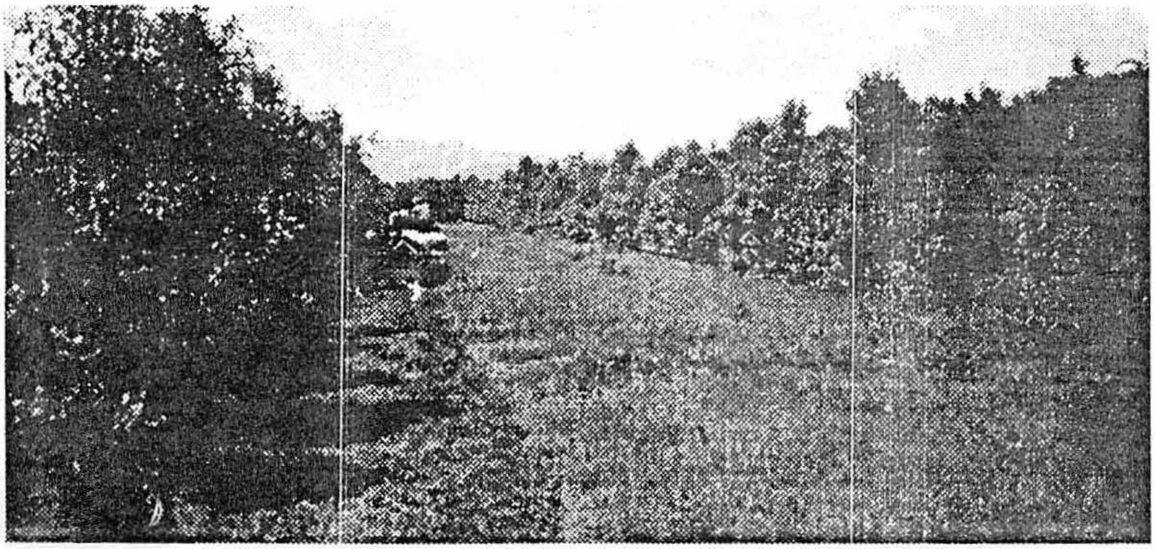
Productive Land Use Systems
Haiti

South-East Consortium for International Development
and
Auburn University



Status of Seed Orchards and Tree Improvement Trials in Haiti and Plan of Activities 1993-1994

by
Joel C. Timyan
February, 1993

SECID/Auburn PLUS Report No. 1

This work was performed under USAID Contract No. 521-0217-C-00-0004-00

TABLE OF CONTENTS

Forward

This document accomplishes several purposes. Firstly, it provides a summary of work accomplished to date in tree improvement and germplasm conservation in Haiti under the Agroforestry Outreach Project and the subsequent Agroforestry II project, both funded by the United States Agency for International Development. Secondly, it provides a summary of the status of tree selection at the end of 1992 and outlines the work that needs to be done during the two remaining years of the Productive Land Use Systems Project (PLUS). Thirdly, it provides convincing evidence, with real data, of the benefits of tree selection, and, conversely, the risks involved in distributing seed of unknown genetic sources. Mr. Timyan's review will provide those agencies working directly with Haitian farmers up-to-date information on sources of seed for important tree species while assisting SECID/Auburn University in continuing tree germplasm improvement under PLUS. For funding agencies and policy makers, this document provides ample justification for continued support of genetic conservation and improvement of trees in Haiti. Whether argued from an environmental, an economic or a humanitarian perspective, continued support of tree improvement is well worth the effort.

Genetic improvement of economically important trees is uncommon in developing countries in the tropics. The potential benefits to this project thus reach far beyond the bounds of Haiti. However, much work remains to be done if this work can significantly benefit the Haitian farmer. Many of the trials have not reached the maturity required to make selections. A distribution system needs to be put in place to ensure that seed of superior trees are provided to farmers. The progress to date has been accomplished with a minimum of staff and resources. We hope that this document will convince policy makers of the need to see these activities through to a successful conclusion.

Dennis A. Shannon
Campus Coordinator
Auburn University

ACKNOWLEDGEMENTS

The author extends his appreciation to those individuals and private volunteer organizations that have participated in the Seed and Germplasm Improvement Project and the AFII. They have generously provided land and management support to allow such an effort to develop in Haiti. The project would not have been successful without this assistance. Their commitment is a worthy example of the spirit that is absolutely necessary for tree improvement.

Project activities have been supported financially by USAID through contracts to IRG and SECID. Their efforts in design and logistical support are remarkable considering the difficult political and economic climate of Haiti during 1987 - 1992.

The author is indebted to the many volunteers and international research organizations for collaborative support. The staff of Auburn University are to be commended for helping in the preparation of this document, particularly Dennis Shannon for his critical review, Terry Rodriguez for her help with the graphics, Louis Verret and Yvon Elie for assisting with the compilation of data and Marilyn Louis for logistical support in Haiti.

LIST OF ACRONYMS USED IN THIS DOCUMENT

AFII	Agroforestry II (a USAID project 1990-1992)
AOP	Agroforestry Outreach Project (a USAID project 1981-1989)
AU	Auburn University
CAB	Centre Agricole de St. Barnabas
CAMCORE	Central America and Mexico Coniferous Resources Cooperative
CATIE	Centro Agronómico Tropical de Investigación y Enseñanza
CBH	Convention Baptist d'Haiti
COHDEFOR	Corporación Hondureña de Desarollo Forestal
CSIRO	Commonwealth Scientific and Industrial Research Organization
FS	Forest Service
IRG	International Resources Group, Ltd.
IITA	International Institute of Tropical Agriculture
IUFRO	International Union of Forest Research Organizations
NGO	Non Governmental Organization
NFTA	Nitrogen Fixing Tree Association
ODH	Operation Double Harvest
OFI	Oxford Forestry Institute
PADF	Pan American Development Foundation
PLUS	Productive Land Use Systems (a USAID project 1992-1994)
SAS	Statistical Analysis Systems
SECID	South-East Consortium for International Development
USAID	United States Agency for International Development
USDA	United States Department of Agriculture

EXECUTIVE SUMMARY

General

1. The status of tree improvement activities developed during the AOP and AFII projects is reviewed and specific recommendations are made for the utilization of improved sources during the PLUS project. Information is provided to allow PLUS to pass on the benefits of improved germplasm to the Haitian farmer.

2. Over six hundred and fifty superior candidate trees have been selected throughout Haiti. More than one hundred orchards, progeny/provenance trials and arboreta have been established. The genetic diversity and superior quality of tree germplasm in this network serves as both an investment and an insurance policy for the Haitian farmer. Conserving improved locally-adapted tree varieties is fundamental to sound natural resource management and critical to the future of an extremely deforested landscape.

3. A cohesive, long-term strategy for safe-guarding the information and conserving forest genetic resources is lacking. Programs to maintain a forward thrust in genetic conservation and improvement are in a constant state of jeopardy and adversely affected by personnel turnover and project design changes characteristic of bi-lateral and international assistance in Haiti. Lack of long-term commitment severely restricts the opportunities to conduct quality research and achieve permanent results.

Tree Improvement Research and Development

4. PLUS should continue as the vanguard of tree improvement in Haiti and share the benefits with other active projects concerned with environmental quality. The project is in a unique position to reap the rewards of over 5 years of USAID activities focused on a tree improvement program including the establishment of orchards, provenance and progeny trials, and a facility for seed research, storage and handling.

5. Genetic tests have shown significant differences in productivity and vigor among families and provenances for most of the tree species selected in the genetic tests. Thirty-eight of the progeny and provenance trials, approximately 70% of those established during 1988 - 1991, are recommended for continued measurements to enable PLUS to evaluate the genetic worth of economically important tree species. A top priority for PLUS should be to capitalize on the gains in order to increase on-farm productivity.

6. The challenge for PLUS in 1993/94 is to place priorities on tree improvement activities that have the greatest impact at the local level and integrate simple and smart indigenous tree management techniques. The greatest emphasis in long term breeding should be given to those species that provide the greatest economic return to local farmers. Innovative silvicultural techniques and land-use interventions should be introduced simultaneously with improved germplasm to increase the potential for sustained gains in productivity, both at the tree level and at the farm level.

7. The elimination of the Seed and Germplasm Specialist position forces a reduced level of SECID germplasm research. The reduction from a team of seven in 1991 to a recommended staff of three during PLUS should maintain the essential orchards and genetic tests, while enabling SECID to address the research problems associated with the production of on-farm seedlings. Monitoring and evaluation activities should target key orchards and progeny/provenance trials and innovative on-farm tree management. Significant information should be published.

