INTEGRATING RICE IMPROVEMENT WITHIN AGROPASTORAL SYSTEMS

ODA HOLDBACK PROJECT PROPOSAL

A Proposal for: British ODA, London, United Kingdom

Executing Agency: CIAT

Centro Internacional de Agricultura Tropical
Cali, Colombia

Collaborating Partners: -CNPAF/EMBRAPA, Brazil

April 1994

12

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TABLE OF CONTENTS

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1.0 BACKGROUND

1.1 SAVANNA AGRICULTURE IN TROPICAL LATIN AMERICA

Tropical Latin America contains about 230 million hectares of savannas, distributed across Brazil (180 million), Venezuela (28 million), Colombia (17 million), Guyana (4 million, and Bolivia (4 million) (Cole, 1986). Savanna agriculture is most developed in Brazil, but the other countries visualize this as a priority ecosystem for future development. About 50 million ha are sown to pastures, and another 12 million ha to crops, particularly upland rice, soybeans and maize. The savannas now supply about 40% of Brazil's total rice and soybean production, and 35% of its maize.

The major constraints to agriculture in the tropical savannas are the acidic, nutrient-poor soils (pH around 4.0 to 4.5 and aluminum saturation above 70%) (Goedert, 1983). Classified as Oxisols and Ultisols, they are very low in phosphorus, potassium, calcium, and magnesium; and excessively high in toxic aluminum species. This chemical poverty can be corrected through judicious applications of lime and fertilizer to obtain high levels of productivity; however, this incurs significant costs, and economic efficiency often dictates less-than-optimal levels of correction. Soil structure and topography in the savannas are suitable for efficient, mechanized agriculture but these soils erode rapidly under excessive tillage, over-grazing or other inappropriate management regimes.

Upland rice is often planted as the first crop in newly-opened savanna land, because it is the only grain crop tolerant to the extreme acid soil conditions. Traditional varieties are low-yielding and farmers grow them more with the aim of aiding the land-clearing process than from a rice production or profit point of view. Normally rice is followed after just one or two years by pasture, either native or introduced grasses, which in many cases are overgrazed, leading to degradation and abandonment. The cycle repeats itself, with more native savanna being cleared and then degraded.

1.2 IMPROVED RICE-BASED AGROPASTORAL SYSTEMS

Farmers participate in the "degrade, abandon and expand" cycle because it is more profitable to do so than to continue to farm the areas where productivity has been exhausted. Researchers in Brazil and at CIAT have been searching for economically viable means of regenerating the soil fertility of existing cultivated areas, and indeed increasing their productivity beyond their initial state. Such systems would provide farmers and governments with alternatives to expansion of the agricultural frontier in order to meet basic income and national food needs, thus removing a major dynamic driving land degradation.

A practical alternative would need to build upon existing farmer experience, infrastructure, market demands, etc. if it were to be adoptable. Since upland rice and pastures have been dominant parts of the traditional system, work concentrated on improving these components.

In the late 1980's, researchers began the development of improved rice-pasture based systems where more productive and input-responsive pasture grasses and legumes are intersown with higher-yielding upland rice varieties (CIAT, 1990; Leal et al., 1991; Madeley, 1993; Kluthcouski et al., 1991).

By intersowing, rather than in sequence, the investment in tillage and fertilization for rice brings the additional benefit of enhancing the establishment of improved pastures, at no extra cost. Higher yielding rice varieties bring enough remuneration to cover the cost of the system, including seed of improved forages (with traditional low-yielding rices, these costs would require incurring additional debt). The pasture cycle continues for about five years, generating not only higher beef production but also other benefits such as improved soil fertility, higher rice yields in the next cycle, a break in the buildup of pests, a more diversified economic base for farmers, and other benefits typical of rotational or ley systems. The result is a reversal of the "degrade and abandon" cycle to one of "invest, improve and stabilize".

BACKGROUND

Some of the benefits of the system identified in large scale field trials and on-farm over the past few years in Colombia include:

Rice yields of 2-3 tons paddy/ha in the first cycle, double the traditional variety monocrop yield;

Rice yields increase to 3-4 t/ha in subsequent cycles, due to enrichment of soil by pasture, as opposed to yearly decline of 400 kg/ha in sequential monocrop rice;

Economic analysis indicates farmers need to achieve rice yields of at least 1.6 t/ha to cover monocrop rice establishment costs, and 2 t/ha to cover improved rice-pasture establishment; traditional rice yields only 1.2 t/ha. The much higher yields of improved rice are thus the key that makes the improved system attractive to producers;

Because the system gives better establishment of more vigorous pasture species, cattle can be released for grazing immediately after rice harvest, instead of the one year establishment period required when traditional pastures are planted alone;

Typical farmer experience at the initial stages of adoption has been to double the livestock carrying capacity of their farms by converting just 5-10% of their area to this system, or conversely, reducing the degradative effects of grazing with the existing stocking rate;

After three years in improved pastures, soil organic matter to 100 cm depth increases significantly;

Soil microbial activity, soil aggregate stability, and microbial P pool significantly increase compared to monocropping.

In Brazil, CNPAF/EMBRAPA estimates that there were more than 50,000 ha grown under improved rice-pasture in 1993, and 100,000 ha are expected in 1994. They expect more than one half million hectares under the system within five years. At present there are fewer farmers in the savannas of the other countries, but Colombia established the system on about 5,000 ha in 1992 and 1993, with expectations that it will spread to 100,000 ha in five years. Venezuela is expecting to have 25,000 ha by the same time.

