
# Proposition de projet régional sur

# l'amélioration génétique du Taro *(Colocasia esculenta)*

# en Asie du Sud Est et en Océanie

*Vincent LEBOT*

**MICAP / CIRAD**

*20 juin 1995*

**Proposition de projet régional sur l'amélioration génétique du Taro (*Colocasia esculenta*) en Asie du Sud Est et en Océanie.**

En Asie du Sud Est, le taro, et les plantes racines-tubercules en général, connaissent un regain d'intérêt en raison de leurs potentialités pour assurer les besoins grandissants de cette région en amidon. Les responsables des filières industrielles et vivrières de l'amidon sont actuellement confrontés à un même souci de diversification des cultures exploitées dans le cadre d'un développement agricole durable et du fait de l'accroissement démographique de cette zone géographique.

Les instituts du système CGIAR ont porté leurs efforts sur la pomme de terre, la patate douce (CIP) et le manioc (CIAT). Bien que l'IITA bénéficie d'un mandat international pour les ignames, sa présence effective sur le terrain est quasi-inexistante en Asie et en Océanie. Le taro est quant à lui, une plante orpheline du système de recherche agronomique international. Bien qu'il n'existe pas de programme régional d'amélioration génétique pour cette plante, les volontés nationales sont très affirmées (voir en annexe). La France et le CIRAD ont donc certainement un rôle à jouer pour dynamiser les travaux entrepris par de nombreuses équipes dans cette région où les réalités géographiques sont contraignantes et qui nécessitent de gros efforts de coordination.

Le taro est identifié dès 1974 par l'Académie des Sciences Américaine comme étant une culture tropicale sous-exploitée à fort potentiel économique. Plus de vingt ans plus tard, l'IPGRI confirme que ce potentiel reste à développer et inscrit le taro sur la liste des espèces négligées. Le taro est cultivé commercialement sur plus d'un million d'hectares à l'échelle de la planète, mais les superficies cultivées sont certainement beaucoup plus importantes car cette plante occupe une place privilégiée dans le potager tropical. Le taro est très apprécié des populations d'Extrême Orient (Chine, Japon) et du Sud-Est Asiatique. Il constitue la plante alimentaire de base de toute l'Océanie et fait l'objet d'une industrie de transformation en raison de la très bonne digestibilité de son amidon à grains très fins (1 à 4$\mu$m de diamètre); il est particulièrement recherché pour les aliments hypo-allergéniques.

Les taros correspondent à deux variétés botaniques: le *C. esculenta var. esculenta* (dasheen) et le *C. esculenta var. antiquorum* (eddoe). Le dasheen présente un large corme central, des stolons et quelques petits cormes périphériques rarement utilisés, sauf à Hawaii où ils sont employés pour produire du *Poi*, une pâte très appréciée. L'eddoe possède un petit corme central entouré de nombreux cormes périphériques; ceux-ci peuvent rester en dormance plusieurs mois et composent la majorité du rendement. Les dasheens sont surtout cultivés en terrasses irriguées et les eddoes tolèrent les systèmes pluviaux.

Compte tenu de ses qualités vivrière et commerciale importantes pour les pays de cette région, il apparaît essentiel que cette culture bénéficie d'un programme de recherches

destiné à évaluer les caractéristiques et potentialités du germoplasme utilisé par les programmes d'amélioration nationaux. Certains de ces programmes sont déjà anciens puisque la maîtrise de l'induction florale et des croisements contrôlés datent de la fin des années 70. C'est à cette époque que des stratégies d'amélioration sont élaborées en Papouasie-Nouvelle Guinée, aux îles Salomon, à Fidji, aux Samoa et à Hawaii.

Les moyens mis en oeuvre sont disparates mais l'approche reste la même:
- inventaire des cultivars locaux,
- caractérisation à l'aide de descripteurs morpho-agronomiques,
- identification des clones les plus prometteurs pour l'amélioration,
- induction des floraisons par pulvérisations de gibbérellines,
- pollinisations croisées,
- évaluation des hybrides $F_1$ et initiation de cycles de sélection récurrente.

Ces programmes n'ont pas abouti en raison de l'étroitesse des bases génétiques utilisées par ces programmes d'amélioration. Aujourd'hui, la situation est alarmante et la culture du Taro est confrontée à des chutes de rendement considérables dues à des épidémies d'origines virales et fongiques.

***Le projet proposé au quatrième PCRD de la CEE (INCO DC):***

Ce projet vise à développer un réseau d'échange de matériel végétal et à dynamiser les programmes d'amélioration de cinq pays: la Papouasie-Nouvelle Guinée, l'Indonésie, la Malaisie, les Philippines et la Thaïlande. Il s'agit aussi de permettre aux pays d'Océanie d'introduire et de bénéficier du germoplasme sélectionné, en toute sécurité. Au terme de ce projet de quatre ans, les partenaires devraient bénéficier d'informations précises sur les potentialités de leurs populations de base et les programmes d'amélioration devraient être en mesures d'élaborer des stratégies à long terme à partir de larges bases génétiques. Pour la France et le CIRAD, ce projet devrait présenter une opportunité de développer des recherches en coopération sur une plante racine importante pour cette région.

Pratiquement, il s'agit:
- d'évaluer les potentialités des cultivars locaux (environ 1,500 accessions) et les caractériser à l'aide de mesures morpho-agronomiques et de marqueurs moléculaires;
- d'identifier des cultivars résistants au *TLB*, *DMV* et *ABVC*;
- conduire une étude de diversité génétique sur 100 isolats de *Phytophthora colocasiae* à l'aide de marqueurs moléculaires;
- de sélectionner environ 150 géniteurs qui seront utilisés pour élargir les bases génétiques des programmes d'amélioration et d'étudier les caractéristiques physico-chimiques de leurs amidons;
- expédier ces 150 géniteurs à l'Université de Wageningen pour les cultiver *in vitro* et

les certifier exempts de viroses (*DMV* et *ABVC*);

- renvoyer les plants-mères *in vitro* au *R & D Centre for Biotechnology* de Bogor, en Indonésie, pour multiplication *in vitro* de manière à atteindre des effectifs suffisamment importants pour être redistribués à tous les partenaires;

- une fois les géniteurs introduits, des croisements contrôlés seront effectués et les hybrides $F_1$ seront évalués.

Ce projet permettra de développer des cultivars de taro mieux adaptés aux nouvelles contraintes de culture et donc de contribuer directement au développement agricole durable de cette région. Le taro étant l'une des plantes alimentaires de base de cette zone géographique, il devrait à l'avenir jouer un rôle important pour sa sécurité alimentaire. La mise en place d'un programme d'amélioration génétique s'inscrit donc dans une stratégie de développement à long terme et devrait permettre au CIRAD et à la France de renforcer leurs programmes de coopération scientifique avec des partenaires de cette rgion.

## *TARO: EVALUATION AND BREEDING FOR RAINFED CROPPING SYSTEMS IN SOUTH EAST ASIA AND OCEANIA*

### *1 - OBJECTIVES*

Taro (*Colocasia esculenta*), is an important food crop in many parts of the humid tropics. According to the FAO Production Yearbook, over 5.5 millions tons of taro are produced annually from 1 million ha. However, because taro is restricted to local and regional markets, it is difficult to estimate the real production. Taro has potential not only as a food crop but also for industrial purposes, especially for hypo-allergenic foods.

Irrigated cultivation requires intensive efforts, manual labour and long working hours in muddy flooded fields. Consequently, production from this cropping system tend to decrease. Several cultivars produce tubers in dry land agriculture, which are popular in China, Japan and among Southeast Asians. These cultivars have high nutritive value and good keeping quality but are largely neglected plants with unrealized potential. Breeding can give a substantial contribution to the improvement of this crop.

**The overall objective of this project** is to enhance the competitive position of taro in rainfed cropping systems of S.E. Asia and Oceania. This will be achieved by improving quality and resistance to pests and diseases of taro cultivars, and by increasing the efficiency of production. High priorities are given to DMV, ABVC viruses and Leaf Blight resistances. Seven research organizations in Indonesia, Malaysia, the Philippines, Thailand, Papua New Guinea and Europe participate to this project.

The project is constructed around five components:

- Germplasm characterization and safe exchange;
- Diseases resistance of cultivars and improvement through targeted crosses;
- Agronomical evaluation of cultivars and $F_1$ hybrids;
- *Phytophthora colocasiae* genetic diversity; and
- Physicochemical characteristics of starches from selected cultivars.