8. Forty-six orchards, approximately 80% of those established during 1988-1991, are recommended for continued supervision by SECID. These are located on 12 sites throughout Haiti and represent sixteen hardwood species. Gradually, this number may drop as various site and management factors take their toll.

9. SECID should hire an M.S.-level forester in Haiti to be responsible for the management and research of the orchards and progeny/provenance trials, to synthesize relevant information for integration into the PADF and CARE extension programs and coordinate with PADF and CARE for the production, promotion and distribution of improved germplasm.

REZIMÉ

1. Rapò sa-a voye zye sou éta aktivité ki té fèt sou ameliorasyon pyebwa andedan pwojè AOP é AFII yo. Li fè rekòmandasyon sou ki jan yo ka itilze pi bon sous nan pwojè PLUS-la. Li bay infomasyon pou pèmèt pwojè PLUS-la pataje konesans li sou youn miyò kalite semans pyebwa ak agrikilte Aisyen-yo.

2. Plis ke sis san senkant pyebwa siperyè te chwazi nan tout peyi-a. Plis ke san jaden pyebwa, esè pwovnans/pwojeni, e pèpinye deja etabli. Kalite siperyè ak divesite jenetik pyebwa sa yo sèvi kom youn envestisman ak asirans pou agrikilte Aisyen-an. Konsevasyon espès ak varyété pyebwa ki siperyè epi ki adapte ak kondisyon peyi-a trè enpòtan pou asire youn bon ékilib resous natirel, epi pou sauvtaj youn peyizaj prèske kompletman debwaze.

3. Manké youn strateji solid ki ta pèmèt pwoteje enfomasyon-an ak pou konsève resous jenetik forè-yo pi lontan. Pwojè ki ap chèche avanse nan konsevasyon ak ameliorasyon jenetik ap toujou jwen difikilté a koz chanjman pesonel kap travay nan pwojè yo e chanjman nan bi pwojè yo mem; bagay ki te toujou make ed entenasyonal ak bi-lateral nan peyi dayiti. Mank sa yo rédwi posibilité pou fé bon réchèch kap bay bon rézilta kap diré.

4. Fok PLUS kontinye pran devan nan améliorasyon pyebwa nan péyi daiyti épi pataje benefis yo ak lòt pwojè ki aktif épi konsene tou nan kalite lanviwonman-an. Pwojè sa-a nan youn bel pozisyon dèske li ka rekòlte rekonpans senk ane aktivite USAID ki te konsantre sou youn pwogram améliorasyon pyebwa ki te tou genyen etablisman jaden pyebwa, esè pwovnans ak pwojeni, e youn kay kote yo te fe reshech ak tretman sou semans e ki te sevi kom depo semans-yo tou.

5. Esè jenetik yo montre kek diferans enpòtan nan fos ak pwodiksyon ant fanmi ak pwovnans plisye espes pyebwa seleksyoné-yo. Trant-uit nan esè pwojeni ak pwovnans-yo, prèske 70% nan sak te etabli nan lane 1988-1991, ta merite mezire toujou pou pemet PLUS examine valè jenetik ras pyebwa ki genyen plis empotans ekonomik-yo. Pi gwo angajman PLUS te dwe pou bouske youn fason pou pwofite sou benefis sa yo ki te ka pemet yo ogmante pwodiktivite sou fem yo.

6. Defi PLUS pou ane 1993/94 se detemine ki jan yo pwal fe pou bay aktivite améliorasyon espes pwebwa youn pi gwo empotans youn fason pou li sa fe youn bon efè sou nivo lokal-la ak poul adapté teknik semp ak entelijan pou amenajman pyebwa natif natal. Pi gwo empotans nan pwogram pyebwa-yo sou long dire te dwe pose sou espes ki ap bay plantè yo plis ranman ekonomik. Entwodiksyon de nouvo teknik silvikiltiral e itilizasyon tè, ta dwe mache men dan la men

ak amelyorasyon semans pou ogmanté ak kenbé sou pwodiktivite plante-yo, ni sou nivo pyebwa, ni sou nivo fem-la.

7. Nivo reshesh SECID sou semans pyebwa bèse a koz yo elinine pozisyon spesialis semans-la. Mem si yo gen tan redui personel la kité 7 nan 1991 a 3 moun jodi'a, PLUS ta fe byen kontinye sivèyans sou kek jaden pyebwa ak eksperyans jenetik, SECID ta ka travay sou pwoblem pepinye sou fem. Aktivite suivi ak evaliasyon ta kontinye sou kek jadin pyebwa e esè pwojeni\pwovnans empotan, ansam ak entwodiksyon nouvo teknik amenajman pyebwa sou fem. Tout enfomasyon empotan ta pibliyè.

8. Nou konseye ke SECID kontinye sipèvize karant-sis jaden pyebwa, ki represanté prèske 80% sou sa ki te etabli nan ane 1988-1991 yo. Jaden pyebwa sa yo place sou 12 sit a trave peyi-a e yo representé 16 espes bwa di. Kantite sa-a genyen dwa diminye a koz malè ka rive pyebwa-yo pou tet kek bagay ki mache mal swa sou sit-la mem, ou swa neglijans nan amenajman jaden-an.

9. Fok SECID ta amplwoyé youn agwonom ak tout metriz li, ki ta responsab gesyon ak rechech nan jaden pyebwa e esè pwojeni\pwovnans yo, e ki tap rézimé enfomasyon empotan bay PADF ak CARE pou yo ta kap ko-ordone pwodiksyon, pwomosyon, ak distribusyon semans.

I. INTRODUCTION

A mid-course amendment to Agroforestry II (AFII) on August 14, 1992 created the Productive Land Use Systems (PLUS). Though the goal and purpose of PLUS remain identical to AFII, the methods and personnel for accomplishing these objectives have changed. One of the immediate results following a shift in emphasis away from tree production towards food production has been the reduction in SECID's long-term international staffing and the elimination of the author's position as Seed and Germplasm Improvement Specialist. This comes after a year of project suspension that had effectively shut down tree germplasm improvement activities, placing much of the past USAID investments in seed orchards and genetic tests in jeopardy and future programmatic issues uncertain.

II. PURPOSE AND SCOPE OF WORK

The purpose of this consultancy was to assess the tree improvement trials and seed orchards established by the Seed and Germplasm Specialist under the Agroforestry Outreach Project (AOP) and AFII during the period 1988-1991. Specifically, the scope of work included the following:

1) the preparation of a status report on 52 seed orchards (section IV.A), 52 progeny and provenance trials (section IV.B) and 6 arboreta (section IV.C) established since May 1988. A triage of orchards and trials was made based upon the quality of data and germplasm to be obtained, their usefulness to Haitian farmers and potential in meeting PLUS project objectives;

2) a summary of tree improvement efforts for each of the major agroforestry species and a list of the best seed sources of germplasm for use by the PLUS project (Annex 2);

3) a proposal for capitalizing on past and present activities in germplasm improvement for the benefit of the current PLUS project. This necessitated defining the roles and responsibilities of the South-East Consortium for International Development (SECID) in tree improvement research versus those of Pan American Development Foundation (PADF) and CARE in extension activities associated with the handling and distribution of improved tree germplasm to Haitian farmers (section V).

Activities Accomplished - The author arrived in Haiti on November 1, 1992 and departed on December 23, 1992. An agenda and timetable was submitted to PADF, CARE and USAID within the first week of arrival. Meetings with PADF and CARE personnel in Port-au-Prince were held to discuss the author's purpose and goals of the consultancy, to coordinate field visits with key staff members and to discuss issues related to future participation in tree germplasm improvement and distribution. All seed orchard and trial sites were visited with the exception of two sites in the Jérémie area of the Grande Anse and one site near Anse-à-Veau. This was primarily due to lack of time in accomplishing the priorities set forth in dialogue with PLUS participants.

Site visits were accomplished in 3 major trips from Port-au-Prince: 1) the South and South-west (Fauché, Paillant, Camp Perrin, Cayes area, Labordette, Kalompré); 2) the CARE Northwest (Gonaïves, Bombardopolis, Barbe Pangnol, Passe Catabois, La Fond) and 3) the Plateau Central and the North (Mirebalais, Mme Si, Marmont, Sapatè, Lapila, Terrier Rouge, Crocra). Aside from the provincial trips, the Viard and Roche Blanche sites were visited several times during the consultancy on short day trips. The SECID team was comprised of the author and 2 assistants (Yvon Elie and Louis Verret) who have been involved in the majority of orchard and trial establishment, maintenance and mensuration activities since 1988. George Marcellus, responsible for PADF tree seed collections, handling and purchases, accompanied the SECID team for the first and third trip. This was an excellent opportunity for SECID and PADF to exchange ideas and for PADF to meet the landowners and site managers, to become aware of the techniques and methodologies involved in tree improvement strategies and the elaboration of problems associated with the implementation of germplasm management in Haiti. Mr. Marcellus has visited most of the seed orchard and trial sites with the exception of those located in the CARE Northwest and the Viard site near Kenscoff.

