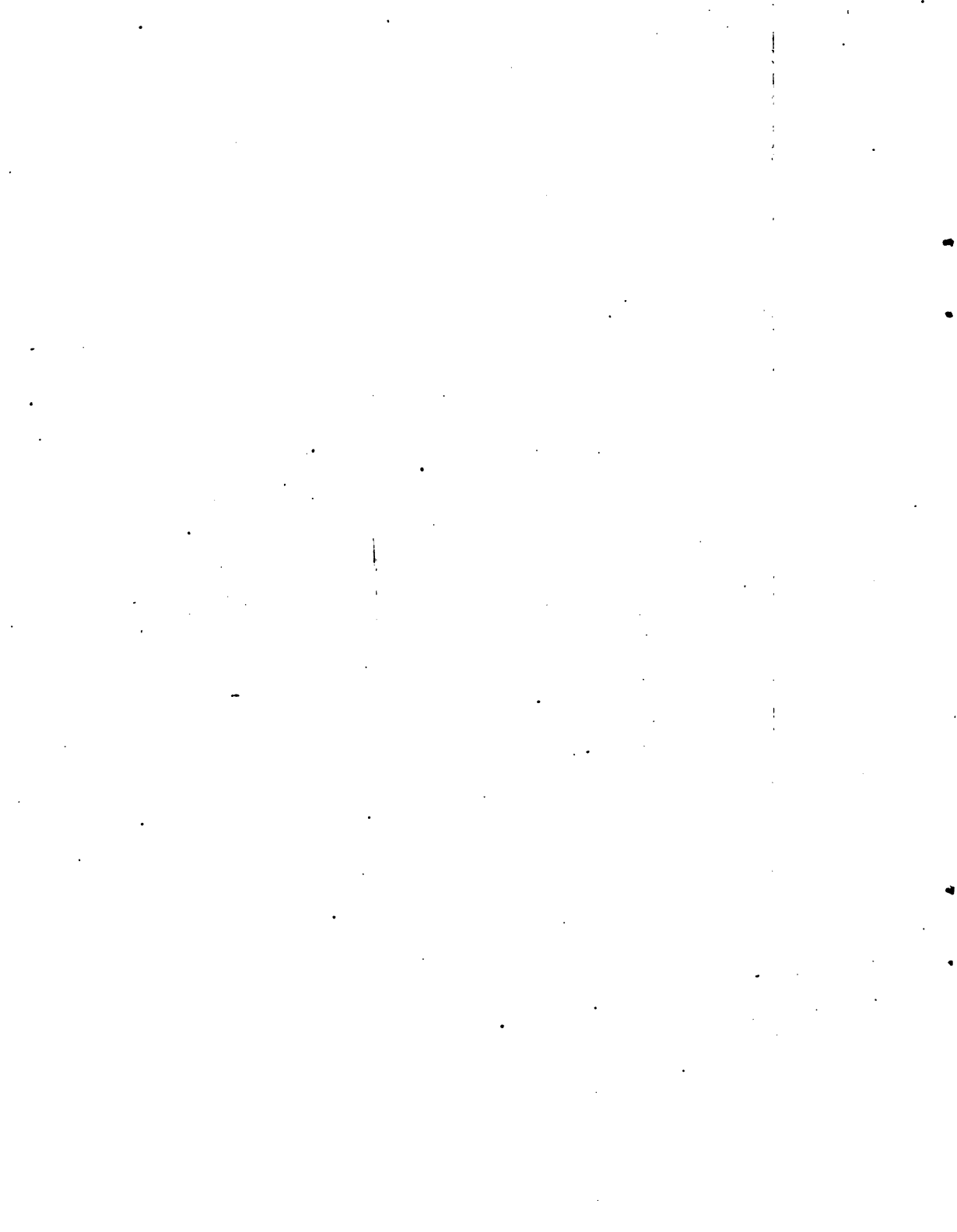
- d. Pasture seed technology has made very good progress at CPAC but because of its essential role in the program more research assistant support is required. Aspects needing further attention include - scarification of legume seeds and some grass seeds like Brachiarias; dormancy of legume and grass seeds; floret and seed development; conditions affecting seed formation such as Ca supply to stem apices; storage conditions for maintenance of germination in legumes and grasses; factors affecting field germination and establishment; harvesting methods, etc.
- e: The ecological aspects of legumes and grasses wherever they are grown in the farming systems. These aspects include persistence, seedling regeneration and spread, balance between the associated species whether crop or pasture plant, competitive effects, etc. This work is tedious but is needed to define deficiencies in species as a basis for improvement by selection, breeding or cultural practices.