1.3 UPLAND RICE IMPROVEMENT FOR THE SAVANNAS

Upland rice breeding has been underway in Brazil since the 1950's and at CIAT since the early 1980's. Initially, CIAT emphasized the moist savanna environments found in Colombia, while Brazil's CNPAF/EMBRAPA worked in more drought-prone areas found in the eastern part of the Brazilian savanna. As the institutions began to work more closely together in the late 1980's, CIAT has moved towards more strategic research aspects, and CNPAF/ EMBRAPA continues with more applied activities geared at germplasm releases. These efforts have been highly successful (Guimarães, 1993; Leal et. al., 1991). Most of the savanna upland rice area in Brazil is now sown to improved varieties yielding substantially more than the traditional land race types grown previously; and in Colombia, savanna upland rice has become established as an entirely new type of crop culture.

JUSTIFICATION 2

2.0 JUSTIFICATION

The world is vitally concerned about increasing the sustainability of agricultural land use, especially as it impinges on environmental conservation and human health. The lowland tropics of South America are a particularly sensitive area, being the home of the most biologically diverse and extensive rainforests on the planet.

However, these forests are currently threatened by a number of forces, including expansion of the agricultural frontier. At the same time, growing populations will need to be fed, and tropical countries face the dilemma of making these two ends meet. Sustainable agricultural systems are needed which enable increases in tropical production without degrading the environment.

The tropical savannas adjoin the margins of these rainforests. Sustainable and more productive agricultural systems in the savannas can provide tropical countries with an "escape valve", i.e. alternatives to further expansion of agriculture into the rainforests.

For this to happen, however improved agricultural systems need to be devised and implemented. Improved agropastoral systems are currently one of the most promising options.

Upland rice breeding has been a key factor in the initial success observed with the improvement of agropastoral systems. Rices have been bred which are more responsive to inputs, and have a more commercially marketable grain type. Farmers intensify their management of these varieties, knowing they will obtain an economically favorable response to those inputs, such that yields are commonly double those of the traditional variety-management package. Higher rice yields generate enough additional income to serve as an incentive for farmers to use it to cover the costs of interseeding improved pastures as well. Improved rice varieties act as the "trigger" that sets off the adoption of the whole rice-pasture system.

The breeding of these more responsive rice varieties is a very recent achievement, mainly over the past decade, and there are indications that much more progress can be attained. One neglected aspect has been the effect of the crop-pasture interaction on rice performance. It has been observed that competition between the rice and some pasture species takes a major toll on potential rice yield, ranging from 5 to 30% or more, depending on the growth habit of the particular rice variety used. Later-maturing rices appear to suffer greater yield losses because a larger portion of their growth cycle overlaps with the vigorous growth period of the pasture. Also, shorter rices seem to suffer greater yield loss, presumably due to more aerial competition with the pasture canopy (and possibly correlated root growth habits). While disadvantageous in competition with pasture, these traits may be desirable in some situations: later maturity may enhance yield potential where rainfall is adequate, and short height helps reduce lodging.

Clearly, trade-offs in rice traits are involved, which are only understood at the empirical level at present. Until now selection in the rice breeding process has been mainly conducted under monocrop conditions. Small numbers of advanced lines have been tested in a pasture association, but these empirical observations need to be strengthened by a better basic understanding of the mechanisms involved, leading to principles that could guide selection for specific key traits early in the breeding process. We need to know what specific traits are important; what are the tradeoffs among them; and how they can be efficiently selected for. At the same time, we need to develop our skills in applying this information and technology.

CNPAF/EMBRAPA and CIAT have accumulated considerable knowledge and experience on rice-based agropastoral systems over the past decade, which will provide a solid starting point for this investigation and assure its relevance and practical direction. Additionally, CIAT has acquired knowledge and experience on rice-weed interactions (Fischer, 1993 and Fischer et. al., 1993, 1994) which can serve as a perspective to expand our understanding of the upland rice/pasture association. CIAT has also drawn upon the experiences of IRRI in modelling rice-weed systems (Kropff et. al. 1993), which will be expanded upon in this proposal.

The drier, eastern parts of Brazil's savanna area present drought stress as a major factor that can be expected to interact with rice-pasture performance in association. CNPAF has experience on analysis of rice plant responses to drought, which can be extended to analyze the effects in the association in this project.

PROJECT DESCRIPTION

3

3.0 PROJECT DESCRIPTION

3.1 GOAL AND PURPOSE

The Goal of this project is to contribute to increasing the agricultural productivity of the tropical savannas in Latin America in a way that also helps protect and even enhance the area's natural resource base.

The project's Purpose is to identify rice traits which improve rice performance in association with intersown pastures.

3.2 CONCEPTUAL FRAMEWORK, AND APPROACH

There have been few investigations of the mechanisms of interaction between upland rice and other species, but studies of rice-weed interactions can help orient this project (e.g., Fischer et. al. 1993, 1994). Furthermore, studies are available on interactions between other upland crop species, as well between from non-crop species in the ecological literature.

Plant interactions can be positive or negative, but our experience to date enables us to operate on the assumption that, in this project, the effects of the grass will be negative on the yielding capacity of the intersown rice crop. Therefore we will limit our framework to the negative effects of the interaction. Legume interference will not be addressed in this project, as explained later.

Some definitions of terminology are necessary. In this document we will use the general term "interference" to indicate a negative effect of one plant upon another, without implying what mechanism may be involved. Two general mechanisms of interference will be referred to: competition, i.e. the effect of a plant acquiring a resource also in demand by another; and allelopathy, a chemical inhibitory or toxic effect of one plant on another.

Interference ability should be distinguished from the response of a plant being interfered with. Responses to interference include those found in host-pathogen interactions such as resistance, tolerance, avoidance/escape, etc.

Another basic precept is that total production in intercropping situations is maximized when the species complement, rather than overlap, their growth and nutrient demand patterns in space and time. We will accept this precept as our working hypothesis with the qualification that in agropastoral systems, total production may not be the ideal target from the farmer's point of view. Farmers adopting improved rice-pasture will be highly dependent on quick income from the rice to pay back loans drawn to cover the costs of tillage, seed, fertilizer and other inputs. High pasture biomass production during the association phase, above and beyond what is necessary for successful pasture establishment, is not desirable if that extra biomass has to come at the expense of rice yield. Well-established pastures quickly accumulate additional biomass once the competing rice species is removed.