Several breeding programmes have been initiated in South east Asia and Oceania in order to provide farmers with improved cultivars but success has been somewhat limited due to the narrow genetic bases involved (Lebot and Aradhya, 1991). Taro cultivars are propagated vegetatively and in many islands of S. E. Asia and Oceania, most cultivars share a common genetic background (Lebot, 1992). If taro breeding is to have a constructive future in S.E. Asia and Oceania, it is important to exchange germplasm to broaden the genetic bases of existing programmes. In S.E. Asia, there is now a high degree of interest in this crop, a priority expressed by Asian countries during RECSEA (Regional cooperation in S.E. Asia in plant genetic resources) and SAC (South Asia plant genetic resources coordinators) meetings, and the need to enhance regional activities on improvement strategies, germplasm evaluation and *in vitro* exchange of genotypes. Scientific expertise exists in the region and it is appropriate to strengthen regional cooperation.

Major constraints for taro breeding programmes are narrow genetic bases and the lack

of knowledge of the genetic diversity in the species; the limitations in access to and knowledge of additional sources of disease resistance, as well as the absence of information on the potential agronomic value of genotypes. Incidence of various pests and diseases in taro crops leads to economically significant food and income losses. The main causes are taro leaf blight (TLB), a severe fungal disease (*Phytophthora colocasiae)* that causes yield losses of 25 to 50%, dasheen mosaic virus (DMV) and alomae bobone virus complex (ABVC).

Chemical control strategies are unfeasible, too expensive, and/or unsuited for existing farming systems, particularly in smallholdings. This alarming situation urgently calls for a regional and collaborative approach and a systematic search is therefore needed. Proper characterization of the germplasm existing in this geographic area (overall approximately 1,500 accessions) will allow the identification of genotypes which could provide the basis for a sustainable solution to these constraints through coordinated germplasm evaluation and breeding.

Exchanging taro germplasm can be dangerous since it can spread viruses which severely decrease yield. Propagation via *in vitro* culture can produce pathogen-free taro cultivars but a certification program and strict quarantine is required to distribute this genetic material on a regional scale. With the development of reliable biotechnological tools, especially isozymes, the possibilities to assess genetic diversity have significantly increased. In some cases however, distinct morphotypes cannot be differentiated by their zymotypes and require the use of new DNA markers. A preliminary survey using isozymes, combined with the use of molecular markers applied to selected genotypes, is therefore cost efficient. It allows the accuracy improvement of fingerprinting individual cultivars and the assessment of genetic diversity existing within and between participating countries (Lebot and Aradhya, 1991).

Early steps in the establishment of multilocational agronomic trials are the identification of a core sample of the many cultivars that are available and the adoption of a reliable quarantine procedure which can handle large numbers of cultivars. The application of isozymes and DNA markers to the characterization of germplasm will confirm results obtained by systematic and traditional morpho-agronomic descriptions. These data will facilitate the application of better breeding strategies. A core sample of cultivars originating from all participating countries and interesting for breeding purposes, will be created and will assemble approximately 10 % of the total number of accessions.

**The specific objectives of this (four years) project are:**

- to characterize approximately 1,500 taro accessions and analyze its genetic diversity using morpho-agronomic traits and molecular markers, using both isozymes and RFLPs or AFLPs;

- to make available a wider range of germplasm to participating countries as part of a regional network of *in vitro* genotypes exchange. Approximately 150 selected and indexed genotypes will be distributed to broaden the genetic bases of breeding programmes;

- to identify sources of DMV, ABVC and TLB resistances and to introduce them in targeted crosses;

- to assess the genetic diversity existing between *Phytophthora colocasiae* isolates originating from participating countries using isozymes and RAPDs markers;

- to study the physicochemical characteristics of starch from 150 selected genotypes;

- to identify and overcome barriers to progress in taro breeding and develop adequate breeding strategies based on data obtained from molecular and agronomical studies;

- to coordinate evaluation and breeding efforts, to enhance cooperation between participating countries and to establish an efficient means of sharing information.

**The proposed project conforms with the objectives, priorities and policy guidelines of the INCO-DC program of the EEC in that it:**

- will contribute to a long-term stable cooperation between EEC research institutes with biotechnological expertise, countries which possess the genetic diversity and the countries where taro is being produced, marketed and consumed;

- will contribute to the sustainable conservation of the genetic resource base for breeding programmes;

- will make a significant contribution to environmental protection by allowing the breeding of better adapted and disease resistant cultivars, thus providing the basis for a more sustainable rainfed production system;

- will especially benefit the smallholders who are frequently disadvantaged by the high cost of chemical disease and pest control;

- will benefit all producers and consumers by the availability of better quality taros and will contribute to the future development of this crop.

## 2 - *WORK CONTENT*

**2.1- Organizational aspects.** The following institutions will be involved in the project:

*1- **CIRAD-CA** (Project coordinator): 2477 av. du Val de Montferrand, BP 5035, 34032 Montpellier cedex 1, France. CIRAD* will coordinate the project (2 consultancy visits per year in SE Asia), train scientists, organize meetings, and conduct a diversity study on *Phytophthora colocasiae* using isozymes and RAPDs markers. CIRAD will also analyze the physicochemical characteristics of starches from 150 selected genotypes (core sample) cultivated in a tropical glasshouse in Montpellier, France.

*2- **Wageningen Agricultural University** (associated contractor): Department of Plant breeding, Wageningen, The Netherlands.* This partner will tissue culture mother plants of 150 selected genotypes (and index them for DMV and ABVC viruses), and conduct DNA markers fingerprinting. The core sample of 150 genotypes will be cultivated in a tropical glasshouse in Wageningen.

*3- **Indonesian Institute of Sciences** (associated contractor): Research and*

*Development Center for Biotechnology, Bogor, P.O. Box 422, Indonesia.* This partner will develop an isozyme laboratory to screen 1,500 accessions for at least seven enzyme systems and a tissue culture laboratory to propagate 150 selected genotypes (production of at least 3,000 plantlets). This partner will also conduct the standard evaluation and breeding field work.

*4- **University Pertanian Malaysia** (associated contractor): Department of Agronomy and Horticulture, Faculty of Agriculture, Serdang, Selangar, Malaysia.* This partner will conduct evaluation and breeding field work as well as *in vitro* propagation of introduced genotypes.

*5- **Department of Agriculture and Livestock of Papua New Guinea** (associated contractor): Agricultural Research Division, P.O. Box 417, Konedobu.* This partner will conduct evaluation and breeding field work as well as *in vitro* propagation of introduced genotypes.

*6- **Philippine Root Crops Research and Training Center** (associated contractor): Visayas State College of Agriculture (VISCA), Baybay, Leyte.* This partner will conduct evaluation and breeding field work as well as *in vitro* propagation of introduced genotypes.

*7- **Department of Agriculture of Thailand** (associated contractor): Chatuchak, Bangkok 10900.* This partner will conduct evaluation and breeding field work as well as *in vitro* propagation of introduced genotypes.

*8- **IPGRI-APO**, Singapore (associated contractor): the regional office of the International Plant Genetic Resources Institute*, will assist the network for data base management and information sharing. It will provide scientific backstopping on conservation and genetic aspects.

*9- **IRETA-USP** (associated contractor): Alafua Campus, Private bag, Apia, Western Samoa.* This partner will receive the core sample of selected genotypes and will propagate it in vitro so that countries in Oceania can beneficiate from the project as well.

Participating institutions will provide necessary infrastructure (land and laboratory), technical staff and laborers. *CIRAD* and *Wageningen University* will collaborate with these institutions to train scientists to the application of molecular techniques and to survey genetic diversity. Scientific backstopping will be provided for multivariate analyses and germplasm management and use strategies.

- Four annual meetings will be organized, one each year in a different country, to discuss results and on-going research progress and activities. An international workshop on ***"the Applications of Biotechnological Techniques for Taro Breeding"*** will be organized in Bangkok, November 1996, at the Third Asia-Pacific Conference on Agricultural Biotechnology.

- Sufficient expertise to manage the germplasm, to adopt adequate breeding methods and strategies will be developed through training efforts and through the active participation in multilocational evaluation activities. A scientist from Southeast Asia will be trained to isozymes technology at *CIRAD, Montpellier*, France. And an other scientist will be trained to taro tissue culture and DNA markers technology by *Wageningen Agricultural University*.