- f. With the increasing *Leucaena* use in Brazil it is very important, as previously discussed, to define accurately the mimosine-DHP effects, if any, on cattle productivity.
- g. With respect to breeding work on pasture plant improvement in other centres, CNPGC scientists at Campo Grande have done several years work on *Centrosema* and *P. maximum* and have made a start with *Brachiaria*. At km 47 near Rio de Janeiro a decade of work has been done on *Centrosema* breeding for improvement of agronomic characters other than acid-soil tolerance. All this breeding work would make more progress if cooperation with CPAC were established.

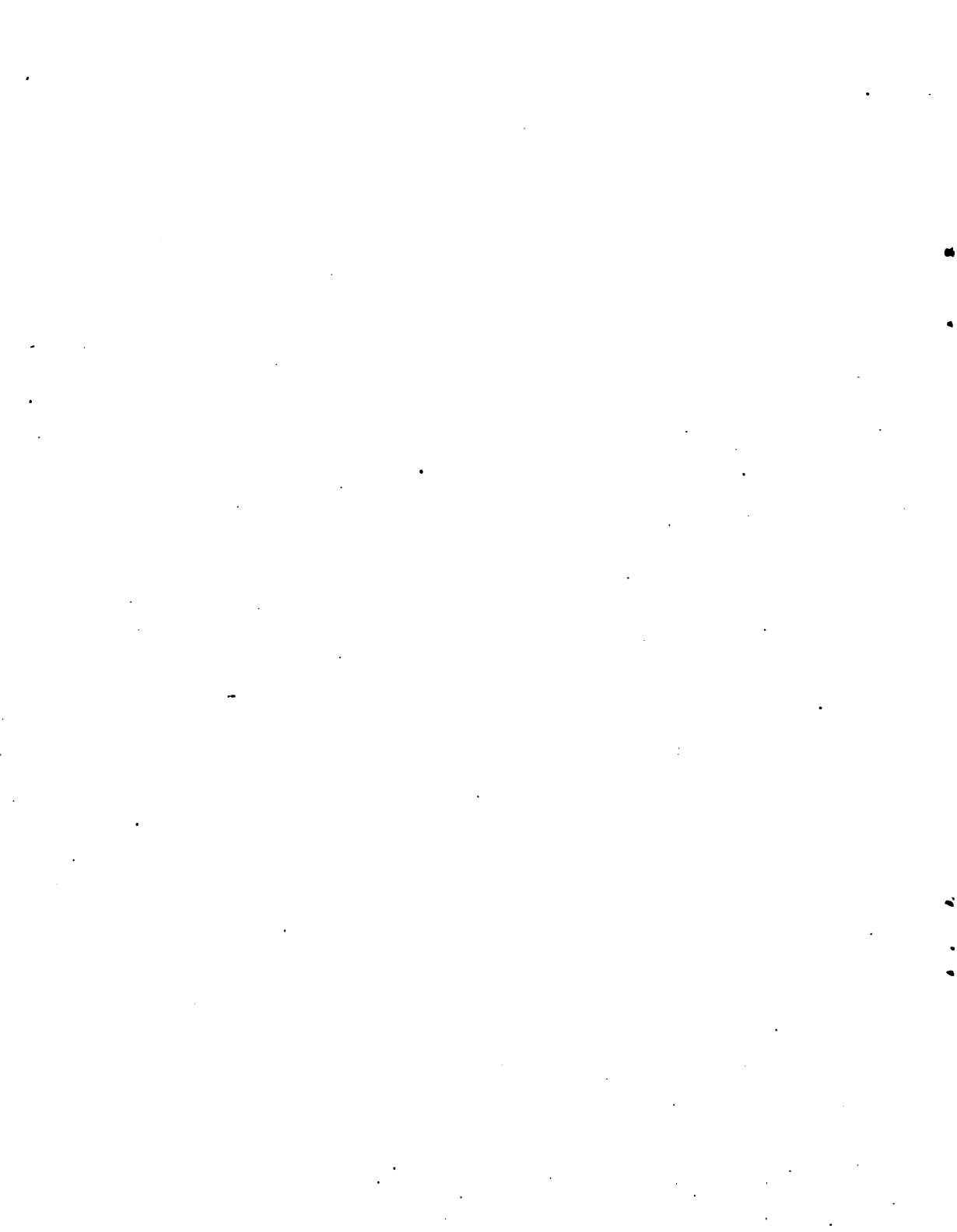
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**FINAL REPORT OF WORK DONE BY DR. E. M. HUTTON  
UNDER AN EMBRAPA - IICA CONTRACT DURING 1987**





**EMBRAPA**

EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA  
CENTRO DE PESQUISA AGROPECUÁRIA DOS CERRADOS

Brasília-DF., June 17 th, 1987.