While these considerations help to define the desirable rice plant, they do not indicate what characteristics breeders can select for to attain that plant. Characters that have often been mentioned in relation to the acquisition of nutrients essential for maximum growth and yield include:

i) Shoot characters (competition for light): height, leaf and canopy area, light penetration, architecture (prostrate vs. erect, wide vs. narrow leaves, high vs. low tillering, etc.).

ii) Root characters (competition for soil nutrients): mass, depth, volume, thickness, root length density, root activity, and allelopathy.

These characters are not static; development rate over time, tolerance to stresses, and ability to quickly recover from stresses could be key attributes for each.

More interference with rice has been observed from the grass than from the legume forage component. Therefore, to achieve focus we only intend to address interference between rice and forage grass species in this project.

Other issues we will not address are a) interference between rice and weeds, and b) interference between rice and volunteer pasture regrowth. These are important issues in improperly-managed agropastoral systems, but they can be greatly reduced through management practices such as: a well-maintained 3-5 year forage cycle which controls weeds that could be troublesome to rice; and a pre-plant herbicide application to kill the remaining weeds plus the previous pasture before sowing the new crop. Volunteer pasture plants are well established and so aggressive that it is unlikely that rice breeding can contribute significantly to their control.

3.3 METHODOLOGICAL ISSUES

For a comparison across two sites (Colombia and Brazil), it would be ideal if the same rice genotypes, pasture species and cultural practices would be used, so that differences in results are solely attributable to differences in environment. However, these methodologies interact with environments, and for the results to be most useful, the most appropriate methodologies should be used for each environment. Our aim is to obtain results at a fundamental or mechanistic level, so we need to use methodologies that perform efficiently in each environment.

Our general approach, then will be to standardize wherever possible, but not where this would render the results irrelevant or academic; in such situations, we will choose the most appropriate methodology for the particular environment.

The details of particular rice genotypes, pasture species and cultural practices to be used at each site will be determined during the initial planning workshop.

3.4 PROJECT OUTPUTS

Major outputs will consist of the following:

Characterization of the mechanisms of interference between intersown upland rice and the most important improved grass pasture species;

Identification of key rice plant traits that can be selected for to maximize rice yields without endangering pasture establishment;

More rapid and practical screening techniques that breeders can use in performing these selections;

Characterization of the effects of crop-pasture interference on the drought resistance of different genotypes; and

Strengthened interaction and skills development between CIAT and CNPAF, Brazil in this subject area.

3.5 ACTIVITIES

Activities are described in order of the above outputs and are graphically illustrated in Figure 1.

1. ***Characterization of the mechanisms of interference between intersown upland rice and the most important improved grass pasture species:***

To attain this output we will do an in-depth study on about eight contrasting upland rice genotypes, intersown with the major available genotype of each of two forage grass species. Choice of rice varieties and forage species may differ between the Brazilian and Colombian sites as described earlier, depending on adaptation and availability of seed.

Interference per se will be quantified using a three-plot technique: rice monocrop, grass monocrop, and intersown rice-grass. The monocrops serve as the control treatments; interference will be measured as performance in the mixed plot, relative to the control.

The Dewit "replacement series" method (1960) will enable us to discriminate between the two major mechanisms of interference, namely, competition and allelopathy. Evidence of allelopathy will be confirmed using screenhouse pot or seedling assay methods, but we will not be able to do biochemical characterization of putative allelopathic compounds within the resources of this project.

While we are characterizing interference, we will also be characterizing the apparent causes of it, and responses to it. Shoot characters will be measured using conventional foliage area, light penetration, and gravimetric techniques. Powerful new techniques will be employed to obtain difficult root data. Mechanized soil core sampling, and root washing and scanning technology will allow us to sample about 150 plots per week, per site during peak periods. Since the forage grass species exhibit C4 metabolism, while rice is C3, the carbon isotope discrimination technique (Svejcar and Boutton, 1985) will be used to measure their individual root masses when grown in mixture.

The data will be used to generate genotypic coefficients in crop competition models available from IRRI (Kropff and van Laar, 1993) and CERES (Michigan State University, IFDC, and IBSNAT, 1993) and to adapt those models if necessary for the particular application of rice-pasture associations.

We would like to take advantage of this ODA-supported project to involve UK institutions in some of these methodological aspects, particularly the application of advanced techniques such as carbon isotope discrimination and others. During the first year we will make contacts to gain information on these institutions and identify opportunities which may be subsequently integrated into this project.

Figure 1

Work Breakdown Structure Linking Project Activities to Project Outputs

Program Goal

To increase the agricultural productivity in the savannas ecosystem while protecting the native savannas.

Project Purpose

To identify and utilize rice traits that enhance the performance of the rice-pasture system, to increase sustainable productivity.

Outputs / *Activities*

Mechanisms and Components of Rice-Pasture Interference

- Manipulate key rice genotypes, pasture species, sowing conditions,dates, rates, and species proportions to generate a database for study and appropriate for modeling rice-pasture interference.
- Identify the type of interaction, sepparating competition from other antagonistic effects such as allelopathy.
- Identify most successful rice-pasture combinations (competition avoidance, niche differenciation), and establish rice traits and growth characteristics related to such succesful associations.
- Observe effects on competition and related rice traits of two different environments: drought prone (Brazilian Cerrado) and low fertility, acid soil (Colombian LLanos).
- Generated database fed to competition models (adapting IRRI's crop-weed competition model) for sensitivity analysis with different genotypes, plant traits, and environments to develop concepts of desirable traits. CIAT and CNPAF modellers meet for collaborative approach.