- An *in vitro* tissue culture and isozymes laboratory will be established in Indonesia to train local scientists to the applications of biotechnological techniques to taro breeding.

## 2.2 - Proposed Technical Work plan

The whole plan is conducted in rainfed conditions without any irrigation. Susceptibility of cultivars is measured under natural inoculum pressure and favorable conditions for disease development. The tests are conducted in each participating country using international standards.

1- Morphological description of all accessions using IPGRI/FAO standardized descriptors in all participating countries:

| | |
|---|---|
| Papua New Guinea | 500 |
| Indonesia | 500 |
| The Philippines | 200 |
| Malaysia | 150 |
| Thailand | 150 |
| Total | 1,500 accessions approximately |

2- Isozyme characterization (at least 7 enzyme systems) of all accessions. Leaf tissues and/or suckers and cormels are sent to the *R & D Centre for Biotechnology*, Bogor, Indonesia, for electrophoresis; all plant material will be destroyed after electrophoresis for safety and quarantine reasons. Material originating from ABVC infested areas such as Papua New Guinea will be introduced in liquid nitrogen following the procedure developed by Lebot and Aradhya (1991).

3- Incorporation of morpho-agronomic and isozyme characterizations results into country and regional data bases. Selection by the responsible scientist in each country, in collaboration with the project coordinator, of cultivars with breeding potential. A core sample will be created assembling approximately 10% of the total number of accessions.

4- A core sample of 150 cultivars promising for breeding purposes, is sent to *Wageningen University* for *in vitro* culture and virus indexing. For each selected cultivar, a sample of 5 vitro tubes is sent, after indexing, to tissue culture laboratory in Indonesia for propagation (approx. 750 vitro-tubes). After propagation, a set of 5 disease-free *in vitro* cultures per cultivar is sent, from the project tissue culture laboratory, based in Bogor, to participating countries for propagation (production of approx. at least 3000 *in vitro* plantlets). Participating countries can subsequently propagate *in vitro* these disease-free cultures, about 500 plantlets are received per country during the project duration. The cascade approach gives a fast and high propagation ratio for this selected germplasm.

5- DNA markers (RFLPs and/or AFLPs) are applied to the core sample of 150 cultivars approximately, in order to conduct diversity studies and accurate molecular fingerprinting of potential parents to be used in national breeding programmes. AFLPs markers are also applied to differentiate distinct morphotypes exhibiting identical zymotypes.

6- After hardening of cultures/seedlings, introduced cultivars are compared to the elite of local cultivars in field trials. The agronomic evaluation of the most promising cultivars in every country (20 cultivars maximum) is conducted using conventional RCB's. One variety trial will be established each year. Overall, three agronomic trials will be conducted in each participating country during the project life span.

7- Once agronomical evaluation is completed and the promising parents/genotypes identified, targeted crosses are carried out (approx. 50 crosses resulting in 50 progenies ($F_1$ hybrids) of 50 plants each (approx. 2500 plants). The procedure involved for inducing flowering (gibberellic acid spray) and making crosses is fairly simple and straight forward. Basically, pollens from one parent material is transferred or used to pollinate the spadix of another plant.

8- Evaluation of progenies. Assessment of general and specific combining abilities, and heritabilities. Elaboration of breeding strategies.

2.3 - **Description of activities** (in Papua New Guinea, Indonesia, Malaysia, Thailand and the Philippines, partners will follow the same step by step procedure as follows) :

***Step 1: Characterization of the collections.*** Highly heritable morphological descriptors will be used to describe all accessions. Characters of agronomical importance, such as resistance/tolerance to TLB, DMV and ABVC and adaptation to rainfed cropping system, will be scored as well. A common database and a common format for data exchange will be designed. The data base will be able to export and import ASCII files between countries (dbase format will be appropriate). These files will assemble passport data recorded at the collection site in each participating country as well as accurate morphological descriptions. Palatability tests will be conducted to assess local consumers preferences. The information will be published in a project report and will be made available to all collaborating researchers involved in the network.

***Step 2: Sorting the collections and identification of duplicates.*** Young suckers and/or leaf tissues from all the accessions existing in country collections will be sent to the *R & D Center for Biotechnology* in Bogor, for assessing genetic diversity using at least seven enzyme systems following a procedure developed by Lebot and Aradhya (1991).

Fingerprints will be used to identify distinct morphotypes corresponding to an identical zymotype and will produce relevant information on genetic distances. This isozyme characterization combined with the morphological descriptions will lead to the identification of duplicates within and between countries. These data will be used to avoid the introduction of genotypes already existing in national germplasm collection.

***Step 3: Evaluation of agronomic traits.*** Screening tests will be conducted in natural infestation conditions to identify cultivars conferring resistance/tolerance to TLB, DMV and ABVC and adaptation to rainfed cropping system. Trials aim at evaluating the performances of the most promising local cultivars. Not more than 20 will be compared in these trials. This is the routine field evaluation of the agronomic performance in practical conditions using conventional randomized complete blocks design. The information gathered will be made available to interested parties.

***Step 4: Rationalizing the collections.*** The combination of the results gained from the agronomical trials and from the standardized characterization, using both isozyme and morphological data, will result in the selection of a core sample of cultivars-candidates for exchange between collaborators (approx. 10% of total accessions). Will be included in the core sample, cultivars with a peculiar resistance to TLB, DMV and ABVC, with interesting quality/palatability characteristics and/or with remarkable agronomic performances. Informations gained from isozymes studies will also be used to identify cultivars to be included in the core sample.

***Step 5: Acquisition of useful germplasm from collaborators.*** Once country collections have been fully characterized and evaluated, the most interesting genotypes will be introduced and evaluated under local conditions. The core sample of cultivars is sent from each country to *Wageningen* for viruses indexation and *in vitro* propagation. Virus free mother plants are sent to the *R & D Centre for Biotechnology*, Bogor, for *in vitro* propagation. A set of virus free *in vitro* plantlets is subsequently sent to collaborators for *in vitro* propagation. After local evaluation, genotypes with interesting potential will be introduced into national breeding programs.

***Step 6: Genetic recombinations and tentative introductions of resistances into local germplasm.*** Targeted crosses will be conducted between the most promising genotypes (local cultivars and core sample received from collaborators). Breeders will initiate, in each country, targeted crosses between well identified genotypes originating from their own germplasm as well as from other participating countries. A maximum of 50 targeted crosses will be conducted in each country in year four of the project and will result in the composition of base populations with broad genetic bases to be used for recurrent selection.

## 2.4 - Molecular markers

Isozymes are inexpensive to assess genetic diversity existing in germplasm within and between countries (see Lebot and Aradhya, 1991). An Indonesian scientist, employee of the *R & D Center for Biotechnology* will be trained by *CIRAD* during the first four months of the project in Montpellier, France. With the technical assistance of *CIRAD*, an isozyme laboratory will be established in Bogor and all accessions (1,500) will be studied for MDH, IDH, PGI, 6-PGD, ME, SKDH and ADH, using starch gel electrophoresis. These data will be used:- to identify identical zymotypes and to evaluate the variability existing within germplasm collections in participating countries; - to conduct an eco-geographical survey of taro genetic variation; - to assess genetic distances existing between potential parents selected to be included in the core sample. However, isozymes are not sufficently discriminant to be associated with several segregating agronomic traits and therefore need to be combined with DNA markers to improve fingerprinting accuracy. RFLPs and/or AFLPs will be used by *Wageningen University* to fingerprint the 150 genotypes of the core sample. The selected genotypes will be cultivated in a tropical glasshouse in *Wageningen*, so that plant material is freely available. Genetic knowledge generated by these markers will help the choice of base populations for recurrent selection.

## 2.5 - Tissue culture

Tissue culturing taro is a simple standardized procedure. DMV and ABVC viruses (*dasheen mosaic potyvirus, dasheen bobone rhabdovirus, dasheen badnavirus*) are eliminated from taro plants using tissue culture without heat treatment (Zettler *et al.* 1989, Yam *et al.* 1990). Taro plants can be readily freed from DMV and ABVC viruses by meristem tip culture when small (0.5mm or less) meristem tips are used. A variety of media have been used successfully to culture and regenerate taro plants from excised meristem tips. Regardless of the medium used, considerable variation in growth rate and amount of suckering is observed between cultivars, some cultivars grow very easily in tissue culture, sucker readily while others are extremely slow.