The SECID team met with 3 of the 4 CARE regional field managers at their respective field stations. Due to time constraints and schedule conflicts, the SECID team did not meet with Régis Yves Laurent at the La Fond station. The team de-briefed CARE in Gonaïves following the trip in the Northwest and the rest of the PLUS participants in Port-au-Prince prior to the author's departure from Haiti. A rough draft of the current status of seed orchards and progeny/provenance trials, with a summary of recommendations, was delivered to the PLUS participants at the time of de-briefing.

III. OVERVIEW OF SEED AND GERMPLASM IMPROVEMENT ACTIVITIES 1987-1991

Key developments leading up to the implementation of the Seed and Germplasm Improvement Project (USAID Contract No. 521-0122) in 1987 were discussed in the evaluation report by Palmer (1985), the University of Maine and USAID recommendations (1985a), the Ford recommendations (1986) and the Rios tree improvement design recommendations (1986). The need for such a program evolved with the emphasis of the AOP and AFII on tree production and distribution. Since IRG began in 1987, seed and germplasm improvement focused on tree improvement and seed orchard development for the economically important species of the Haitian farmer. This has involved the testing and improvement of those species ideally suited to agroforestry systems and developing local capacities to supply improved germplasm to the Haitian farmer (Timyan, 1988; Dvorak, 1989; Timyan et al., 1989). The project was suspended twice within the last 5 years of operation under USAID orders. SECID and Auburn University (AU) assumed responsibility of project activities when the IRG contract terminated in 1989.

The activities accomplished represent an initial testing phase in the improvement of Haiti's tree genetic resources. The role of IRG and SECID/AU has encompassed the selection of candidate trees representing both native and exotic species in Haiti; the management support required to establish, maintain and measure a network of orchards, progeny/provenance trials and arboreta; and research investigating seed problems. These activities represent the only attempt in Haiti to conserve the genetic base of several promising local and exotic tree species and improve these species for economic gain. Studies on conservation of native fruit tree and endemic palm species have also been implemented.

The sequence of activities associated with the tree improvement project during 1987 - 1992 is summarized in **Figure 1**. Each of the major activities are described below.

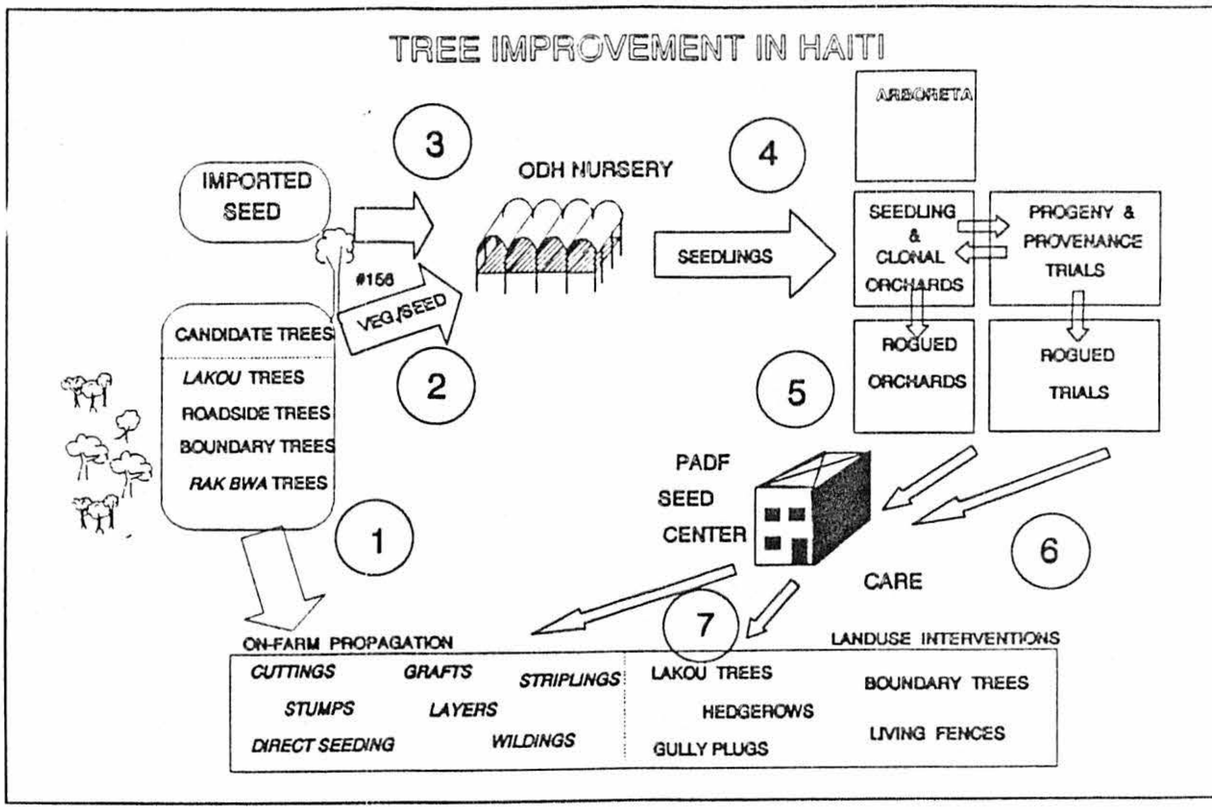


Figure 1. Description of the tree germplasm improvement program in Haiti. The sequence of major activities in the process include: **1** Identification of major species utilized by Haitian farmers; **2** Superior tree selection and **3** importation of germplasm from abroad for propagation in nursery, **4** establishment of orchards, progeny/provenance trials and arboreta, **5** the roguing of orchards and progeny/provenance trials, **6** handling and distribution of improved seed to Haitian farmers via PADF and CARE.

A. Superior parent tree selection - The selection of superior trees for useful traits forms the genetic base of the breeding populations that yield improved germplasm. Candidate trees were selected for qualitative characteristics that contribute to the economic value of the species. The hardwood lumber and pole species were selected for such traits as stem form, height to the primary fork, branching patterns and resistance to disease, insects and wind. Hedgerow species were selected primarily for biomass productivity and coppicing ability. In addition to the seed and clonal material that was collected from the local candidate trees, seed lots were imported from forestry research institutions and international seed brokers for testing and to increase the genetic diversity of the local populations.

Six hundred and sixty trees representing forty species were selected throughout Haiti (Table 1). The candidate trees were marked and numbered. Data collected for each candidate included the assigned number, names of the tree and garden owners, site descriptors (coordinates and elevation), tree measurements (total height, diameter at breast height, height to primary fork, crown width), seed harvest dates and phenology information. The data is on Lotus 123 computer spreadsheet with hardcopies available for distribution at the SECID office.

The majority of the seed lots used in the trials were propagated at the Operation Double Harvest nursery. This was the most efficient way to maintain records for each seed lot, keep seed lot identification secure and assure uniformity in seedling quality. The nursery stock was then established in seedling seed orchards, progeny trials and arboreta as discussed below.

Table 1. List of species that included superior parent tree selections in Haiti during the period 1988-1991.

LATIN NAME	CREOLE COMMON NAME	ENGLISH COMMON NAME	NO. OF PLUS TREES	NO. OF IMPORTED ACCESSIONS
* *Acacia auriculiformis* A. Cunn. ex Benth.	akasya	black wattle	17	10
* *A. nilotica* (L.) Willd. ex Delile	akasya	acacia	8	0
* *Albizia guachapele* H.B. & K.	albizya	albizia	3	1
* *Azadirachta indica* A. Juss.	nim	neem	7	12
Calophyllum calaba Jacq.	damari	calaba tree	16	0
* *Cassia siamea* Lam.	kasya	yellow cassia	37	7
* *Casuarina cristata* Miq. subsp. *cristata*	bwa pin	casuarina	2	1
* *C. equisetifolia* L. ex Forst. & Forst.	" "	Australian pine	24	4
* *C. glauca* Sieber ex Sprengel	" "	casuarina	3	1
Catalpa longissima (Jacq.) Sims	chenn	yokewood	127	1
Cedrela odorata L.	sed	W. Indian cedar	39	16
Chrysophyllum cainito L.	kaymit	star apple	7	0
Cinnamomum montanum (Sw.) Berchtold & Presl.	lorié	laurel	11	0

Table 1 (cont.).