Identify traits related to interference and yield

- Crosses involving parents with contrasting behavior to develop selection schemes for obtaining segregants with combinations of identified traits for competitiveness.
- Identify traits or trait complexes genetically associated with rice's ability to compete with an associated species.
- Identify which of the competition-related traits of rice have pleiotropic effects on yield.
- Identify genotypes that may have direct use in breeding after the project ends.
- Make crosses to combine desired traits, with agronomically acceptable backgrounds.

Develop rapid and practical screening techniques

- Based on relevant soot and root traits identified, develop quick measurement methodologies suitable for screening large numbers of genotypes.

Evaluate the effects of the association with a pasture species on rice drought tolerance

- Effect of competition on water use efficiency.
- Relate competition under drought stress to rice root, shoot, and growth characteristics.
- Identify traits in rice genotypes with certain degree of niche differenciation for partial competition avoidance, when associated with a pasture species under moisture stress.

Strengthening of CNPAF an CIAT skills, sharing of knowledge

- Planning workshop in year 1 (CNPAF, CIAT).
- Exchange visists of CNPAF and CIAT scientists to the two sites during the season.
- Final year workshop to disseminate findings (Brazil, Bolivia, Colombia and Venezuela).
- Publications in refereed journals.

Project management

- Revise design based on donor suggestions.
- Finalize contract with donor.
- Administer subcontracts with other consortia partners.
- Submit progress report to donor.
- Participate in project evaluation.
- Submit end-of-project report to donor.

This information will help us gain a basic understanding of how contrasting genotypes grow and respond to the presence of an intersown pasture grass. This will enable us to propose hypotheses about which traits are most important, and develop the skills necessary to measure them more efficiently for use in the objectives below.

2. ***Identification of key rice plant traits that can be selected for to maximize rice yields without endangering pasture establishment:***

The analysis indicated in no. 1 above will provide an indication of traits associated with desirable levels of interference of the rice plant with forage grasses. However, since this analysis is from a limited sample of rice genotypes, it will not be possible to conclude whether it is certain traits, or rather complexes of traits found in particular genotypes, that make them highly or less-interfering. Nor will this analysis allow us to conclude whether interference traits have negative pleiotropic effects on rice yield.

To clarify these issues, we will choose an appropriate and practical crossing scheme to obtain contrasting trait combinations. Generation advance will be accelerated through anther culture or, if recalcitrant, through single seed descent. These materials will only be ready by the third year of the project. To the extent that traits associate independently, this process will generate a number of trait combinations in different genetic backgrounds, which will allow us to distinguish between "specific" effects of some traits and trait complexes, which only operate in particular backgrounds, from "general" effects of other traits, which are expressed across a range of backgrounds. It is more likely that traits expressing a general effect may be the cause of that effect, and therefore these are the traits breeders may be most interested in. This method will also help elucidate correlations between interference traits and yield, and identify some simple trait combinations that may also be useful for breeding. Some of the best lines identified in these experiments may have direct use in breeding.

Because these trials will be quite large, some streamlining shortcuts will have to be taken so that the task is manageable. Based on knowledge gained in the first two years of the project, we will be able to identify the few highest-priority traits, use shortcuts in trait measurement methods, and plan the most interesting crosses for this objective.

3. ***More rapid and practical screening techniques that breeders can use in performing these selections:***

As outcomes of objectives 1 and 2, we will have gained experience with several fairly complex measurement methodologies and traits, and will have an idea about which are potentially most useful for breeders to use in larger populations. Based on this we will attempt to modify and simplify the techniques to obtain just the most critical information in the most rapid and economical way possible, on a scale of hundreds of analyses per season. For example, we hope to be able to identify one or a few key time point(s) and depth(s) of sampling that reflect root competition as it affects rice yield. This would tremendously reduce the labor and expense of deriving seasonal curves over a range of depths to characterize a genotype. Likewise, we expect to identify critical times to measure the shoot canopy and habit, and rapid methods for their estimation.

For mass screening techniques, less complex designs will need to be devised to measure interference, probably foregoing one or both of the controls described in objective 1.

4. ***Characterization of the effects of crop-pasture interference on the drought resistance of different genotypes:***

At the Brazilian site, drought stress resistance and/or recovery ability is expected to be an important trait influencing the expression of interference by both rice and pasture grasses. Past research has characterized the drought tolerance of different rice varieties grown in monoculture. This project output will examine how pasture interference affects varietal drought tolerance. Varieties contrasting for drought tolerance will be grown with and without pasture grass in association, in field plantings at different sowing dates and in soil boxes that can be covered during rainfall events, to achieve drought stress at different growth stages, particularly the reproductive stage. The evaluation of drought resistance will be based on yield relative to irrigated plots and to monoculture upland plots. Water consumption and water use efficiency will be monitored in the box trials, as well as the growth parameters described earlier.

5. ***Strengthened interaction and skills development between CIAT and CNPAF, Brazil in this subject area:***

Skills development will be hands-on, through collaborative research rather than a training-type approach. This will ensure that valuable techniques and experience enter directly into the ongoing research programs at both institutions. An initial joint planning meeting, three exchange visits, and a final workshop (including the other savanna countries) are proposed to plan the experiments, to monitor progress, and to discuss, consolidate and share results. Several publications in refereed journals are expected as well.

4.0 PROJECT MANAGEMENT

The Project Organization Chart is shown in Figure 2.

CIAT will be responsible for project monitoring, administrative management and reporting. This will include purchase of capital equipment items and disbursement of funds to Brazil. CNPAF, Brazil will provide CIAT with necessary accounting of funds disbursed to, and expended in Brazil. CNPAF will also provide CIAT with an annual report of technical progress on the project, and this will be monitored and discussed during the annual exchange visits and final workshop. CIAT will consolidate that information with its own reports to provide an annual report to the donor at the end of years 1 and 2, and a final report in year 3, including both financial and technical components.