## 2.6 - *Phytophthora colocasiae* diversity

Characterization of resistance and its genetic basis provide guidelines for breeding programmes, particularly in the initial choice of cultivars. Distribution and variability of *P. colocasiae* will be studied to provide breeders with information on the structure of existing populations. Intraspecifc polymorphism will be assessed using starch gel electrophoresis of isozymes. Protein extracts from approximately 100 isolates collected on susceptible and resistant accessions will be electrophoresed following the procedure developed by Blaha *et al.* (1994). Comparing isozyme electromorphs allows to measure genetic distance and diversity between *P. colocasiae* isolates originating from different countries. Banding

patterns are often simple, easy to differentiate and may be related to the homo- or heterozygous state of a pair of alleles. Comparing isozymes electromorphs allows the assessment of the diversity within the species. Because *P. colocasiae is* diploid and heterothallic, it is believed that an eco-geographical survey of its genetic variation should provide interesting information. RAPDs will be used to improve fingerprinting accuracy of isolates. Isolates will be cloned and grown in CIRAD laboratories in Montpellier.

### 2.7 - Chemical and physicochemical characteristics

For taro breeding, the starch quality is a major selection criteria. It is therefore essential to study the starch physicochemical characteristics of cultivars selected as parents for targeted crosses. Genotypes included in the core sample will be studied for the characteristics of their starch: percent yield calculated on a dry basis, viscosity, swelling power and solubility, gelatinisation temperature range, amylose content, least gelling concentration, gel consistency and oxalate crystals content (and its relation with acridity). The selected genotpes (150) will be grown in a glasshouse in Montpellier to avoid genotype/environment interactions affecting starch quality.

### 2.8 - Timetable

***Year 1***:

- Analysis of existing data on taro germplasm existing in Indonesia, Malaysia, the Philippines, Thailand and Papua New Guinea.
- Identification of needs of supplementary surveys to complete collection in specially endangered sites and/or in sites where highly valuable germplasm can be found (e.g. with high disease resistance). Execution of limited new surveys and collections of new accessions.
- Characterization of all accessions (1,500) using morpho-agronomic traits. Scoring of accessions for resistances to TLB, DMV and ABVC.
- Training of an Indonesian scientist at CIRAD, in Montpellier during the first four months. Isozyme survey of all accessions for seven enzyme systems conducted in Bogor, Indonesia.
- Organization of a workshop at the third Asia-Pacific Conference on Agricultural Biotechnology, Nov. 10-16 in Bangkok on *"Applications of Biotechnological Techniques for Taro Breeding"*.

***Year 2***:

- Completion of characterization using morpho-agronomic traits and isozymes. Identification of a representative sample of the base population which should be of special interest for further conservation and breeding purposes (approximately 10% of total accessions = 150 cultivars).

- In each collaborating country, partners establish the first agronomic trial (5 RCBs, five reps, 50 plants per plot) to compare the agronomic performances of a maximum of 20 promising local cultivars.

- Propagules (corms and/or suckers) of the core sample are sent to Wageningen University for molecular fingerprinting, viruses detection and *in vitro* culture.

- Characterization of the core sample by using most adequate genetic markers, including AFLPs markers.

- An *in vitro* set of the core sample (5 *in vitro* plantlets per genotype) is sent to Bogor for *in vitro* propagation.

- *In vitro* propagation of the core sample in Bogor and distribution for multilocational trials.

***Year 3***:

- In each collaborating country, partners establish the second agronomic trial (5 RCBs, five reps, 50 plants per plot) to compare the agronomic performances of a maximum of 20 selected local cultivars and to confirm results obtained from the previous trial.

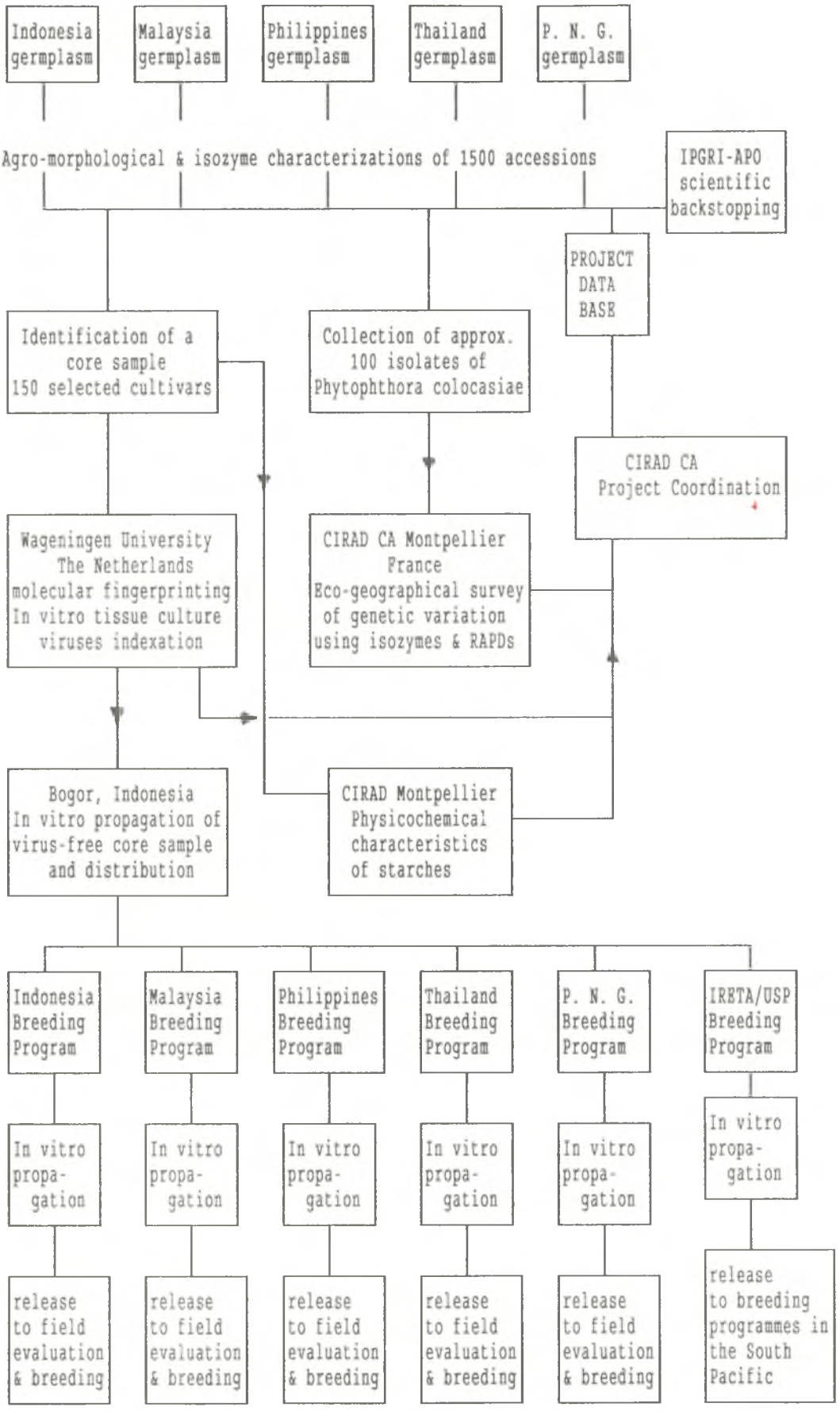
- Use of the base population (local cultivars plus introduced core sample) to initiate an improvement strategy. Targeted crosses will be realized in participating country between selected genotypes and the resulting $F_1$ seed population planted out.

***Year 4***:

- In each collaborating country, partners establish the third agronomic trial to compare the agronomic performances of a maximum of 20 selected local and introduced cultivars.

- Adoption of a recurrent selection breeding strategy using a broad genetic base. The dynamic continuous management of these populations would allow continuous management progress for agronomic traits and preservation of genetic diversity originally present in the germplasm collections.

- After additional 1 - 2 years, more observations and a new cycle of intercrossing among valuable individuals can be initiated. Selection should take into account agronomic characteristics as well as genetic diversity (to be followed by isozymes markers).