LATIN NAME	CREOLE COMMON NAME	ENGLISH COMMON NAME	NO. OF PLUS TREES	NO.OF IMPORTED ACCESSIONS
Colubrina arborescens (Mill.) Sarg.	kapab	coffee colubrina	59	1
Conocarpus erectus L.	mang nwa	black mangrove	2	0
Cordia alliodora (Ruiz. & Pav.) Oken	chenn kapawo	onion cordia	4	6
Dipholis salicifolia (L.) A. DC.	akoma rouj	willow bustic	9	0
* *Eucalyptus camaldulensis* Dehnh.	kaliptis	river red gum	21	2
* *E. paniculata* Smith	"	eucalyptus	1	2
* *E. tereticornis* Smith	"	forest red gum	8	3
Genipa americana L.	gynpa	marmelade-box	10	2
* *Gliricidia sepium* (Jacq.) Walp.	lila etranjè	mother-of-cocoa	100	26
Guarea guidonia L.	bwa rouj	american muskwood	2	3
* *Leucaena diversifolia* (Schlecht.) Benth. subsp. diversifolia	lisina ti fey	diversifolia	7	5
* *L. leucocephala* (Lam.) de Wit subsp. glabrata	lisina	leucaena	1	4
Licaria triandra (Sw.) Kosterm.	lorie	Gulf licaria	1	0
Lysiloma sabicu Benth.	taveno	West Indian sabicu	50	1
Mammea americana L.	zabriko	mamay apple	3	0
Manilkara zapota (L.) v. Royen	sapoti	sapodilla	6	0
Mastichodendron foetidissimum (Jacq.) Cronq.	akoma	mastic	6	0
Ocotea leucoxylon (Sw.) Mez	lorié	whitewood	10	0
Ocotea sp.	lorié	laurel	2	0
Omphalea triandra L.	nwazet	Hunter's nut	3	0
Prunus occidentalis Sw.	lamandye	W. Indies laurelcherry	4	0
Swietenia mahogani Jacq.	kajou	W. Indian mahogany	18	1
S. berteroana Krug & Urban	frenn etranjè	simarouba	14	0
Simarouba glauca DC. var. *latifolia* Cronq.	frenn	princess tree	79	1
Trichilia hirta L.	monbin bata	broomstick	7	0
Zanthoxylum elephantiasis Macf.	piné jonn	prickly ash	1	0
Z. martinicense (Lam.) DC.	piné blan	Martinique prickly ash	17	0

* denotes an exotic or naturalized species

B. Seed orchards - A seed orchard is a plantation of genetically superior trees, isolated to reduce pollination from genetically inferior outside sources and intensively managed to produce frequent, abundant, and easily harvested seed crops (Fielberg and Soergaard, 1975). Each seed orchard contains progeny of superior parent trees, propagated either from seed (seedling seed orchard) or vegetatively (clonal seed orchard). The number of tree families represented in the orchards vary according to orchard and species, the goal being to maximize the degree of cross breeding among superior families, maintain sufficient genetic diversity for breeding purposes and multiply germplasm of high genetic and physiological quality.

Sixteen species were established in fifty-four orchards. These orchards are located at twelve sites in Haiti (**Figure 2**). A primary consideration in the establishment of the orchards was to locate the orchards on land owned by non-governmental organizations and individuals who have a positive record of providing services to the local communities and who are capable of a long-term commitment required of orchards. Anticipated demand for improved seed and risks, primarily associated with local management capabilities and uncertain site/species matching requirements, required that several orchards be established country-wide for each species.

An intensive effort was made to maintain adequate records of orchard establishment, maintenance interventions and measurement periods. These records and maps are contained under a separate file for each orchard site at the SECID office.

By the time several of the orchards were yielding seed in 1991, PADF and CARE began phasing out the containerized production of seedlings for which much of the anticipated demand for seed was targeted. Several of the seed orchards were harvested prior to the suspension of AFII in 1991.

C. **Progeny and Provenance Trials** - These trials are the proving grounds for the seed sources. Progeny trials are designed to detect differences among families for a given species in order to evaluate the genetic value of the superior tree selections and the adaptability of its progeny. Provenance trials test differences among populations that have evolved under selection pressures

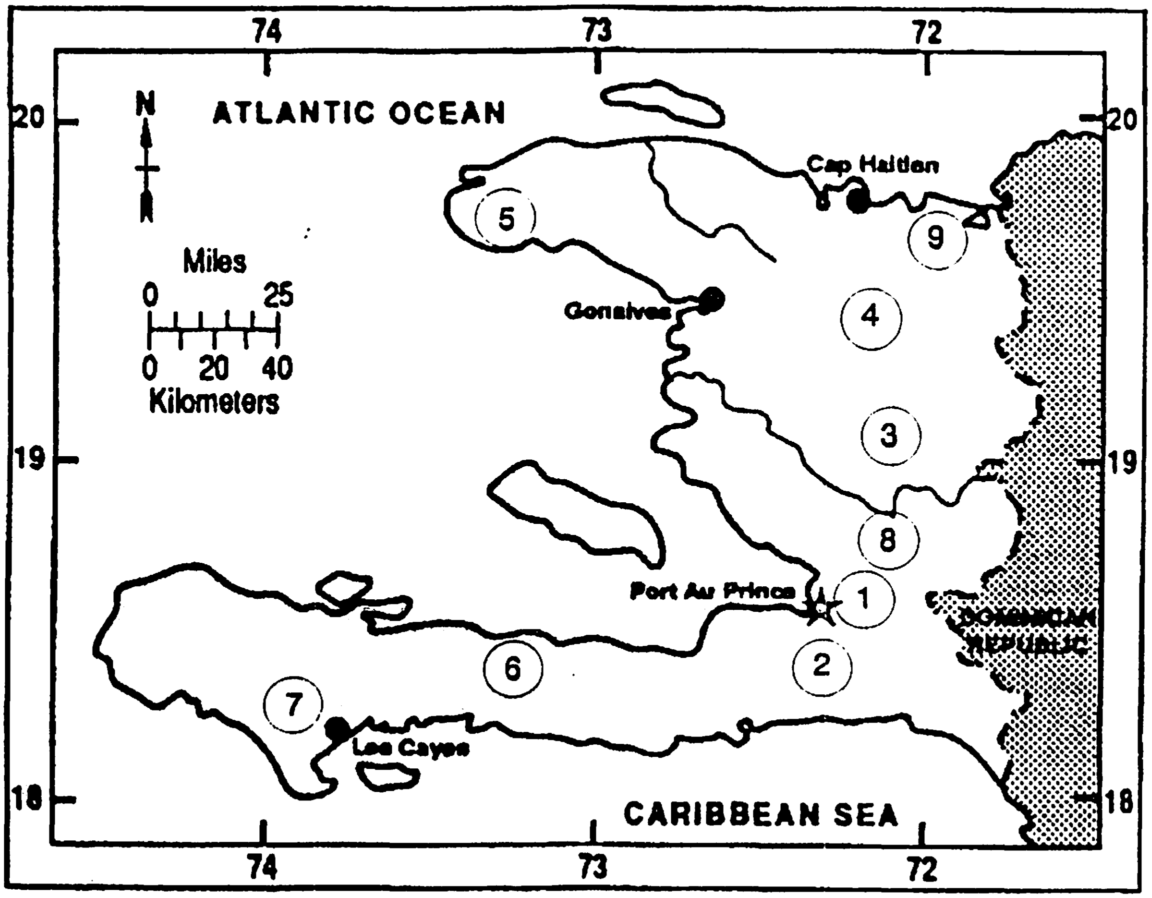


Figure 2. Seed orchard sites established in Haiti by IRG (1988-1989) and SECID/AU (1990-1991). 1 = Roche Blanche, 2 = Viard, 3 = Marmont and Sapatè, 4 = Lapila and La Jeune, 5 = Bombardopolis, 6 = Paillant, 7 = Laborde and Haut Camp, 8 = Mirebalais, 9 = Terrier Rouge.

unique to a given geographic region. For exotic species, it was imperative that the widest genetic base be introduced and evaluated to select that portion of the genetic make-up best adapted to local conditions. Prior to the project, this had not been done for several species that are wide-spread and utilized throughout Haiti (i.e., *Azadirachta indica*, *Cassia siamea*, *Gliricidia sepium* and *Leucaena leucocephala* subsp. *glabrata*). If properly managed and selectively thinned, the progeny and provenance trials themselves serve as a good source to make plus tree selections, broaden existing genetic bases and developed as improved stands for the production of seed.