Persons responsible for the project will be:

CIAT:

Dr. M. Winslow, Rice Program Leader

Dr. A. Fischer, Project Coordinator
Crop Physiologist/Weed Ecologist

Dr. E. Guimaraes, Rice Breeder

Dr. J. Saravia, Project Support (Progress Reports)

Mr. E. Pacini, Financial Controller

CNPAF/EMBRAPA:

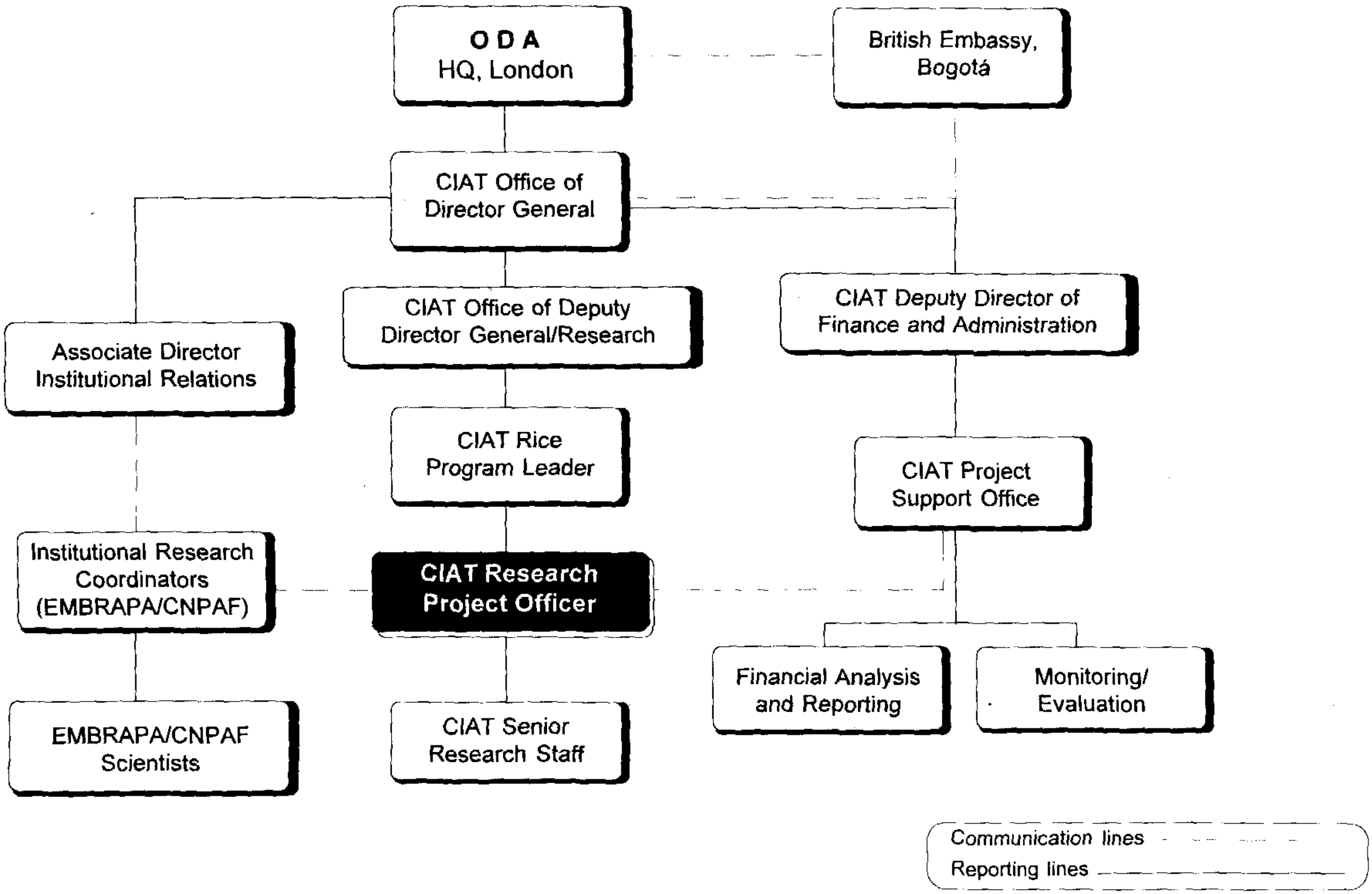
Dr. B. da Silveira Pinheiro, CNPAF National Coordinator and Plant Physiologist

Dr. F. Zimmerman, Statistician and Modeller

Dr. O. Peixoto, Rice Breeder

Figure 2

Project Organization Chart



Project Development Office
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5.0 BUDGET

The proposed budget is attached. The budget is broken down into CIAT and CNPAF portions since the work will be based at their respective sites and daily management of expenditures will be handled by the respective institution.

5.1 BUDGET NOTES:

1. *Personnel*: this amount will cover local staff salary costs.

2. *Supplies*: expendables such as seed, fertilizer, fuel, spare parts, consumables, etc.

3. *Services*: land preparation, machinery and lab equipment maintenance and repairs, communications charges, etc.

4. *Equipment*: this covers a root length scanner needed by CNPAF for the root analyses.

5. *National travel*: CIAT's research site is at Villavicencio, a 12-hour drive from its Cali Headquarters. This item covers the cost of six supervisory trips Cali-Villavicencio (by air) per year, plus ground transport to move support staff, equipment and supplies.

6. *International travel*: Two scientist exchange visits/year are planned. In the first and third years, Brazilians will visit the CIAT site; and in the second year, CIAT staff will visit the CNPAF site (Goiania).