Taro germplasm exchange network in S.E. Asia and Oceania involving tissue culture and propagation of selected genotypes

## *3 - BENEFITS*

A fast growing population is continuously increasing the pressure on arable land. There is an increasing need for more crop diversity in order to maintain productivity and to protect the environment. There is also a need for a greater range of alternative crops which can produce food under less-than-favorable conditions as well as crops which can help to sustain the environment under increased pressure. The rising demand for starch as foodstuff and for industrial uses in Southeast Asia has pushed the need to search for novel sources of starch which are abundantly available but so far underutilized. The proposed project therefore aims to provide an essential knowledge on the genetics, agronomy and on the physicochemical characteristics of taro, an under-exploited crop with promising economic potential. The development of improved and rainfed-adapted cultivars will enhance the position of taro in agriculture and will allow the diversification of rice-based cropping systems. Taro has a potentially high output per ha compared with other crops, particularly on marginal land, it can provide a comparatively cheap source of calories. In addition, it is appropriate for sequential and mixed cropping systems, which are often highly relevant to local agro-climatic conditions as well as to small farm production.

Taro genetic resources represent the essential base for the genetic improvement of this crop. However, secure conservation is not yet assured since adequate use of germplasm has not been achieved. The existing knowledge on the potential value of the accessions is limited. This research project will conduct systematic characterization and evaluation of the germplasm and this will lead to the identification of desirable traits needed by taro breeders. Through research and breeding efforts, these characters will be transferred into desirable genetic backgrounds of adapted populations and will thus become available to the taro breeders in each participating country. In addition, this project will develop an information base for continued research into the conservation, use and breeding of taro.

An improved plant quarantine system via *in vitro* culture will facilitate the safe and timely exchange of germplasm between countries accompanied by relevant information. The countries of South East Asia and Oceania will benefit through more sustainable conservation of the taro genetic diversity as well as through access to improved germplasm. These producing countries will be able to incorporate more and better genetic diversity in their improvement programmes and, thus allow for more productive and less environmentally unfriendly production systems. This will benefit the smallholders through more productive cultivars adapted to rainfed cropping systems and better quality taros. It will also lead to less losses caused by diseases and pests, and to a decrease in the use of irrigated systems thus contributing to facilitate the increase of cultivated areas.

Several countries in Oceania (the Solomons, Vanuatu, New Caledonia, Fiji, Samoas, Tonga, Cooks and Tahiti) will also benefit from the project indirectly. The core sample of selected genotypes will be sent for propagation to the *South Pacific Commission* tissue culture laboratory in Suva (Fiji) and to the *University of the South Pacific* laboratory in Alafua (Western Samoa), so that breeders in this geographic zone can beneficiate from the

project. The geographical impact of this project is therefore broader than the five participating countries.

With limited resources for taro breeding and rising costs, international cooperation is to be encouraged. Genetic resources and their utilization are a common base for this. The value of meetings among specialists in the genetic improvement of tropical crops and the need for networking have been largely demonstrated. Such networks encourage the sharing of information and development of new ideas on which future progress depends. The cooperation between research institutes and breeders in South East Asia and in European countries will facilitate the urgently needed transfer of biotechnology and will allow human capacity building. Scientists from collaborating countries will be trained to the use of molecular markers for germplasm characterization, biodiversity studies and applications to taro breeding. The systematic gathering and analyses of the information will have a direct positive impact on the institutions and scientists involved since it will bring scientists working on taro in contact with each other; it will lead to more efficient and effective breeding efforts; it will provide a better insight in the problems and constraints, thus facilitate a better focussed approach to their solutions.

To sum up, a meaningful cooperation between research institutes in Indonesia, Malaysia, the Philippines, Thailand, Papua New Guinea, and European partners (CIRAD and Wageningen University), will allow:

- the formation of a core sample consisting of carefully selected cultivars;
- the inclusion of identified genotypes in participating countries ongoing breeding efforts;
- the subsequent evaluation of improved cultivars obtained via targeted crosses.
- the application of biotechnologies to taro breeding and a significant contribution to the capacity building;
- an optimum and rational management and use of germplasm;
- an easy adoption of research results and the establishment of an international network between Europe, S. E. Asia and Oceania;

***Project outputs:***

- More efficient management of germplasm resulting in identification of duplicates, increased availability of germplasm and reduced costs of operation;
- Standard methodologies for characterization and evaluation of taro germplasm adopted;
- Germplasm collections characterized and their genetic diversity assessed by complementary techniques;
- Training of local scientists in the application of biotechnological tools to taro breeding;
- Molecular and biochemical markers applied to the germplasm and base populations, thus facilitating breeding progress;

- Increased knowledge of the genetic diversity of taro to guide breeding programmes;
- A representative core sample of desirable genotypes, and from diverse genetic origins, identified and safely distributed to collaborating countries;
- Multi-locational trials of potentially useful genotypes carried out in participating countries;
- Exchange of material increased through improved quarantine procedures as shown by reduced time in quarantine, security, integrity and cost via *in vitro* techniques;
- Adequate breeding methods and strategies used in participating countries;
- Easy access to, and rapid dissemination of, relevant data.

***References***:

**Blaha G., Hall G., Warokka J.S., Concibido E.** and **Ortiz-Garcia C.** - 1994. *Phythophthora* isolates from coconut plantations in Indonesia and Ivory Coast: characterization and identification by morphology and isozyme analysis. *Mycol. Res.* 98 (12): 1379-1389.

**Lebot V.** - 1992. Genetic vulnerability of Oceania's traditional crops. *Experimental Agriculture*, 28 (3): 309-323.

**Lebot V.**, and **M. Arhadya** - 1991. Isozyme Polymorphism in Taro (*Colocasia esculenta* Schott.) from Asia and Oceania. *Euphytica* (56): 55-66.

**Zettler F. W., Jackson G.V.H.** and **E. Frison** (eds) - 1989. FAO/IBPGR Technical guidelines for the safe movement of edible aroid germplasm. Food and Agriculture Organization of the United Nations, Rome. IBPGR 24pp.

**Yam T. W., Young J. L. P., Fan K. P. L.** and **Arditti J.** 1990. Induction of callus from axillary buds of Taro (*Colocasia esculenta var. esculenta*, Araceae) and subsequent plantlet regeneration. *Plant Cell Report*s 9: 459-462.

## *5- BACKGROUND INFORMATION ON PARTNERS*

### Partner 1: CIRAD-CA (Project Coordinator)

CIRAD (Centre de Coopération Internationale en Recherche Agronomique pour le Développement) is a french research organization specialized in tropical and sub-tropical agricultures. CIRAD mission is to contribute to the socioeconomic development of these regions through research, experimentation, training and scientific information. The Center has 1800 employees, including 900 scientists who work in and cooperate with more than 50 different countries. CIRAD budget amounts to approximately 1 billion french francs (200 millions US$) and more than half of which is derived from public funds. The Center is organized in seven departments:

*CIRAD - CA*, annual crops
*CIRAD - CP*, perennial crops
*CIRAD - FLHOR*, fruit and horticultural crops
*CIRAD - Forêt*, forestry species
*CIRAD - EMVT*, livestock and veterinary medicine
*CIRAD - GERDAT*, laboratories and logistic
*CIRAD - SAR*, food technology and cropping systems

CIRAD operates:

- through its own research stations located in France (Montpellier and Corsica) and in French overseas territories,
- in partnership with national agricultural research systems or international agricultural research centers in tropical and Mediterranean countries,
- or directly in development projects.

The Center emphasizes a development oriented and an applied research strategy. This strategy favours environment-friendly sustainable agriculture with an efficient use of natural resources and CIRAD is concerned with the risks of biodiversity depletion and genetic erosion. Considering the diversity of crops studied at CIRAD, the various on-going partnerships, and the important research facilities in France and overseas, the Center has tremendous potential for developing scientific activities related to genetic resources and crop improvement in the tropics.

### Officer in charge: Dr. Vincent Lebot

Mailing address: MICAP/CIRAD 2477 avenue du Val de Montferrand BP 5035, 34032 Montpellier Cedex 1, France. tel.# 33 67 61 59 27, fax.# 33 67 61 56 05, email: lebot@cirad.fr

Academic Background: *Ph.D., Plant Physiology*, *M.Sc., Plant Physiology*, *B.Sc., Agronomy* (major: Tropical Crops).

**Recent publications relevant to the project:**

**Lebot V., B. Meilleur**, and **R. M. Manshardt** - 1994. Genetic diversity in Eastern Polynesian cultivated bananas. *Pacific Science* 48 (1): 16-31.