Consultancy report of Dr. E.M.Hutton under an EMBRAPA/IICA contract for the period April-June, 1987.

1. Transfer of Leucaena technology to CPAC

The main purpose of the consultancy was to make suggestions to CPAC and my counterpart Dr. Mário Soter on the management of the Leucaena hybrid populations and species in three November plantings of 1982, 1984 and 1985. Two main aspects were covered:

- a) Selection and seed collection of the best acid-soil tolerant forage and wood types during the current 1987 dry season.
- b) Plan for the November 1987 wet season plantings on LVE and LVA areas of the selections made. Copies of these 2 lots of suggestions are attached to this report.

Close association has been maintained with Dr. Mário Soter in the field and office, so all important points pertaining to the selection and development of the Leucaena hybrids have been discussed. These include types of trees and their characteristics, importance of profile mineral analyses and root growth to a depth of 1 m (or more) as bases for assessment of acid-soil tolerance, measurement of the all-important dry season growth, bud density/unit branch length relative to regrowth and yield, regrowth after cutting back at the end of the dry season, nodulation, fertilizer application, preparation of seed for planting, crossing techniques and the main soil chemical factors involved in leucaena adaptation to the acid soils of Brasil.

A very good interchange of ideas and techniques have resulted from this consultancy. Dr. Mário Soter will be able to consult me from time to time in Australia by

correspondence if further clarification is needed.

2. Associated Leucaena projects at CPAC

- a) It is necessary for the Forestry group to study the potential of the best wood types selected in the Leucaena program. If suitable selections are identified they could be used in association with, or in rotation with eucalypts in acid soils.
- b) The acid-soil tolerant rhizobium selected at CPAC appears essential for the Leucaena nodulation in acid soil. Cunningham Leucaena nodulates only in the establishment year, whereas the vigorous acid-soil tolerant Leucaena hybrids renodulate each wet season from the residual rhizobium in the soil. This is an important fact in the long-term maintenance of their vigor. The nodulation cycle in Cunningham and some of the best acid-soil tolerant hybrids needs study by the bacteriology group.
- c) An important aspect which also needs investigation is the Ca requirement of Leucaena in LVE and LVA soils. The Ca requirement for example of the new acid-soil tolerant Leucaena hybrids appears to be lower than that of Cunningham. As Ca is a key factor in Leucaena adaptation to acid soils more precise information is required on quantities and forms of Ca needed for maximising productivity.

3. Place of Leucaena in agricultural systems on acid soils

Adequate fertilizer additions are essential for Leucaena growth and persistence on poor acid soils. To offset fertilizer costs the establishment of Leucaena with a suitable cash crop like maize or rice should be a general practice. Dr. J. Zoby has demonstrated this by establishing his CPAC Leucaena "banks" with rice. In some São Paulo fazendas Leucaena establishment with maize has been very successful. Also the residual fertilizer left after a cropping sequence could be sufficient for a successful and cheap Leucaena



establishment.

Leucaena protein "banks" should be established with a suitable grass like the acid-soil tolerant P. maximum, but after several years need an adequate fertilizer input to maintain productivity. The cheapest method to add fertilizer to them is to replace the grass with a crop sequence like soybean, maize, rice. This means that the Leucaena rows of protein "banks" need to be far enough apart to accomodate the use of machinery. A suitable planting plan could be, double Leucaena rows 60 cm apart to maintain protein production with about 4 m between the double rows. This intercropping system could be used on a large or small scale, but would require management of the Leucaena by heavy grazing or cutting. Heavy slashers would be needed where this system was adapted on a large scale.

A permanent intercropping system with Leucaena as described would maintain adequate forage protein production for animals in the dry season. It would also inhibit soil erosion which is a problem in intensive cropping sequences.