7. *Workshops*: three Brazilians will attend an organizational workshop to be held at Villavicencio in the first year, and two CIAT staff plus four scientists from other savanna countries will attend a final workshop at Goiania in the third year.

8. *Indirect costs*: It refers to support services provided to the project team.

Table 1

ODA – Integrating Rice Improvement within Agropastoral Systems

Budget Total and Breakdown by Activities and Year

In £

ITEM	1994–95	1995–96	1996–97	Total
CIAT				
Personnel	5,105	5,445	5,785	16,335
Supplies	1,020	1,020	1,020	3,060
Services	2,040	2,040	2,720	6,800
National travel	1,700	1,700	1,700	5,100
International travel	–	2,040	–	2,040
Workshops	3,400	–	–	3,400
Indirec costs	1,225	1,275	1,430	3,930
TOTAL CIAT	**14,490**	**13,520**	**12,655**	**40,665**
CNPAF/EMBRAPA				
Personnel	–	–	–	–
Supplies	5,100	2,380	2,380	9,860
Equipment	6,805	–	–	6,805
Services	2,040	3,400	3,400	8,840
National travel	340	1,700	1,700	3,740
International travel	2,040	–	2,040	4,080
Workshops	–	–	6,805	6,805
Indirect costs	655	300	655	1,610
TOTAL CNPAF/EMBRAPA	16,980	7,780	16,980	41,740
TOTAL PROJECT	31,470	21,300	29,635	82,405

ODA–IRIAS
27–Apr–94
PROPOSED

E. Pacini

Emil E. Pacini
Financial Controller (A)

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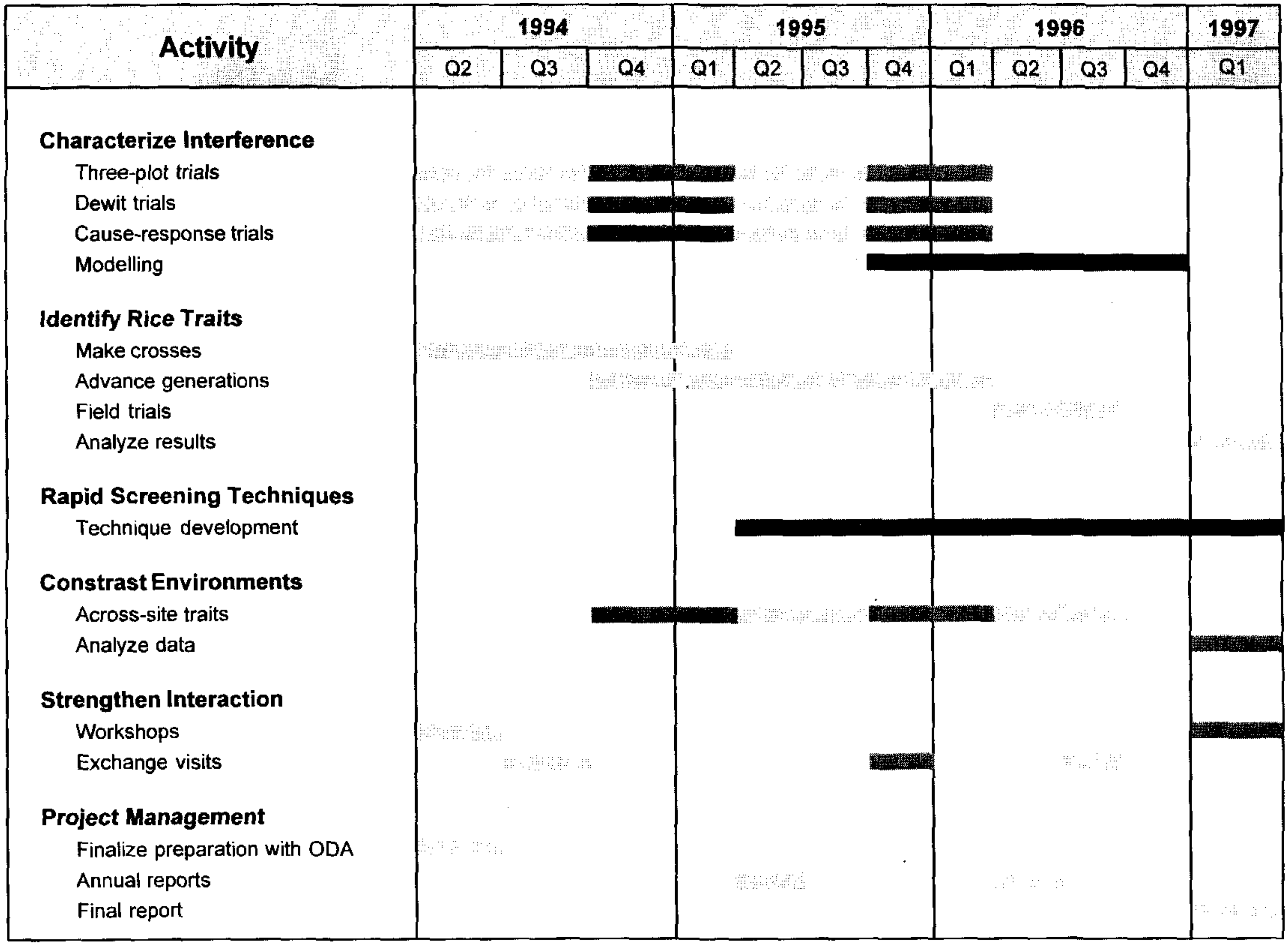
Appendix A

Gantt Chart for Project Implementation Schedule of Activities* by Quarter



* Note, upland rice growing season in Colombia is May-October; in Brazil, November-May

CIAT Site
CNPAF Site
Joint

Appendix B-1

CIAT C.V.