**Lebot V., Arhadya M., R. M. Manshardt** and **B. Meilleur** - 1993. Genetic relationships among cultivated bananas and plantains from Asia and the Pacific. *Euphytica* (67): 163-175.

**Lebot V.** - 1992. Genetic vulnerability of Oceania's traditional crops. *Experimental Agriculture* 28 (3): 309-323.

**Lebot V.** and **M. Aradhya** - 1992. Collecting and evaluating Taro (*Colocasia esculenta*) for isozyme variation. IBPGR/FAO *Plant Genetic Resources Newsletter* (90): 47-49.

**Lebot V.**, and **M. Arhadya** - 1991. Isozyme Polymorphism in Taro (*Colocasia esculenta* Schott.). *Euphytica* (56): 55-66.

## 5. *FINANCIAL INFORMATION, SUMMARY OF COSTS*

| Category | Partner 1 CIRAD | Partner 2 Wageningen | Partner 3 Indonesia | Partner 4 Malaysia | Partner 5 Papua N. G. | Partner 6 Philippines | Partner 7 Thailand | Partner 8 IPGRI APO | Partner 9 IRETA USP |
|---|---|---|---|---|---|---|---|---|---|
| 1. Labour | 30 000 | | 34 000 | 24 000 | 24 000 | 24 000 | 24 000 | | |
| 2. Travel and Subsistence | 60 000 | 12 000 | 8 000 | 8 000 | 8 000 | 8 000 | 8 000 | 8 000 | 8 000 |
| 2.1 Meetings | 8 000 | 8 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 |
| 2.2 Exchanges of staff | 30 000 | 30 000 | | | | | | | |
| 2.3 Total | 98 000 | 50 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 | 12 000 |
| 3.2 Centralized data handling | 18 000 | 8 000 | 24 000 | 8 000 | 8 000 | 8 000 | 8 000 | 8 000 | 8 000 |
| 3.3 Exchange of materials | 28 000 | 8 000 | 28 000 | 8 000 | 8 000 | 8 000 | 8 000 | | |
| 3.4 Joint publications | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | 4 000 | | |
| 3.5 Consumables | 32 000 | 24 000 | 34 000 | 12 000 | 12 000 | 12 000 | 12 000 | | 12 000 |
| 3.6 Durable Equipment | 24 000 | 10 000 | 45 000 | 8 000 | 8 000 | 8 000 | 8 000 | | 8 000 |
| 3.7 total | 106 000 | 54 000 | 135 000 | 40 000 | 40 000 | 40 000 | 40 000 | 8 000 | 28 000 |
| Total (1 + 2 + 3) | 234 000 | 104 000 | 181 000 | 76 000 | 76 000 | 76 000 | 76 000 | 20 000 | 40 000 |
| 5. Overheads | 35 100 | | 18 100 | 7 600 | 7 600 | 7 600 | 7 600 | 2 000 | 4 000 |
| Total | 269 100 | 200 000 | 199 100 | 83 600 | 83 600 | 83 600 | 83 600 | 22 000 | 44 000 |
| 6. % of contribution of Commission | 53 | | 49 | 35 | 32 | 35 | 41 | 50 | |
| Recurrent costs | 240 000 | 248 000 | 208 000 | 152 000 | 176 000 | 152 000 | 120 000 | 40 000 | |
| TOTAL | 509 100 | 398 000 | 407 100 | 235 600 | 259 600 | 235 600 | 203 600 | 20 000 | |

# *ANNEXES*

*Avis des partenaires*

# AGRICULTURAL RESEARCH DIVISION
## Department of Agriculture and Livestock

TELEGRAMS: AGRIC, KONEDOBU,
TELEPHONE: (675) 211046, 213527,
TELEX: TLX 22143
FACSIMILE: (675) 214364,

P.O. BOX 417,
KONEDOBU
PAPUA NEW GUINEA


Dr Vincent Lebot,
CIRAD/MICAP,
2477 av. du Val de Montferrand,
BP5032 Montpellier Cedex 1,
FRANCE

1st May 1995
Wa/23-1-106

Dear De Lebot

Re: Proposed project on taro evaluation and breeding for rainfed cropping system in South East Asia and Oceania

Thank you for your faxed letter and copy of the project proposal of 25th April.

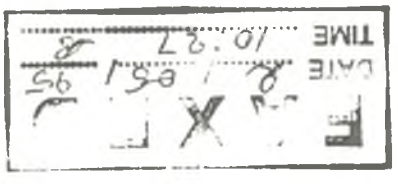
I am glad you have been in contact with Dr Ivancic, Plant Breeder on Taro at Bubia Research Station. We regard taro as a very important root crop, second only to sweet potato. However it has more significant economic importance as an export crop than any other root crops. Subsequently we have embarked on national taro improvement programme under the leadership of Dr Ivancic. In this regard your project proposal is timely and is of great interest to us.

Over the next two weeks we will discuss the proposal and provide detail comments to you thereafter. In the mean time I would like to confirm that this organization would certainly like to collaborate with CIRAD/MICAP on the proposed taro evaluation and breeding project.

I look forward to receiving further correspondence on this subject from you soon.

Yours sincerely

B M WAYI
Director
Agricultural Research



cc : Mr E.C. Sitapai, Deputy Secretary, Technical Services.
: Dr A. Ivancic, Principal, Plant Breeder, Bubia.
: Mr S. Sar, Team Leader, Bubia.

INDONESIAN INSTITUTE OF SCIENCES

R & D CENTRE FOR **BIOTECHNOLOGY**

No. :294 /II.4/KS/95 Bogor, 24 March, 1995.

Dr. Vincent Lebot
MICAP/CIRAD
2477 av. du Val de Montferrand
BP 5035, 34032 Montpellier Cedex 1
FRANCE

Dear Dr. Lebot,

This is to acknowledge receipt of your letter of March 9, 1995. Indeed I am very much interested in joining the group/project for several reasons :

1. Taro has not been given very much attention by researchers in Indonesia
2. We have a small taro collection in our garden which we intend to develop.
3. We have sufficient staff who would be willing to get involved in the project.

An integrated/collaborative effort which you put in the proposal would be an effective as well as efficient way to achieve the intended goals. The only problem remains is how to get financial support? I hope we could get it from the EEC.

In that respect too please find enclosed a copy of the proposal in which I have put a few comments for your consideration.

Thank you very much for your kind attention

Yours sincerely,

Dr. Made Sri Prana
Director

Head Office : Jalan Raya Bogor Km 46, Cibinong 16911, Bogor INDONESIA
P.O. Box Bogor : 422 Cable Address : DIRBIOTEK
Phone : (021) 8754587 ( Sentral ), 8754625, 8754626, 8754627, 8753650
Fax. : (021) 8754588

c/ws70/dinas/made/lebot

AGENCY FOR AGRICULTURE RESEARCH AND DEVELOPMENT
Institute for Agricultural Technology Assessment
(BPTP Karangploso). PO Box 188, Malang, 65101.
INDONESIA Fax: 0341-471255

Malang, 30 May 1995

Dr. Vincent Lebot
MICAP/CIRAD

Fax : 33 67615605
2477, Avenue, du Val de Montferrand
BP 5035, 34032 Montpellier
Cedex 1, France

Dear Dr. Lebot,

Thank you for your letter of May 5, 1995, offering a collaborative research on taro (Colocasia sp).

We would be happy to collaborate with your institute, studying on "Taro : evaluation and breeding for rainfed cropping systems in South East Asia and Oceania".

Our new institute, IATA (Institute for Agricultural Technology Assessment) will be cooperating with the RILET (Resarch Institute for Legumes and Tubers) here, in Malang to conduct this research project.

Taro is a potential food crop commonly planted in East Java, and Malang area is the main producing centre, which has not been researched. Therefore, your offer is most welcome.

Thank you for your cooperation, and best regards.

Sincerely yours

S u m a r n o
Director

Agency for Agricultural Research and Development
RESEARCH INSTITUTE FOR LEGUMES AND TUBER CROPS
(RILET)

Jl. Raya Kendalpayak
P.O. Box 66 Malang 65101

Phone (0341) 81468
Fax. 62 - 0341 - 81496

Malang, 22 May 1995

Dr. Vincent Lebot
MICAP/ Genetic Resources
CIRAD
2477 av. du val de Montferrand
BP 5035
34032 Montpellier Cedex 1

Dear Dr. Lebot,

Let me please to respond your letter addressed to Dr. Faisal Kasryno DG of AARD. I am an agronomist of root crops in RILET, which particularly dealing with breeding and agronomic researchs.