#### 4. The mimosine-DHP problem in Leucaena

When the Leucaena dry matter intake of cattle is less than 30% no trouble with hair and weight loss etc in cattle are experienced from the goitrogen DHP (di-hydroxy pyridone), a break down product from mimosine in the rumen. A concentrated Leucaena diet can cause problems and these have already occurred on a large São Paulo fazenda with extensive Leucaena plantings.

It is important that CPAC bring in rumen fluid containing the DHP degrading bacteria from Dr. R.J. Jones, CSIRO, Davies Lab. Townsville, Australia and transfer it to a group of cattle with access to Leucaena. Contact of the infected cattle with other cattle during feeding will transfer the bacteria so whole herds can be infected. However infected cattle need occasional access to Leucaena to keep the specific DHP degrading bacteria active.

It appears that Brazil does not have this bacteria at present. Also evidence from Australia indicates that even where there are no symptoms from Leucaena feeding, liveweight gains of the cattle are

increased when the bacteria are introduced into the herd. If the bacteria are introduced into the CPAC herd more extensive areas of Leucaena need to be planted using the new acid-soil tolerant hybrids and monitoring mimosine in the forage and DPH in urine of infected or non-infected cattle.

Attempts have been made elsewhere without success to breed low mimosine hybrids from L. leucocephala - L. pulverulenta crosses. Low mimosine hybrids would be an advantage not only for cattle, but also for monogastric animals like chickens and pigs often fed rations containing Leucaena leaf-meal. Whether CPAC should commence breeding Leucaena for low mimosine is debatable.

#### 5. General comments on forage research at CPAC

##### a) The place in agricultural systems of the legumes and grasses developed at CPAC

Legumes are not popular with farmers because of their lack of persistence in pastures and difficulties associated with their management. However, Leucaena has stimulated a lot of farmer interest because of its persistence and quality when established. As already outlined, there are also difficulties with this legume in its soil adaptation and management, but these are being overcome by CPAC. It is important to stimulate farmer interest in all the promising legumes at CPAC, but this will only occur if their place in farming systems can be clearly defined.

Conventional large-scale grazing experiments are not realistic these days because of high and increasing fertilizer prices. Farmers are reluctant to apply fertilizers to legume-grass pastures and are starting to realize the value of residual fertilizer left in soil after cropping. CPAC should, if possible, commence work on crop-pasture rotations and examine the residual fertilizer after a cropping sequence, and the utilization of this fertilizer in a subsequent pasture phase. For example after a cropping phase, there is no reason why a high-quality P. maximum - Centrosema pasture should not be grown as types adapted to the cerrados are now available.

With native pastures there is an opportunity to introduce Stylosanthes species like S. capitata, using mineral pelleting to supply the legume and prevent over-stimulation and competition of the native grasses. Stylosanthes have an advantage due to low mineral requirements, including P. The animals on these pastures need P supplementation for best results. Degraded B. decumbens pastures could probably be treated in the same way, although in many areas farmers are trying to eliminate this grass because of the difficulties it causes in cropping.

b) The collection of promising legumes and grasses at CPAC

CPAC does not have the resources, particularly in personnel, to evaluate fully all the promising legumes and grasses that have had a preliminary assessment. A more relaxed approach to wide scale testing of promising, unreleased introductions on farms is indicated. This would be on the understanding that the material is promising, but not properly evaluated. The farmers would soon determine those worth developing, and at this stage CPAC could describe and publicise the most promising for seed production and general use. CSIRO and DPI used this approach in Queensland with success.

Promising unreleased legume species appear to be Arachis pintoi, Centrosema brasilianum and Centrosema hybrids, LVE adapted Leucaena hybrids, Desmodium ovalifolium, Stylosanthes vulgaris minerão and S. capitata hybrids. S. capitata 1097 has already had sufficient evaluation for release. In grasses, the promising species include Brachiaria dictyoneura and other Brachiaria species, Andropogon gayanus synthetic, acid-soil tolerant Panicum maximum, and Paspalum species, especially P. plicatum.