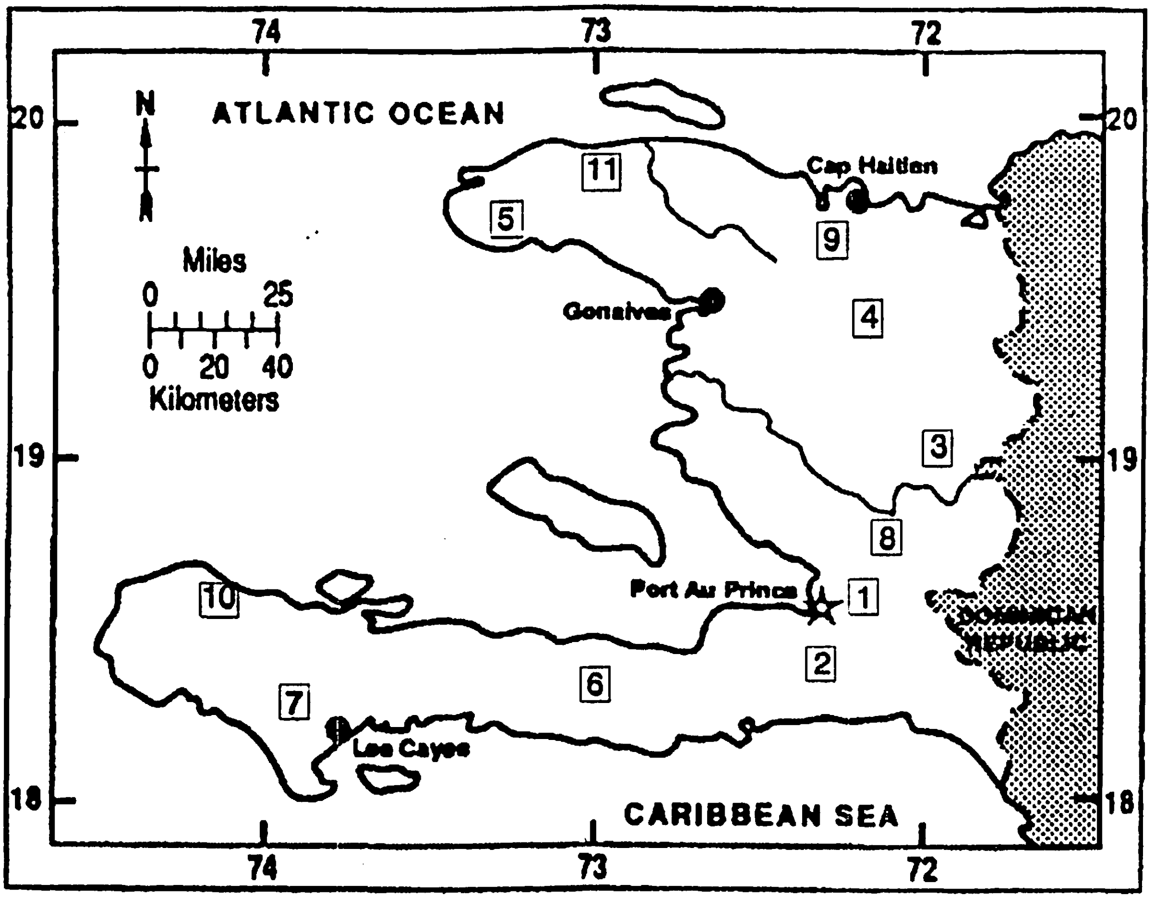


Figure 3. Progeny and provenance trial sites established in Haiti by IRG (1988-1989) and SECID/AU (1990-1991). 1 = Roche Blanche, 2 = Viard, 3 = Osedi, 4 = Lapila, 5 = Bombard, 6 = Labordette, 7 = Laborde, Bérault, Haut Camp and Pémel, 8 = Mirebalais, 9 = Crocra, 10 = Gélin and Prèvilé, 11 = Passe Catabois.

A network of progeny and provenance trials are located throughout Haiti (**Figure 3**). Fifty-two progeny and provenance trials were established for twenty-eight species. The evaluation of these trials provides the necessary information to rogue the seedling seed orchards (i.e., eliminate inferior families and provenances) and determine the best adapted seed sources. The top priority for selection is broad adaptability across sites.

The trials were scheduled to be measured at intervals corresponding to 6, 12, 36 and 60 months from their establishment date. As a result of project suspension by USAID and current re-orientation procedures of the AFII/PLUS transition period, this measurement schedule was altered. Parameters at 6 and 12 months included vertical height growth, stem length and a score for observed damage; stem diameter at 1.3 meters above ground was included in the measurements at 36 months. A report for each of the measurement periods included a statistical summary sheet of survival and height growth by family or provenance, as well as a damage report. Statistical summaries and damage reports, arranged by species and site for each of the measurement periods, are located at the SECID office.

D. Arboreta - Arboreta contain a wide diversity of tree species for exhibition and study. The largest arboretum in Haiti established during the AOP and AFII is the old Cazeau site of the Operation Double Harvest nursery. Over 120 exotic and native tree species were established during 1981 - 1989 with a majority of the species being represented by several provenances. Improved stands for seed production, comprising of second and third generation selections, were established by Double Harvest for *Leucaena diversifolia*, *Cassia siamea*, *Eucalyptus camaldulensis*, *Azadirachta indica*, and *Casuarina equisetifolia*.

The arboreta established by SECID (**Figure 4**) followed a completely randomized design, each species planted as a single tree and replicated 20 - 30 times. Theoretically, the species have equal chance of growing adjacent to each other. These arboreta are host to many uncommon native tree species (e.g., *Manilkara zapota*, *Attalea crassispatha*, *Zanthoxylum elephantiasis*) as well as new introductions to Haiti (e.g., *Pterocarpus macrocarpa*, *Terminalia ivorensis*, *Tabebuia heterophylla*, *Toona ciliata*).

E. Tree Seed Research - Research to improve local seed handling procedures was conducted during 1988-1991 at the PADF Seed Center. A review of seed testing, storage and distribution capabilities of the AOP were addressed by Dr. Jack Vozzo, Mississippi State University, during

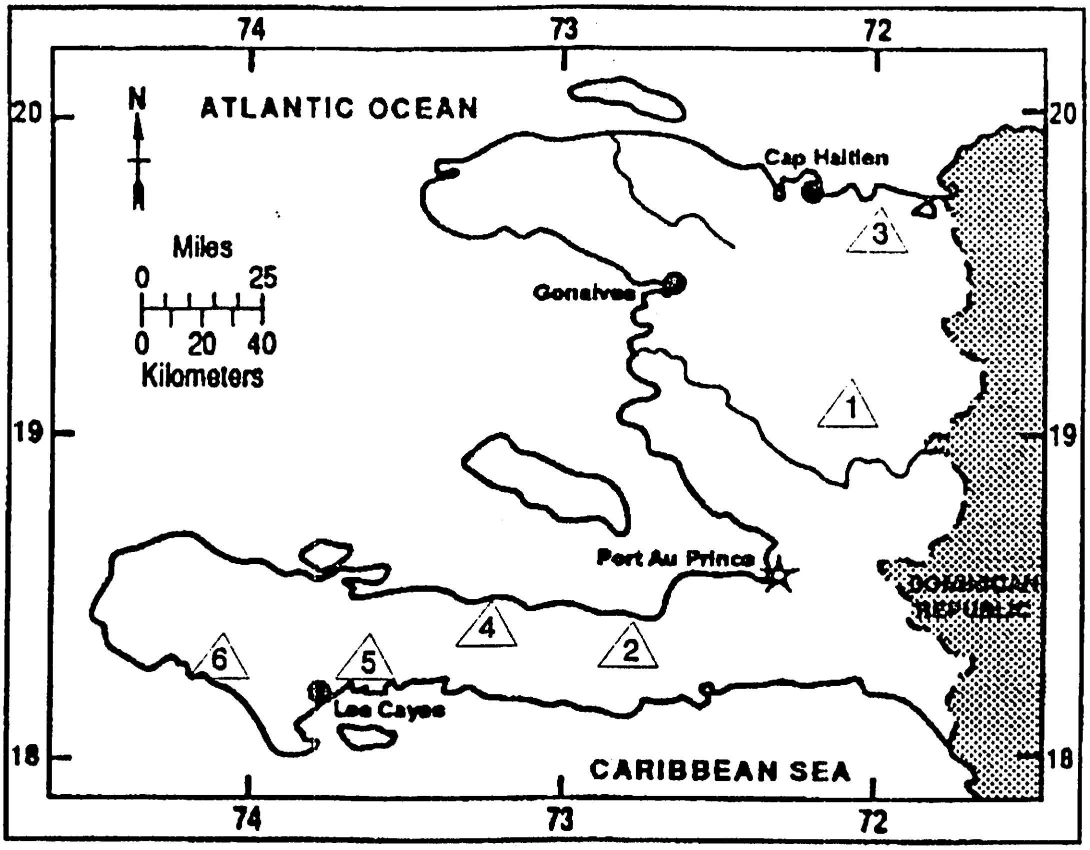


Figure 4. Arboreta sites established in Haiti 1990-1991 by SECID/AU. 1 = Marmont, 2 = Fauché, 3 = Terrier Rouge, 4 = Paillant, 5 = Sudre, 6 = Grande Plaine.