Regarding to your proposal for exploring and conserving germ plasm of taro, I am fully agree. As you know this crop has a wide of ecological adaptation. Taro can be found in low altitude until high altitude near by frost level. Taro can also be found in swamp area as well as in dry upland. It seems that the genetic variability of taro is widely available. Unfortunately, till recently RILET do not have any collection of taro. Therefore I am very glad joining to your proposal and field exploration as well. The collection and characterization could be done further in RILET headquater. RILET fascilitates with arround 200 ha of experimental farm, and equiped with laboratories.

In 26 May - 20 June 1995 I will travelling to Irian Jaya, assessing research needs for root crops, particularly those sweet potato and taro.

I am looking forward to hearing from you.
Kindly regards,

Yours sincerely,

Yudi Widodo
Root Crop Program

cc : Dr. Suyamto (Director of RILET)

DEPARTMENT OF AGRICULTURE
Chatuchak, Bangkok 10900 Thailand: Tel. 579-0151-8
Telex : 84478 INTERAG TH, 84103 DOA TH
Fax : (662) 5615024
Telegramm : DEPAGRI

No. 0916/ 2347

15 May B.E. 2538 (1995)

Dear Dr. Lebot,

Referring to your facsimile received on May 3, 1995, regarding a collaborative project on taro (Colocasia esculenta). We have already considered your draft project proposal and conclude that we are interested in collaboration with the project. Since the taro yield in Thailand is low at present, the project should enable the improvement of taro production in this country.

Currently, taro research program in our Department is mainly concentrated on varietal collection, characterization and also evaluation of some local cultivars. We need to improve taro variety for high yield and resistance to diseases. This collaboration should also provide more knowledges and experiences to our scientists involving in this field.

We would like to take this opportunity to express our sincere thank for offering this collaboration to our Department. We look forward to hearing from you soon.

With best regards,

Yours sincerely,

Banchong Panyasiri
Deputy Director General
Department of Agriculture

Dr. V. Lebot,
MICAP/CIRAD
2477 av.du Val de Montferran
BP 5035,3403 Montpellier cedex 1,France
ph. # 33 67 61 59 27. Fax# 33 67 61 56 05

CROPS RESEARCH DIVISION

27 April 1995

Dr. Vincent Lebot
MICAP/CIRAD
FAX #3367615997

Dear Dr. Lebot:

This has reference to your faxed proposal on Evaluation and Breeding for Rainfed Cropping Systems on Taro in Southeast Asia and Oceania for possible collaboration with the Philippine Root Crop Research and Training Center (PRCRTC).

We wish to inform you that PRCRTC as the national commodity center of the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) on root crops is capable to undertake research work on taro. Moreover, the center had already done several researches on varietal improvement of taro. Presently, Dr. Jose R. Pardales, Jr. is the lead person on this area. The mailing address of the center is:

Philippine Root Crops Research and Training Center (PRCRTC)
Visayas State College of Agriculture (ViSCA)
Baybay, Leyte
Philippines

On the otherhand, PCARRD can coordinate the proposed research on taro since we have forged a Memorandum of Agreement (MOA) with CIRAD in the field of scientific and technical research in the following forms:

a) joint planning and implementation of joint or complementary research projects;

b) exchange of researchers, experts or technicians;

c) supply or exchange of publications, information and scientific documents;

- more -

**PHILIPPINE COUNCIL FOR AGRICULTURE, FORESTRY, AND NATURAL RESOURCES RESEARCH AND DEVELOPMENT**
Paseo de Valmayor, Los Baños, Laguna 4030, Philippines • P.O. Box No. 425
Tel. Nos. 50014-50015 / 50017-50020 & 50024
Manila Liaison Office: Rm. 103 Gr. Floor, DOST, Bicutan, Taguig, Metro Manila
Tel. No. Direc Line: 822-1651 • Trunklines: 823-80-71 to 75, Local 2420
Cable Address: AGRESPHIL MANILA
Telex No.: 40860 PA R RS PM • Fax No.: (63)(094)50016

Dr. Vincent Lebot
27 April 1995
...../page 02

d) germplasm exchange;

e) organization of joint seminar or colloquis; and

f) courses, study missions and generally all types of personnel training or skill enhancement activities

We are also closely working with Dr. Jean-Francois Julia, CIRAD Representative to the Philippines, all the arrangements stipulated in the MOA for smooth implementation of R & D activities in the Philippines.

Thank you and we hope this new collaborative work will boost the taro industry.

Very truly yours,

ESTER L. LOPEZ
Officer-in-Charge

***END***

Visayas State College of Agriculture
**PHILIPPINE ROOT CROP RESEARCH AND TRAINING CENTER**

April 11, 1995

Dr. Vincent Lebot
Genetic Resources
MICAP-CIRAD
2477 av. du Val de Montferrand
BP 5035, 34032
Montpeller Cedex J. France

Dear Dr. Lebot:

This is to acknowledge receipt a copy of your project proposal on "Taro (Colocasia esculenta): Evaluation and breeding for rainfed cropping systems in South East Asia and Oceania for EEC funding which was sent to us through FAX.

Thank you very much for considering our center as one of your research collaborators in South East Asia. We appreciate such opportunity to be working with you. We also signify our interest, willingness and support to collaborate to your project which is very timely to strengthen our varietal improvement program on taro.

With kind regards.

Very truly yours,

FERNANDO A. EVANGELIO
Officer-In-Charge
PRCRTC

Baybay, Leyte, Philippines: ViSCA, Manila Office, #8 Lourdes Street, Pasay
Metro Manila, Philippines Tel. 521-20-27 Fax: (632) 588-692

Visayas State College of Agriculture
PHILIPPINE ROOT CROP RESEARCH AND TRAINING CENTER

22 April 1995

Dr. Vincent Lebot
MICAP/CIRAD
2477 av.du Val de Montferrand
BP 5035, 34032 Montpellier cedex 1
France

Dear Dr. Lebot,

Thank you for your invitation for the Philippine Root Crop Research and Training Center to join in your proposed porject on "Taro: evaluation and breeding for rainfed cropping systems in Southeast Asia and Oceania". A copy of the proposal was shown to me by Prof. Fernando A. Evangelio for comment.

The PRCRTC have an ongoing breeding and evaluation project which was started in the late 1980's. The work is progressing but additional inputs such as those derived from your proposal is much desirable. At present, our taro germplasm is being managed by Dr. Jose R. Pardales, Jr., and I took care of the breeding activities together with Dr. Jose L. Bacusmo (a breeder/ geneticist by training). Also, our tissue culture works are done by Ms. Villaluz Z. Acedo. Unfortunately, I may not be able to join the project because I shall be on study leave (Molecular Biology and Biotechnology at UP Diliman) starting June 1995, I still hope that with Dr. Bacusmo taking the leadership the project will push through.

Nonetheless, I proposed to add an activity that may be separated from your proposal, but is surely needed if the evaluation of lines have to be hastened. Since the incipient of our breeding work, the discrimination or selection against those progenies that are acrid slowed down our selection process. Though we used dry matter content and yield as the major criteria in the early selection, we still obtain progenies that are acrid in the later part. We use human panelist to help us discriminate the presence of acridity, but this discourages further involvement of the same people. Hence I proposed that the project or a related project should be made to develop a rapid screening technique for the presence of acridity similar to the one used in testing for the HCN content in cassava.

Baybay, Leyte, Philippines: ViSCA, Manila Office, #8 Lourdes Street, Pasay
Metro Manila, Philippines Tel. 521-20-27 Fax: (632) 588-692

Although crystals of calcium oxalate are considered the "culprit" in acridity, I have read that a Japanese scientist thought that 3,4 - dihydroxybenzaldehyde is the causal agent. Another group believed that some form of enzymes in taro confer this acrid reaction. (I am particularly interested in this acridity and its function in aroid evolution. I hope this can be part of my graduate study.) With these substances present in taro, a thorough organic chemical study should be done. Once the true causal substance is known then we may be able to develop the rapid screening technique - even just a simple qualitative procedure. I have been trying to look into this but unfortunately we do not have the necessary equipment for identification of the purified substance and the procedure for the synthesis of the same substance for verification. I am sure you may be able to find a suitable laboratory in France that can do the research job or host a research scientist to assist in the work. I am looking forward to this procedure to be established.