**EMBRAPA**

EMPRESA BRASILEIRA DE PESQUISA AGROPECUARIA  
CENTRO DE PESQUISA AGROPECUÁRIA DOS CERRADOS

Memo. re Suggestions for 1987 Leucaena program CPAC

There were 3 plantings November 1982, November 1984 and November 1985. They have adequate populations of the different Leucaena lines and 6 crosses are represented between a line of L. leucocephala and one of L. diversifolia. In the crosses L. leucocephala with 104 chromosomes contributes desirable agronomic characters including large leaflets, branching and good forage yield, rapid grazing recovery and good yields of larger seeds giving better establishment. L. diversifolia with 52 or 104 chromosomes contributes acid-soil tolerance and deep rooting in acid soils of pH 5 or less, fine leaflets unsuitable for forage and small seeds with poor field establishment.

In the following outline, action for 1987 in the different Leucaena lines and crosses in the 3 planting is suggested. Important selection criteria include height, basal stem girth and vigor indicative of deep rooting and acid-soil tolerance, large leaflets and branching for forage types and fine leaflets and minimal branching for wood types. It is suggested that some of the best wood types should be selected for cooperation with CPAC forestry section, especially as rate of growth appears to be as good that of eucalypts in the 1985 planting. Large leaflet types with minimal initial branching have potential for forage and forestry; with grazing or cutting with a heavy slasher they branch and can produce more forage than less vigorous branched types.

#### I. 1982 planting

1. Necessary to collect bulk seed from outstanding wood types in L. diversifolia 23 (selections from K 583) with 104 chromosomes (plots 57-63, 66 e 67) as poorly represented in 1985 planting (Pegs 57, 61, 65) due to leaf cutter damage.

2. In 11/78-15 (K420 selection) necessary to collect seed of vigorous fine-leaflet 29C-1 as nottested because no seed until 1986. Not necessary to collect seed of fine-leaflet trees 29A-12 e 29-34 as well represented in 1984 and 1985 plantings. (In 1984 29A-12 plots 8, 10, 12 - in 1985 Pegs 29, 30 second block; in 1985 29A-34 Pegs 31 second block e 42 third block). Not necessary to collect seed of large leaflet types such as 29A-4, 6, 11, 17 and 29C-2, 6 as well represented in 1984 e 1985 plantings. 29A-9 the best in 1984 plots 7, 9, and in 1985 Peg 2 first block. Rest of 29 selections in 1984 plots 2, 4, 6, 11, 13-16 and in 1985 planting as bulk K420 selections Pegs 3, 4, 15 first block, Pegs 29, 30 (no number) second block.
3. Not necessary to collect seed from L. diversifolia 25 (K408 selection) and 26 (K454 selection), also from the various crosses as well represented in 1984 and 1985 plantings.

## II. 1984 planting

1. a) Necessary to continue collection of bulk seed of vigorous green large leaflet trees of 29A-9 in plots 7, 9 ; keep separate as best 29 selection.  
b) Necessary to continue collection of seed from vigorous green trees of other 29's in plots 2, 4, 6, 11, 13-16 and bulk as K420 selections.  
c) Necessary in 29A-12 plots 8, 10, 12 to bulk seed from vigorous med. leaflet trees.
- 2) Necessary to bulk the seed of vigorous green, medium leaflet trees of Texas 1074 (native from Laredo, South Texas) in plots 17-23 as this type has not been tested. Not necessary to collect bulk seed of other less vigorous Texas 1074 trees as well represented in 1985 planting, Pegs 50 (including no number) and 51.  
Texas 1074 is a different type of L. leucocephala with high

drought and frost tolerance and should be retained in spite of its lower acid-soil tolerance.