Centro Internacional de Agricultura Tropical

Albert Jean Fischer

Position in Project: Project Coordinator, Rice Program

Professional Experience:

- 1993-1994, participated in a training course at IFDC (International Fertilizer Development Center), Muscle Shoals, Alabama on the principles and use ofthe CERES models; collaborative work on modelling was established with that institution.
- 1992, after a contest was offered the Weed Science position in the Inland Valleys Program at the International Institution for Tropical Agriculture (IITA), Ibadan, Nigeria.
- 1989, hired by the International Center for Tropical Agriculture (CIAT) as Rice Weed Scientist/Agronomist at Cali, Colombia to develop components for integrated weed management in rice, and to conduct training activities for rice researchers and extensionists of Latin American countries.
- 1988, worked for IPPC/USAID to conduct an extensive study on the safety of pesticide use in Morocco.
- 1988, participated at OSU/IPPC in the modelling of grasshopper control campaigns in the Sahel (Chad) as an aid for decision making and in cost/benefit analysis.
- 1987, appointed by IPPC/USAID to teach a series of four short courses on the rational use of pesticides and pesticide safety to extensionists and farmers in Panama.
- 1987, appointed by IPPC/USAID to teach a short course on the rational use of pesticides and pesticide safety to extension agents in Senegal.
- 1987, visited the MIAC/Maroc dryland agriculture project conducted by a consortium of midwestern American Universities (MIAC) jointly with the Moroccan government, in Settat, Morocco. Was offered the weed science project leader position.

- 1987, traveled to Chad on an IPPC/USAID assignment to conduct a crop loss assessment on millet and to gather information for expert systems modeling being developed at OSU/IPPC to assist grasshopper/locust control campaigns.

- 1986 & 1987, lectured at the short course on Weed Management Strategies and Methods held at Oregon State University and sponsored by IPPC/USAID with participants from seven developing countries.

- 1984, appointed by IPPC/USAID to conduct a university-level weed science course at the Escuela Agricola Panamericana, El Zamorano, Honduras. Was offered the Weed Science professor position at that institution.

- 1983, began Ph.D. degree program at Oregon State University with Drs. Arnold Appleby, Steven Radosevich and Mr. Larry Burrill, sponsored by the International Plant Protection Center (IPPC).

- 1981, began MS degree program at Oregon State University (OSU) with Drs. Arnold Appleby and J.H. Dawson participating in the research activities of both.

- 1980, received diploma at Chapingo to the best teacher from students of three different classes.

- 1979, appointed professor-researcher in Weed Science and Pesticide Application Equipments and Techniques at the University of Chapingo (México's largest state agricultural university), near México City.

- 1978, with a private firm in Argentina, was in charge of research on *Rhizobium* inoculants for legumes, their production, and testing (field and greenhouse), as well as, culture collection maintenance.

- 1978, intensive training on techniques (including serology) for working with *Rhizobium* at the Department of Agriculture of the State of Rio Grande do Sul, Porto Alegre, Brazil.

- 1976, conducted weed and herbicide research for the Agricultural Research Center of Uruguay.

- 1975, employed by the Plant Protection Center of Uruguay working in phytopathology (diagnose through Koch's postulates, culturing of fungi and bacteria).

Main Research Topics Recently Developed:

- Integrated weed management for sustainable cropping systems, where estimates of crop losses from weed competition are viewed as a tool for making economic decisions about the need and means for weed control.
- Characterization of propanil-resistant junglerice (*Echinochloa colona*) biotypes.
- Red rice (*Oryza sativa*): growth analysis for biotype differentiation, and competition studies for management decisions.
- Development of competitive rice cultivars.

Professional Memberships:

- Weed Science Society of America
- International Weed Science Society
- Agronomy Society of America
- Rice Technical Working Group
- Uruguayan Assoc. Agric. Eng.

Education:

Ph.D. Weed Science
Oregon State University, July 1988
Thesis: Intra- and Interspecific Interference between Sweet Corn (*Zea mays* L.) and a Living Mulch of White Clover (*Trifolium repens* L.)

M.S. Weed Science
Oregon State University, 1983
Thesis: Interference of Annual Weeds and Seedling Alfalfa

1983, was the only student nominated by the **Crop Science Department** for the M.S. Student of Excellence Award.

B.S. Agronomy and Animal Production
University of the Republic of Uruguay, South America. 1976

Languages:

English, Spanish, French	-Excellent
Portuguese	-Conversational
German	-Fair

Citizenship: French

Country of Residency: Colombia

Recent Publications (last 5 years):

Fischer, A.J. (1990). Weed Management Approaches for Latin America. Proceedings Twenty-Third Rice Technical Working Group. Biloxi, Mississippi, USA, Feb., 1990: 26-28.

Fischer, A.J. (1991). [Integrated weed management: environmental implications, loss prediction, agronomy and pests]. Manejo integrado de malezas: implicaciones ambientales, predicción de pérdidas, agronomía y plagas. In Red de Mejoramiento de Arroz para el Caribe. Mesa Redonda sobre Protección Vegetal. Santa Clara, Cuba 107 p.

Fischer, A.J., D. Trujillo, and A. Moreno (1991). [Resistance of *Echinochloa colonum* to propanil]. Resistencia de *Echinochloa colonum* a propanil. In Proceedings of XXI COMALFI Congress, and 1st National Symposium on Plant Physiology and Mineral Nutrition. Manizales, Colombia. Feb. 1991: 20-22.

Fischer, A.J. (1991). [Yield losses from red rice competition]. Pérdidas de rendimiento por competencia de arroz rojo. In VIII INGER International Rice Conference for Latin America and the Caribbean. Documents for discussion. Villahermosa, México, Nov. 10-15, 1991.

Fischer, A.J. (1992). [Criteria for studying competition]. Criterios para estudiar competencia. In Proceedings of XXII COMALFI Congress, Villavicencio, Colombia, Feb. 1992: 26-28.