a consultancy in 1988 (Vozzo, 1988). Laboratory research focused on germination problems of *Simarouba glauca* var. *latifolia* (Timyan and Vaval, 1993), seed maturity problems of *Colubrina arborescens* and storage factors controlling the longevity of *Catalpa longissima* and *Azadirachta indica*. Field research has investigated the regional differences that exist in peak fruiting periods and seed physiological quality of selected tree species. Research in AFII has led to improved methods of seed collection, storage and germination, enabling PADF and CARE to strengthen their role in seed distribution.

F. Collaboration with International Research Institutions - A number of institutions prominent in tropical forestry and biodiversity have collaborated in Haiti with the USAID AOP and AFII

Seed and Germplasm Improvement project. Important among these research efforts has been:

1) the study of the native palms of Haiti with the World Wildlife Fund and the New York Botanical Gardens (Henderson et al., 1991; Timyan and Reep, in press), **Contact:** Dr. Andrew Henderson or Dr. Michael Balick;

2) the evaluation of wood biomass yields of Central American fuelwood species with Oxford Forestry Institute (Stewart et al, 1992), **Contact:** Ms. Janet Stewart or Mr. Colin Hughes;

3) the *ex situ* conservation of endangered Haitian palms, notably *Attalea crassispatha* and *Pseudophoenix lediniana*, with Fairchild Tropical Gardens, **Contact:** Mr. Charles Hubbuch;

4) the research of azadirachtin quality in neem (*Azadirachta indica*) with W.R. Grace & Co., **Contact:** Dr. James Walter; and the genetic variation in neem seed yield and azadirachtin content, including the establishment of a progeny/provenance trial of *Azadirachta indica* with Agridyne (formerly Native Plants, Inc.), **Contact:** Mr. Brian Moss;

5) the storage of *Azadirachta indica* and *Swietenia* spp. seed with Royal Botanic Gardens, Kew, England, **Contact:** Dr. Paul Tompsett;

6) the evaluation of *Gliricidia sepium* provenances for biomass production in an alley cropping design, with Oxford Forestry Institute, **Contact:** Dr. A.J. Simons;

7) the evaluation of *Swietenia mahogani* x *S. macrophylla* hybrid and other important forestry species from Puerto Rico with the Institute of Tropical Forestry, **Contact:** Mr. John Francis or Mr. Alfredo Rodriguez;

8) the evaluation of *Leucaena* spp. with Nitrogen Fixing Tree Association and Oxford Forestry Institute, **Contact:** Dr. James Brewbaker or Mr. Colin Hughes;

9) the evaluation of lethal yellowing of coconuts with USDA Sub-tropical Research Station, Miami (Theobald, 1989), **Contact:** Mr. William Theobald

IV. STATUS OF CURRENT ORCHARDS AND TREE IMPROVEMENT TRIALS

A. SEED ORCHARDS

1. General Observations

1.1 The relationship between SECID and the orchard owners has been on a matching basis. The orchard owners provide the land, security and supervision; SECID provides technical management, establishment costs and a varying amount of running maintenance costs. The trees are the property of the owner, though the orchard was established and maintained under the technical supervision of SECID.

The orchard owners are to be commended for the support and management costs incurred since September, 1991 when SECID basically terminated field activities. This attests to their commitment and die-hard attitude that is necessary if tree improvement and the seed orchards will ever survive in Haiti.

1.2 All seed orchards were visited during the months of November and December, 1992 to determine their status. The *Gliricidia sepium* clonal seed orchard at Lapila was measured at this time, being the first time that a survival assessment had been made since establishment in May, 1991.

1.3 Several seed orchards of *Acacia auriculiformis*, *Leucaena* spp., *Catalpa longissima*, *Colubrina arborescens* and *Lysiloma sabicu* are yielding seed at this time. Most of the orchards are not in production, though they should be prior to the end of 1994. It is likely that most of the orchards containing the following species **will not** produce seed within the next 2 years: *Simarouba berteroana*, *S. glauca*, *Swietenia mahogani*, *S. mahogani* x *S. macrophylla* hybrid, *Calophyllum calaba* and *Grevillea robusta*. The project should realize how fortunate it is to have so many orchards producing seed in 2-4 years. Most high value trees in forestry do not.

To what extent these orchards can provide the seed demand of PLUS should be a priority of the project to determine. None of the orchards have been rogued (eliminated of the inferior families).

1.4 A number of orchards are approaching or already past the stage of stand development that requires roguing. The orchard owners have rightly withheld from executing any thinning themselves. They are relying on SECID to provide them with the correct procedures and technical information. However, the lack of management supervision by SECID for the past 12 months has meant that timely silvicultural interventions have not been implemented. Crown closure of the orchard diminishes seed production and selected trees within the stand do not develop to their potential. Furthermore, the absence of regular site visits and management interventions implies abandonment of the orchards by the project. Over time, these factors will negate whatever past investments have been made and the orchards will gradually deteriorate. PLUS is at a critical stage to send a positive signal to the orchard owners that their collaborative efforts are not being wasted.

1.5 The younger orchards established in 1991 and some of the older orchards on poorer sites are vulnerable to severe weed competition and have suffered neglect. This is particularly critical for the important provenance-wide *Acacia auriculiformis* orchards, the *Grevillea robusta* orchard at Viard (with the progeny of 23 superior trees selected by CSIRO in Australia) and the *Gliricidia sepium* clonal orchard at Lapila. If no intervention occurs by PLUS in 1993, it is likely that several of the 1991 orchards will be lost.

1.6 In addition to the termination of supervisory and management responsibilities, the regular schedule of measurements has been suspended. This may not be important if the species and families in the orchards are represented at other sites by progeny and provenance trials. However, it is critical for those families and provenances that are established only in the seed orchards.

2. Status of the Seed Orchards

The orchards, as they are currently performing across sites, may be classified in four major categories. The top orchards are characterized by adequate supervision by the local orchard owner and a successful match between species and site. The latter is indicated by a rough measure: a minimum height increment of 1 meter/year for the timber species and 2 meter/year for the faster growing fuelwood, polewood and hedgerow (or living fence) species. These thresholds appear to be necessary in order for such hardwood species to be considered seriously by the Haitian farmer. It is assumed that these minimal growth rates, during the first 5 years from establishment, are similar for the adequate production of seed.

Several orchards are adequately maintained, but lack the right match between species and site conditions. It was particularly difficult to evaluate the younger orchards, since many of them could change dramatically in growth and vigor over the next few years or were inadequately weeded resulting in problems assessing survival and growth. Caution is reserved in making a judgement call at this early stage for many of the young orchards.

The orchards were assigned to one of four categories as follows:

Category	Criteria
1a	Orchard in good or excellent shape; height growth averaging 1 meter or more per year for timber species[1] and 2 meters or more per year for fuelwood, polewood or hedgerow species[2]. Supported by progeny or provenance trial information for cross site evaluation and roguing.
1b	Same as Category 1a, but lacking evaluative support of genetic trials on other sites in Haiti.
2a	Orchards in fair or good shape; height growth under 1 meter per year for timber species and 2 meters per year for polewood, fuelwood or hedgerow species. Supported by progeny/provenance trials for evaluation and roguing for cross site evaluation and roguing purposes.
2b	Same as Category 2a, but lacking support of genetic trials on other sites in Haiti.
3	Orchards in vulnerable condition and will be eliminated if no further management.
4	Orchards eliminated as a result of off-site conditions, poor management or neglect.