3. Among L. diversifolia lines 25 (Plots 51 e 52), 26 (Plots 47, 49, 55), 30 (104 chromosome selection from K156) in plot 53 and L. diversifolia 31 (104 chromosome selections from K145a) in plots 46, 48, 50, 54 only necessary to collect bulk seed of best trees of L. diversifolia 30 in plot 53 as badly affected by leaf cutters in 1985 planting (Peg 52). Others are well represented in 1985 planting - 25 Peg 48; 26 Pegs 27, 49, 55; 31 Pegs 33, 47.
4. Cross 24-19/2-39 (Cunningham type) x L. diversifolia 25 (52 chromosomes) in plots 56-93, 100-103. Necessary to bulk seed of vigorous, green, branched, large leaflet  $F_3$  trees even though well represented as  $F_4$  trees in 1985 planting (Pegs 19-25 first block) and  $F_3$  trees (Pegs 35, 36, 38 second block and Pegs 44, 58, 59, 62, 63 third block) in 1985 planting. Acid-soil tolerance is a multigenic character so continual selection in older trees (now 2  $\frac{1}{2}$  years) is necessary. Selection of trees better in morning when lighting right to avoid trees with yellowing (Ca e Mg deficiency). Avoid fine leaflet-segrates.
5. Cross 2-5/9-7 (Cunningham) x L. diversifolia 26(52 chromosomes) in plots 104-120. Necessary to bulk seed from the large leaflet dark green vigorous  $F_3$  trees even though represented in the 1985 planting ( $F_3$  trees Pegs 39, 40, 41, second block; Pegs 60 e 64 third block and  $F_4$  trees Pegs 16, 17 first block). The same selection criteria apply as in 4.
6. Cross 24-19/2-39 (Cunningham type) x L. shannoni 16 (K473 selection) with 52 chromosomes in plots 94-99. Necessary to bulk seed from the relatively few dark green, vigorous, large leaflet  $F_3$  trees as they have a different genetic base. Represented in 1985 planting -  $F_3$  trees Peg 46 third block,  $F_4$

trees peg 18 first block.

7. Cross 11 (K420 selections) x *L. diversifolia* 26 with 52 chromosomes in plots 24, 25, 27-33. None of the  $F_2$  trees attractive enough for selection as the more vigorous ones have fine leaflets. Larger leaflet  $F_2$  trees lack vigor and the only vigorous one (33A-5) is sterile. Cross also represented in the 1985 planting Pegs 7 e 8 first block.
8. Cross 11 x *L. diversifolia* 31 with 104 chromosomes in plots 34-45. All these  $F_2$  trees are wood types but necessary to bulk seed of the relatively few most vigorous trees. Represented in 1985 planting -  $F_2$  trees Pegs 5, 13, 14 first block; Peg 32 second block; Pegs 43, 56 third block and  $F_3$  trees Peg 54 third block.
9. 11 x *L. shannoni* with 52 chroms. in plot 26 A. None of the  $F_2$  trees worth selecting. Also represented in 1985 planting  $F_2$  trees Peg 10 Block 1.

- N:B. a) Crossing 24-19/2-39 Cunningham type of *L. leucocephala* with *L. diversifolia* 25 resulted in promising large leaflet forage types in the 1984 and 1985 plantings. The same resulted from crossing *L. leucocephala* 11 with *L. diversifolia* 25 as shown by the 1985 planting.
- b) Crossing Cunningham 2-5/9-7 with *L. diversifolia* 26 resulted in promising large leaflet types but crossing *L. leucocephala* 11 with *L. diversifolia* 26 resulted in poor mainly fine leaflet types.
- c) Crossing *L. leucocephala* 11 with the 104 chromosome *L. diversifolia* 31 resulted in mainly vigorous wood types. This is always likely to occur when crossing *L. leucocephala* lines with 104 chromosome *L. diversifolia*, as evidenced by the Brewbaker cross K156 *L. divers.* (104 chrom.) x K8 (*L. leucocephala*) in the 1985 planting Peg 9.



- d. Crossing L. leucocephala 24-19/2-39 with 52 chromosome L. shannoni 16 resulted in promising large leaflet trees but crossing L. leucocephala 11 with L. shannoni 16 resulted in poor F<sub>2</sub> trees.