Fischer, A.J. (1992). [Weed management: components and criteria for their integration]. Manejo de malezas: componentes y criterios para su integración. In Proceedings IV International Congress on Integrated Pest Management, Escuela Agrícola Panamericana, El Zamorano, Honduras, Apr. 1992 (in press).

Fischer, A.J. (1992). [Approaches to study crop-weed interference]. Enfoques para el estudio de la interferencia de las malezas con los cultivos. In Proceedings IV International Congress on Integrated Pest Management, Escuela Agrícola Panamericana, El Zamorano, Honduras, Apr. 1992. CEIBA 33(1):271-289.

Appendix B-1

CIAT C.V.

Centro Internacional de Agricultura Tropical

Elcio Perpétuo Guimarães

Position in Project:

Breeder, Liaison with CNPAF

Professional Experience:

Centro Internacional de Agricultura Tropical (CIAT)
Cali, Colombia (1989- present)

- *Responsible for breeding activities for upland rice ecosystems.*

Centro Nacional de Pesquisa de Arroz e Feijao (CNPAF/ EMBRAPA)
Goiania, Brasil (1976-1989)

- *Responsible for breeding activities for upland rice ecosystems and hybrid rice.*

Research Experience:

Member of a team that was responsible for the release of more than 20 varieties for the Brazilian upland conditions (Cerrado Area).

Coordinator of projects on several areas related to breeding (irrigated and upland rice breeding projects and hybrid rice) .

National Coordinator of the Brazilian Rice Program at CNPAF/ EMBRAPA.

Acting coordinator of the INGER Network at CIAT.

Director of 4 master and 6 bachelor theses.

Education:

Ph.D. Plant Breeding and Cytogenetics, Agronomy Department
Iowa State University
Ames, Iowa, USA. 1982-85

M.Sc. Genética e Melhoramento de Plantas, Instituto de Genética
Escola Superior de Agricultura "Luiz de Queiroz"
Piracicaba, São Paulo, Brasil. 1976-78

B.S. Agronomy, **Escola Superior de Agricultura "Luiz de Queiroz"**
Piracicaba, São Paulo, Brasil. 1972-75

Languages: English, Spanish - Fluent
Portuguese - Mother language

Citizenship: Brazil

Country of Residency: Colombia

Publications:
(last 5 years)

1992 E.P. Guimarães y Y. Ospina R. Evaluación del Progreso en la Selección de Líneas Resistentes al Añublo del Arroz (Pyricularia oryzae Cav.) en Viveros Internacionales. Fitopatol. Venez. 5(2):37-38.

1992 F. Cuevas-Perez, E.P. Guimarães, and C.P. Martinez. Estado actual de las actividades de fitomejoramiento del arroz en America Latina y el Caribe. Arroz en America Latina: Mejoramiento, Manejo y Comercialización. Memorias de la VIII Conferencia Internacional de Arroz para America Latina y el Caribe, noviembre 10-16, 1991, Villahermosa, Tabasco, Mexico. p15-30.

1992 F.E. Cuevas-Perez, E.P. Guimaraes, L.E. Berrio, and D.I. Gonzales. Genetic base of irrigated-rice in Latin America and the Caribbean, 1971-1989. Crop Science 32(4):1054-1059

1991 E.P. Guimaraes. Arroz Hibrido. Anais da III Reuniao Nacional de Pesquisa de Arroz, Fevereiro 1987, Goiania, Goias, Brasil. p246-262.

1990 A.S. Prabhu e E.P. Guimaraes. Estrategias de Controle da Brusone em Arroz de Sequeiro. Summa Phytopathologica 16(1):46-55.

1990 B. da S. Pinheiro e E.P. Guimaraes. Índice de Area Foliar e Produtividade do Arroz de Sequeiro. I Niveis Limitantes. Pesq. Agropec. Bras. 25(6):863-872.

1989 E.P. Guimaraes, O.P. de Morais, L.G. de Barros, L.C. da S. Neiva, A.A. Soares, R. Bazoni, A.S. Prabhu, e B. da S. Pinheiro. Desenvolvimento, Avaliação e Lançamento da Cultivar Precoce Guarani para o Arroz de Sequeiro. Pesq. Agropec. Bras. 24(8):969-974.

1989 E.P. Guimaraes and W.R. Fehr. Alternative Strategies of Reccurrent Selection for Seed Yield of Soybean. Euphytica 40:111-120.

Appendix C

22 FEB. 1994

File : 3.20.1

FAX MESSAGE

NATURAL RESOURCES RESEARCH DEPARTMENT
OVERSEAS DEVELOPMENT ADMINISTRATION
94 VICTORIA STREET
LONDON SW1E 5JL

FAX: (0)71 917 0679

NUMBER OF PAGES INCLUDING HEADER:ONE

FROM:Mr D E James

DATE: 22 February 1994

TO:Dr Gustavo A Nores, Director General, Centro Internacional de Agricultura Tropical (CIAT)

FILE REF:NRB9294 832/835/004

Dear Dr Nores

HOLDBACK PROJECT R5969: INTEGRATING RICE IMPROVEMENT WITH AGROPASTORAL SYSTEMS.

Thank you for your letter of 26 November 1993 addressed to Mrs Irene Cobb enclosing a revised project proposal.

I am pleased to inform you that this project has been accepted for funding from the Holdback Facility with effect from 01 April 1994. However before we can proceed further we require from you the following:

i. A full project proposal;

ii. the proposal should include clear timebound objectives;

iii. a full financial breakdown in pounds sterling set out in United Kingdom financial years ie April to March, and listing salaries, overheads, equipment, travel (split into local and international), consumables etc, with details of any indirect costs.

I look forward to receiving the above information soon.

Yours sincerely

D. E. James
Natural Resources Research Department