Table 2 is a summary of the status of the orchards, each orchard being assigned to 1 of 4 major categories. These categories can be used as a rough method to rank the importance of

---

[1] Timber species: *Calophyllum calaba*, *Catalpa longissima*, *Cedrela odorata*, *Colubrina arborescens*, *Cordia alliodora*, *Grevillea robusta*, *Lysiloma sabicu*, *Simarouba berteroana*, *S. glauca*, *Swietenia mahogani*, *S. macrophylla*, *S. mahogani* x *S. macrophylla* hybrid

[2] Polewood, fuelwood or hedgerow species: *Acacia auriculiformis*, *Cassia siamea*, *Eucalyptus camaldulensis*, *Gliricidia sepium*, *Leucaena leucocephala* subsp. *glabrata*, *L. diversifolia* x *L. leucocephala* hybrid

the orchards as they are related to overall vigor for each species. However, it should be recognized that the orchards, particularly the younger trials, could switch categories depending on a number of factors such as changes in growth rate and management. Those orchards falling in the first category are the better orchards, not in design, but in terms of species/site matching, site fertility and backstop management provided by the landowner. The orchards, together with the progeny and provenance trials and arboreta are ranked in ANNEX 2 for each of the major species. This is a preliminary ranking of the seed orchards and trials in terms of genetic diversity and potential for germplasm improvement.

Table 2. Status summary of AFII/PLUS seed orchards in Haiti.

LOCATION	DATE EST.	SPECIES	NO. OF FAM.	NO. OF PROV.	MOST CURRENT STATISTICS (months)	YIELDING SEED
			CATEGORY 1a			
Roche Blanche	Oct 88	*Catalpa longissima*	56		36	Yes
" "	Oct 88	*Colubrina arborescens*	27		36	Yes
" "	Oct 89	*Simarouba glauca*	20		36	Yes
" "	Oct 89	*Simarouba berteroana*	4		36	Yes
Mirebalais	Oct 89	*Lysiloma sabicu*	13		36	Yes
Marmont	Aug 90	*Colubrina arborescens*	18		12	Yes
Lapila	May 91	*Gliricidia sepium*	100		19	Yes
Bombard	Oct 89	*S. glauca*	10		41	No
			CATEGORY 1b			
Bombard	Jun 89	*Leucaena diversifolia* subsp. *diversifolia* (K156)	1		12	Yes
Laborde	Apr 91	*Simarouba berteroana*	5		12	No
La Jeune	Jul 91	*Simarouba glauca*	10		12	No
Roche Blanche	Nov 88	*Leucaena leucocephala* subsp. *glabrata* (K636 & K584)	2		12	Yes
" "	Nov 88	*L. diversifolia* x *L. leucocephala* KX3	1		12	Yes
" "	Sep 90	*Swietenia mahogani*	7		12	No
" "	Sep 90	*S. macrophylla*	4		12	No
" "	Sep 90	*Swietenia mahogani* x *S. macrophylla* hybrid	3		12	No
Marmont	Aug 90	*Acacia auriculiformis*	8		12	Yes
"	Aug 90	*Cassia siamea*	13		12	Yes
"	Aug 90	*Swietenia mahogani*	8		12	No

Table 2 (cont.).

LOCATION	DATE EST.	SPECIES	NO. OF FAM.	NO. OF PROV.	MOST CURRENT STATISTICS (months)	YIELDING SEED
			CATEGORY 1b			
Marmont	Aug 90	*S. macrophylla*	3		12	No
"	Aug 90	*S. mahogani* x *S. macrophylla* hybrid	1		12	No
"	Aug 90	*Eucalyptus camaldulensis*	3		12	Yes
"	Aug 90	*Lysiloma sabicu*	10		12	No
			CATEGORY 2a			
Haut Camp	Mar 89	*Simarouba glauca*	9		36	No
" "	Mar 89	*Catalpa longissima*	25		36	No
" "	Mar 89	*Colubrina arborescens*	8		36	Yes
Marmont	Aug 90	*Catalpa longissima*	21		12	No
Viard	Apr 91	*Grevillea robusta*	23		--	No
			CATEGORY 2b			
Marmont	Aug 90	*Calophyllum calaba*	5		12	No
"	Aug 90	*Cordia alliodora*	3		12	No
Laborde	Apr 91	*Acacia auriculiformis*	5	10	12	No
"	Apr 91	*Simarouba glauca*	10		12	No
Terrier Rouge	Nov 90	*Catalpa longissima*	22		6	No
			CATEGORY 3			
Laborde	Apr 91	*Calophyllum calaba*	6		12	No
"	Apr 91	*Colubrina arborescens*	9		12	No
La Jeune	Jul 91	*Catalpa longissima*	20		--	No
Lapila	May 91	*Acacia auriculiformis*	5	10	--	No
Sapate	May 91	*Acacia auriculiformis*	5	10	--	No
Paillant	Apr 91	*Calophyllum calaba*	4		--	No
"	Apr 91	*Colubrina arborescens*	7		--	No
"	Apr 91	*Simarouba glauca*	11		--	No
"	Apr 91	*Simarouba berteroana*	3		--	No
Terrier Rouge	Nov 90	*Acacia auriculiformis*	5		--	No
" "	Nov 90	*Simarouba berteroana*	5		--	No
			CATEGORY 4			
Bérault	Apr 90	*Catalpa longissima*	18		12	No
Marmont	Aug 90	*Cedrela odorata*	4	2	12	No
Paillant	Apr 91	*Catalpa longissima*	21		--	No
Terrier Rouge	Nov 90	*Cassia siamea*	4		6	No
" "	Nov 90	*Simarouba glauca*	12		6	No
" "	Nov 90	*Colubrina arborescens*	9		6	No
" "	Nov 90	*Lysiloma sabicu*	9		6	No

3. Recommendations for Seed Orchards

3.1 PLUS should continue an active role in supervising the proper management procedures of the major seed orchard sites in Haiti. No other tree seed orchards exist in Haiti to the knowledge of the author. The opportunity of fully utilizing the orchards for which they were designed should not be wasted. Consideration of the following benefits in maintaining and improving the orchards favors continued investment:

1) Orchards conserve a broad genetic base that preserves a gene pool for future breeding purposes and integrate elements of biodiversity with the development goals of USAID (1985b)

2) Orchards ensure a reliable local supply of high-quality germplasm, diminishing Haiti's dependency on foreign germplasm sources that are frequently unadapted to conditions of the hillside farmer;

3) Orchards improve on-farm productivity by genetic gains made from the selection of superior genotypes and increased vigor resulting from a broader genetic base;

4) Orchards conserve foreign exchange that would otherwise be spent abroad;

5) Orchards invest in the future capacity of Haiti to export.

3.2 SECID should continue its role as the country-wide coordinator of seed orchard management. This includes the continual upgrading of the orchards, roguing (eliminating inferior families), monitoring fruiting cycles, selective thinning to maximize seed production and maintenance of an orchard database that includes progeny and provenance information and a history of the orchard interventions. The host of private volunteer organizations and individuals who own the orchards do not have the expertise required to make selections for breeding purposes. SECID is in a position to assess the progeny data and rogue the orchards according to the technical protocols that have been developed for the past several years. The orchard is little more than another stand of trees if proper tree improvement techniques are not executed in timely fashion. SECID should expedite orchard information to PADF and CARE for proper seed procurement decisions. Estimates on the quantity of available seed and the timing of peak harvests by species should be a priority of SECID to seed handling schedules of PADF and CARE.

3.3 The series of seed orchards should not be expanded prior to careful consideration of the future role that the current orchards will play vis-a-vis the demand-driven, sustainable interventions that are being encouraged by PLUS. Orchards should function as an integral part of the natural resource management portfolio of USAID. In order for the orchards and their associated progeny trials to be managed properly, a continued level of investment by USAID is necessary. However, there is little sense in continuing this support if the orchards are on the same historical road as the containerized nurseries of the AOP and AFII era. For reasons elaborated above, the orchards, if managed properly, play an important role in maximizing the productive potential of germplasm utilized by the Haitian farmers, now and in the future.

3.4 PADF and CARE should determine the demand by farmers for tree germplasm and develop a strategy that incorporates the supply from improved sources. It cannot be over-emphasized that PADF and CARE should utilize the seed orchards (and other improved local sources) before resorting to untested foreign sources, particularly international seed brokers, or local seed contractors that generally collect from unselected sources and often do not consider the genetic quality of their seed. (International seed brokers do not generally sell top quality tree seed nor do they know what performs best in Haiti. No matter what the price, seed from brokers is generally not certified).

For species such as *Leucaena leucocephala* subsp. *glabrata* or *L. diversifolia* subsp. *diversifolia* that may outcross with the local *delin* (*L. leucocephala* subsp. *leucocephala*), the only way to guarantee purity, is to collect from isolated stands such as the orchard at Roche Blanche or the second and third generation improved stands at Cazeau. Otherwise, the genetic quality of the giant leucaena may degenerate over several generations.