### III. 1985 planting

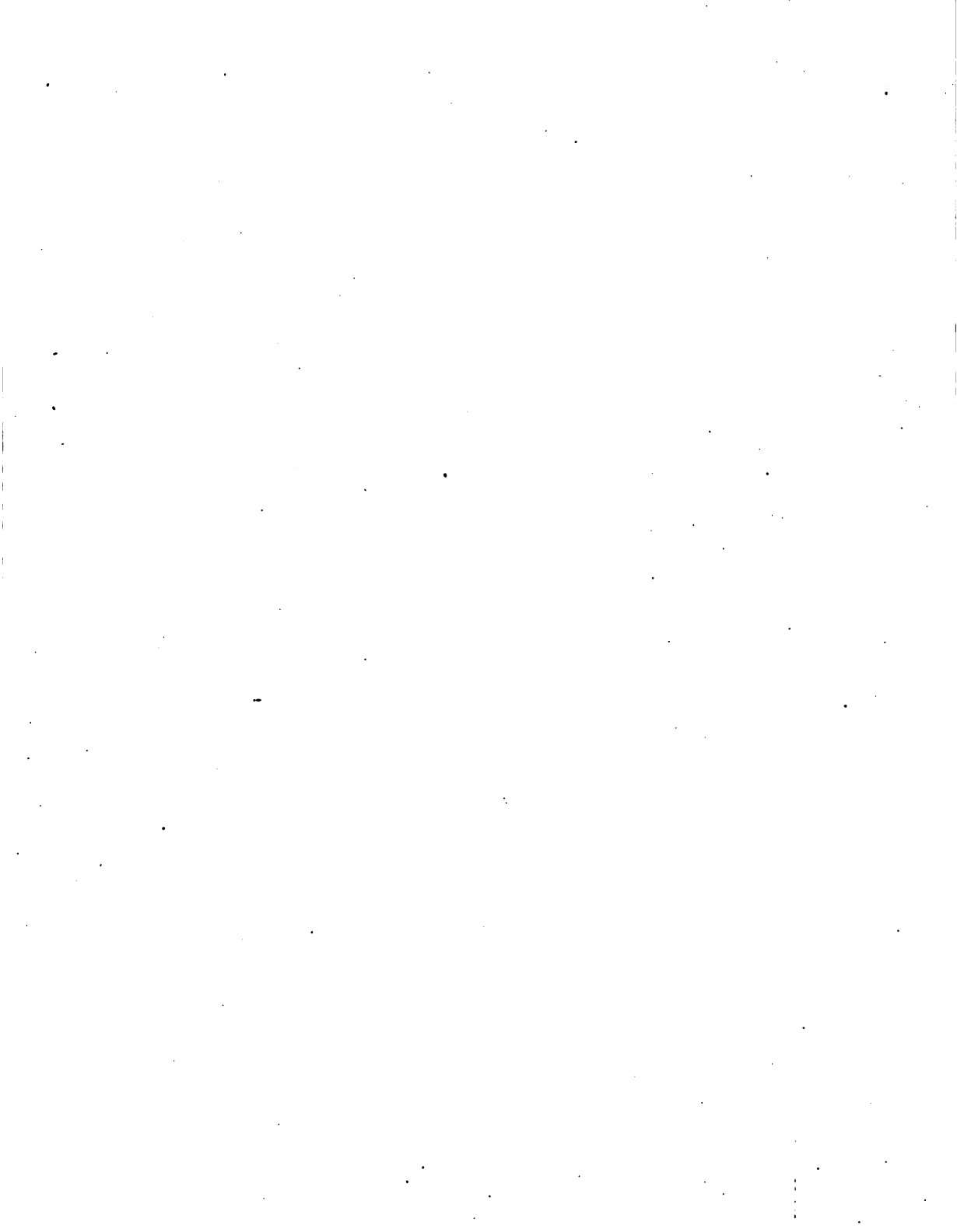
- 1) a. Necessary to collect bulk seed of most vigorous forage types in 29A-9 Peg 2 first block; also best fine-leaflet wood types in 29A-9.  
b. Also as separate lines necessary to collect bulk seed of best forage types and wood types in K420 selections Pegs 3, 4, 15 in first block and Pegs 29 e 30 (No number) in second block.  
c. As separate lines necessary to collect bulk seed of most vigorous wood types in 29A-12 Pegs 29 e 30 (second block) and 29A-34 Peg 31 (second block) and Peg 42 (third block).  
N.B. Will be some difficulty harvesting seed (ladders?) in tall trees of this and other groups. Also seed collection at this stage may have to be restricted to earlier seeders.
- 2) Texas 1074 from Laredo, Sth Texas Pegs 50, 50 (No number) and 51 necessary to collect bulk seed from large leaflet well branched forage types avoiding any with yellowing (Ca deficiency).
- 3) L. diversifolia lines 25, 26 (52 chroms.); 23, 30, 31 (104 chroms.).  
a. L. diversifolia 25 Peg 48 (third block) - necessary to collect bulk seed of most vigorous green trees as original parent and need as reference and control.  
b. L. diversifolia 26 Peg 27 (first block), Pegs 49, 55 (third block) necessary to collect bulk seed most vigorous green trees as original parent, reference and control.  
c. L. diversifolia 23 Pegs 57, 61, 65 necessary to collect bulk seed from few vigorous trees in Pegs 57 a 61 as leaf cutter damage especially 65.