Thank you very much for initiating an international attention for the development of taro breeding and hopefully taro would also become an international economic commodity in the future.

With best wishes and kind regards.

Sincerely yours,

DILBERTO O. FERRAREN

Dr. Vincent Lebot
MICAP/CIRAD, Genetic Resources
Montpellier, Cedex 1
France

Fax No. 33-6761-5605

April 23, 1995

Dear Dr. Lebot,

Thank you for your letter dated March 23, 1995 and the facsimile which I received on Friday. I agree with your research proposal on taro and I am prepared to take part in your team.

In our department, we have a Genetic Resources and Germplasm Unit. However, so far, we have not done the collection of the taro species. Due to the limited amount of fund available, I wish to tell you that for this taro project, we have to secure additional funds. I believe you have some plan to look for funds from international organizations in order to get the project carried out.

I understand many countries will be involved in this project. It can only be materialized if funds are available. Since the project is proposed by you I believe you have the strategy to work it out smoothly. Of course, at my side I will give you all the support.

Due to that April is the examination month and I have to complete marking five B.Sc. Agriculture theses and one external examination of a Ph. D. thesis from India, in addition to the marking of hundreds of test papers. I feel very sorry for the late response of your letter.

Thank you and best regards.

From:

Dr. T.C. YAP
Professor of Plant Breeding
Dept. of Agronomy and Horticulture
Univ. Pertanian Malaysia
43400 UPM Serdang, Selangor
MALAYSIA

Fax No. 603-9483745 or 603-9433097

This letter is dispatched directly from the modem of my PC and therefore no signiture is made.

# SABRAO

## (The Society for the Advancement of Breeding Researches in Asia and Oceania)



April 19, 1995

Dr. Vicent Lebot,
MICAP/CIRAD,
2477 av.du.Val de Montferrand,
B. P. 5035, 34032 Montepellier Cedex 1,
FRANCE.

Dear Dr. Lebot,

Thank you for your letter of March 23, 1995 and your facsimile of April 19, 1995. I learned with pleasure that your proposal has been well received by IPGRI and your potential research partners.

The Department has already reviewed your proposal and agreed in principle for Thai scientists' participation in your Taro project. Dr. Banchong Sikkhamondhol, Deputy-Director General, will be available on his facsimile number **66 2 579 0581.**

I enclose herewith the lists of SABRAO Board Members and Regional Secretaries for your benefit. May I suggest that you contact Dr.Yap to represent Malaysia for he is surely the one who is tailor-made to take up that position.

Please let me know of your further plans to develop your project and I shall be only too glad to do anything I can. I am also enclosing herewith a picture of Taro plants taken from a farmer's field, Samoeng District, Chiang Mai, for your information.

I look forward to your reply at your convenience.

Yours sincerely,

Sumin Smutkupt

Sumin Smutkupt
Secretary-General

Enc. 3

# SABRAO

## (The Society for the Advancement of Breeding Researches in Asia and Oceania)




Ayodaya Tower 240/4-7 11th Floor, Ratchadapisek Rd, Huay Kwang, Bangkok 10310, Thailand

Tel : 2741618-22, Fax : 2741633


22 March 1995

Dr. V. Lebot

MICAP/CIRAD

2477 av.du.Val de Montferrand

BP 5035, 34032 Montpellier Cedex 1

France

Dear Dr. Lebot,

Thank you very much for your letter with two reprints and a proposal of 10 pages on Taro germplasm project which I received by fax on March 20.

I have read your reprints with much interest. I have consulted with Dr. Banchong Sikkhamondhol, Deputy D-G, Department of Agriculture about your proposal and asked him for a participation of the Department. He has agreed in principle to support this project. Your proposal is now being reviewed by the Department for official approval.

For partners in other Southeast Asian countries, please contact our Regional Secretaries as follows:

1. Dr. Anggoro Haidi Permadi

   LEHRI, Jl.

   Tanguban Parahu 517

   Lembang 40391

   Indonesia

2. Dr. T. C. Yap
   Department of Agronomy and Horticulture
   Faculty of Agriculture
   Universiti Pertanian Malysia
   Serdang, Selangar - 43400
   Malaysia
3. Dr. Eufemio T. Rasco, Jr.
   CAPPRAD/CIP
   c/o IRRI P.O. BOX 933
   Manila, Phillippines
   Fax: (632) 818-2087

We still do not have a representative in Myanmar and Vietnam.

For European partners, I would like to recommend that you seek advices from:

Prof. Dr. G. Röbbelen
Institut für Pflanzenbau u. Pflanzenzüchtung
Universität Göttingen
Von Siebold Strasse 8
D-3400 Göttingen, Germany

and

Prof. Dr. Werner Höfner
Universität Giessen
Institut für Pflanzenernährung
Sudanlage 6
D-6300 Giessen, Germany

In addition, I would like to inform you that Thailand will host the ***Third Asia-Pacific Conference on Agricultural Biotechnology during November 10-16, 1996 in Bangkok or Chiangmai.*** If you think you can organize a workshop on "Applications of biotechnological techniques for Taro breeding", please let me know, so I can recommend this workshop to the the local organizing committee.

With best wishes,

Yours sincerely,

Sumin Smutkupt

Sumin Smutkupt
Emeritus Professor of Plant Breeding

On the first year, too, it will be useful to organize a workshop or training to review detailed procedures with cooperators as well as to agree on standard procedures for characterization and evaluation. We can offer you our experience in organizing a variety development network for sweetpotato.

After more than 10 years of SAPPRAD, we have a functioning team. The continuing support of the Australian Government and CIP attests to the effectiveness of this team. Since practically all our collaborators are concerned with root and tuber crops in general, it will be easy for this team to take on the added responsibility of doing taro R and D. You might consider working with the SAPPRAD team. Towards this end, it will be useful if you can attend out next annual meeting which is scheduled in Sri Lanka in late August 1995. It will be an opportunity for you to meet potential cooperators from several countries and also to know the mechanics of SAPPRAD. We can exchange ideas on how SAPPRAD can support your proposed project.

Best regards.

# SAPPRAD

**Southeast Asian Program for Potato Research and Development**
CIP-SAPPRAD c/o IRRI P.O. Box 933, Manila, Philippines
Location: PCARRD Complex, Los Baños, Laguna, Philippines

**FAX**

| | |
|---|---|
| TO: Vincent Lebot<br><br>FAX: 33 67 61 56 05 (France) | FROM: Dr. Eufemio T. Rasco, Jr.<br>Coordinating Scientist<br><br>FAX : 63 2 8182087<br>TEL : 63 94 50015-19<br>Ext 248<br>63 94 50235 |
| PAGES: 2 | DATE: April 21, 1995 |
| SUBJECT: Taro: Germplasm evaluation and breeding for rainfed cropping systems in Southeast Asia | |

REMARKS

☐ Urgent ☐ For your review ☐ Reply ASAP ☐ Please comment

Thank you for inviting me to comment on the above proposal.

The Southeast Asian Program for Potato Research and Development (SAPPRAD), a semi-autonomous network managed by the International Potato Center (CIP) which I am coordinating, does not cover taro at present. We only cover potato and sweetpotato. However, we have informally discussed the idea of including taro in our R and D program. Thus, I welcome your idea of the project.

SAPPRAD covers four of the six countries you enumerated in your proposal. These are Malaysia, Philippines, Indonesia and Thailand. We also anticipate that Vietnam will be included in the next one or two years. SAPPRAD has been in existence since 1982.

I am convinced of the current importance of taro as well as its potential. I am equally convinced that breeding can give a substantial contribution to the improvement of this crop.

I have no comment on the technical aspect of the project as the procedures cited are rather standard for this kind of crop. Our experience in SAPPRAD points to the need for a more careful consideration of the administrative aspects of this kind of project, starting with selection of collaborating institutions and individuals. It is not unusual that even in small countries, there are more than one insitution dealing with taro. Lastly, since the success of a network relies on the willingness of collaborating parties to share germplasm and knowledge, it is essential that you select a group where individuals trust and respect each other. Trust is crucial, particularly that your proposal involves sharing of germplasm, and there is a growing global movement to restrict this kind of activity. For this reason, I suggest that you allocate the first half or full year of the project to the identification of appropriate institutions and individuals, while collecting benchmark information.