- N.B. Most bulk seed of L. diversifolia 23 will need to come from 1982 planting as mentioned.
- d. L. diversifolia 30 peg 52 (third block) necessary to collect bulk seed from few vigorous trees and bulk it with those in 1984 planting. As mentioned used in Brewbaker cross Peg 9 first block.
  - e. L. diversifolia 31 Pegs 33 (second block) and 47 (third block) necessary to collect bulk seed of vigorous trees as original parent, reference and control.
- 4) Cross 24-19/2-39 Cunningham type x L. diversifolia 25 (52 chroms.).
- a. Necessary to collect bulk seed of best F<sub>3</sub> forage trees Pegs. 35, 36, 38 second block and Pegs 44, 58, 59, 62, 63 third block avoiding fine leaflet types.
  - b. Necessary to collect bulk seed of best large leaflet F<sub>4</sub> forage trees Pegs 19-25 first block.
- 5) Cross 2-5/9-7 (Cunningham) x L. diversifolia 26 (52 chroms)
- a. Necessary to collect bulk seed from vigorous, dark green F<sub>3</sub> trees with thicker trunks Pegs 39, 40, 41 (second block) and Pegs 60 e 64 (third block).
- N.B. Leaf cutter damage.
- b. Necessary to collect bulk seed of vigorous, well branched F<sub>4</sub> forage trees Pegs 16 e 17 (first block).
- 6) Cross 11 L. leucocephala x L. diversifolia 25 (52 chroms) Peg 6 first block. Necessary to collect bulk seed of vigorous F<sub>2</sub> forage trees as well as bulk seed of best F<sub>2</sub> fine leaflet wood trees. Select those with thicker trunks and without yellowing.
- 7) Cross 11 L. leucocephala x L. diversifolia 26 (52 chroms)
- a. The larger leaflet F<sub>2</sub> forage trees lack vigor and not worth selecting at this stage.

- b. From the most vigorous fine leaflet F<sub>2</sub> trees necessary to collect bulk seed as wood types.
- 8) Cross 11 L. leucocephala x L. diversifolia 31 (104 chroms)
- a. Necessary to collect bulk seed from vigorous thick trunked F<sub>2</sub> wood trees Pegs 5, 13, 14 first block; Peg 32 second block; Pegs 43, 56 third block.
- b. Necessary to collect vigorous F<sub>3</sub> trees Peg 54 third block with intermediate leaflets as may be useful forage types.
- 9) Cross 24-19/2-39 L. leucocephala x L. shannoni 16 (52 chroms)
- a. Necessary to collect bulk seed of vigorous, well branched, large leaflet F<sub>3</sub> forage trees Peg 46 third block.
- b. Necessary to collect bulk seed of few vigorous, large leaflet F<sub>4</sub> forage trees Peg 18 first block.
- 10) Cross 11 L. leucocephala x L. shannoni 16 (52 chroms) F<sub>2</sub> trees Peg 10 Block 1 not worth selecting.

### Conclusions

With proper replicated trials on LVE and LVA sites at CPAC it will be possible for CPAC to distinguish among the promising acid-soil tolerant Leucaena lines now developed, a number which can be used with confidence by farmers for forage in the Cerrados. Promising acid-soil tolerant Leucaena lines are also available for forestry uses. Associated studies needed in the new acid-soil tolerant lines include nodulation status, effect of anaerobic bacteria developed by Dr. R.J. Jones CSIRO Davies Lab. Townsville, Australia for DHP rumenal breakdown on liveweight gain of cattle grazing Leucaena and agro-forestry systems with Leucaena as a permanent component. Consideration is needed to the possibility of a psyllid (jumping plant lice) invasion causing considerable damage to Leucaena as in Hawaii, Philippines, S.E. Asia, Timor, Papua-New Guinea, and more lately, NE. Australia.



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Responsáveis pela reprodução: Jadir José dos Santos e Murillo Sodré da Silva.

## 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 às 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.

FECHA DE DEVOLUCION



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PM-A4/BR-87-004

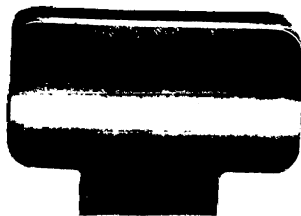
Autor

Título Forage improvements. 1986 and  
1987 consultancies

Fecha Devolución	Nombre del solicitante

Coordenação  
Escritório  
Caixa P  
Brasí





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