In order to better manage the logistical constraints of providing locally available germplasm to regional targets, it is recommended that a committee be set up among PADF, CARE and SECID that meets regularly to discuss germplasm needs, regional deficiencies and programming constraints. The extra effort to integrate the improved sources into the extension system should be handled carefully from the start. A professional business commitment to the orchard owners is essential if PLUS expects their full cooperation. It is recommended that PADF and CARE express a commitment to the orchard owners by negotiating the price of orchard seed and settling on a seed contract well in advance of seed harvest.

It's been the author's experience that seed is wasted in local nurseries. A fee for seed coupled with an increased awareness at the community level may decrease this waste; the project cannot afford to waste improved germplasm.

3.5 The measurement schedule for major orchards in Categories 1 - 3 (Table 1) should be

resumed immediately. This is particularly critical for categories 1b, 2b and 3, since these orchards are the sole source of information we have to rely on for evaluation of family and provenance performance in Haiti.

3.6 **The older orchards, established in 1988 and 1989, should be rogued to advance their status to the next stage of genetic improvement.** In general, the sequence of silvicultural interventions follow the same development process for all orchards. The responsibility of implementing the process of roguing should rest with SECID, since the data analyses and trial information required to eliminate inferior families or provenances is well underway. The actual thinning of trees takes a few hours; the data analyses necessary to make the selection requires expertise and careful statistical interpretation of the progeny and provenance trials. The orchards and the trials cannot be disassociated and must be managed in tandem. A management protocol for the orchards should be drafted and approved by PADF and CARE.

3.7 **The orchards should be viewed as an investment in Haiti's future, rather than as another subsidy to the Haitian farmer.** The functions of the seed orchard cannot be substituted by resources available to the average Haitian farmer. They function as a public good, managed and owned by non-government organizations and individuals with a proven track record of providing services to the local communities. Orchards play a critical role in preserving a local gene pool and halting the genetic erosion that is taking place in Haiti. In fact, the seed orchards in Haiti should be recognized and promoted throughout the Caribbean for the potential of exporting commercial quantities of improved tree seed. USAID/Haiti should facilitate this by communicating to other USAID missions and international organizations involved in tropical forestry and agroforestry.

B. PROGENY AND PROVENANCE TRIALS

1. General Observations

1.1 All progeny trials, except those at the Gélin and Prèvilé sites, were visited in November and December, 1992. The trial at Bombard for *Colubrina arborescens* and the trials at Lapila for *Simarouba glauca*, *S. berteroana*, *Colubrina arborescens*, *Cedrela odorata*, *Cassia siamea* and *Lysiloma sabicu* were measured for 36 months.

1.2 The critical issue at this time is whether the trials will be used for the purposes for which they were designed. **"Most field trials established in the tropics never produce the information that was originally intended" (Dvorak, 1989).** It is a simple procedure to decide which trials to keep and which to discard on the basis of meaningful data. However, if the information produced will not be utilized or is of questionable value, it is useless to continue investing sums of money to keep them going.

1.3 Significant differences in productivity and vigor among genotypes have been observed for the majority of the tree species selected in the progeny and provenance trials. However, the Haitian farmer will not be able to benefit from the genetic gains if continuity is not maintained in tree improvement efforts. Without a continued forward thrust in selection processes, PADF and CARE personnel in charge of seed procurement will not know what seed lot is best adapted for local conditions. There is an obvious potential for distributing poorly adapted, low-quality tree germplasm.

1.4 A greater proportion of progeny and provenance trials, as compared to the orchards, are located on typical garden sites. In general, these trials suffer from greater damage and irregularities associated with traditional agricultural activities of the small farmer (e.g., planting across replications, following portions within the trial, rotating garden owners unaware of the trial, etc.) Several trials have been eliminated **(Category 3 in Table 3)** from field data collection. Results from such trials may be misinterpreted or fail to detect differences due to the inflated value of the error terms. It is of greater concern then that the orchards be measured regularly, since they must serve simultaneously as progeny tests of the superior tree selections.

1.5 Several of the mature progeny and provenance trials established in 1989 are ready to be evaluated and rogued or selectively thinned. None of the trial evaluations have been completed, the process being interrupted by the suspension of the project in 1991. This is a necessary step in order to advance to the second stage of improving tree germplasm in Haiti. **This stage of the process has never been executed for most of the tree species in Haiti and marks an important milestone in germplasm improvement.** The goal is to produce locally adapted germplasm and is accomplished by roguing the seed orchards, distributing cutting material to regions in Haiti lacking quality germplasm for the species considered and converting the trials to improved sources of germplasm.

1.6 As in the case of the orchards, regular measurement schedules have been suspended. It is an important fact that the progeny and provenance trials can **no longer be compared on an equal age basis.** Time is a critical element in the choice of trees as a crop. It determines whether a given species (or provenance or family) is considered from an economic perspective.

If the genetic lines cannot be compared across sites on an equal age basis, then an added source of error (i.e., the age dependent variable of tree growth) is introduced, complicating procedures that are already difficult enough. This decreases the potential of detecting differences among families and provenances based on the criteria of broad adaptability.

2. **Status of Progeny and Provenance Trials**

The status of the progeny trials can be sorted into similar categories as with the orchards based on general growth and vigor. However, many of the trials exhibiting fine growth have been compromised or damaged to the extent that the experimental design is no longer valid. Many of the trials that lack such statistical integrity still offer excellent opportunities to make second generation selections of superior phenotypes.

The progeny and provenance trials have been divided into the following major categories:

1 - Trials in good or excellent shape; height growth averaging 1 meter or more per year for timber species and 2 meters or more per year for fuelwood, polewood or hedgerow species.

2 - Trials in poor or fair shape; height growth under 1 meter per year for timber species and 2 meters per year for fuelwood, polewood or hedgerow species.

3a - Trials eliminated from measurements as a result of lacking statistical integrity. Should be rogued for mass selection of superior phenotypes.

3b - Trials eliminated from measurements as a result of off-site conditions or very poor survival. Should be observed for superior phenotypes for second generation selection.

Table 3 summarizes the status of the progeny trials. As with the orchards, the younger trials could switch categories depending on changes in growth rates, management status of the landowner and other factors that influence tree development. The timber species are distinguished from the fuelwood, polewood and hedgerow (including living fences) species as with the seed orchards.

Table 3. Status summary of AFII/PLUS progeny and provenance trials in Haiti.

LOCATION	EST. DATE	SPECIES	TRIAL TYPE	NO. OF FAMILIES	NO. OF PROV.	MOST CURRENT STATISTICS (months)	YIELDING SEED
			CATEGORY 1				
Barbe Pangnol	Oct 88	*Gliricidia sepium*	provenance		20	28	No
Bérault	Apr 89	*Cordia alliodora*	provenance		5	36	Yes
Bombardopolis	Jun 89	*Colubrina arborescens*	progeny	9		41	Yes
"	Jun 89	*Cassia siamea*	provenance			41	Yes
"	Oct 88	*Gliricidia sepium*	provenance		22	34	Yes
Gélin	Oct 88	*Catalpa longissima*	progeny	8		12	Yes
"	Oct 88	*Simarouba glauca*	progeny	8		12	No
"	Oct 88	*Colubrina arborescens*	progeny	8		12	Yes
Laborde	Mar 89	*Catalpa longissima*	progeny	13		36	Yes
"	Mar 89	*Cedrela odorata*	provenance		10	36	No
Lapila	May 89	*Colubrina arborescens*	progeny	9		42	Yes
"	May 89	*Simarouba glauca*	progeny	7		42	No
"	May 89	*Cassia siamea*	provenance		7	42	Yes
Mirebalais	Apr 89	*Cassia siamea*	provenance		8	36	Yes
Pémel	May 89	*Cordia alliodora*	provenance		4	36	Yes
"	May 89	*Enterlobium cyclocarpum*	provenance		4	12	No
Roche Blanche	Mar 89	*Cordia alliodora*	provenance		6	36	Yes
" "	Mar 89	*Cassia siamea*	provenance		10	36	Yes
			CATEGORY 2				
Bombard	Jun 89	*Cedrela odorata*	prog/prov	1	8	41	No
Crocra	Nov 89	*Catalpa longissima*	progeny	8		12	Yes
"	Nov 89	*Lysiloma sabicu*	progeny	8		12	No
"	Nov 89	*Cassia siamea*	prog/prov	3	2	12	No
Haut Camp	Mar 89	*Cassia siamea*	provenance		5	36	No
Lapila	May 89	*Leucaena* spp.	spp/varietal		6	12	Yes
"	May 89	*Acacia auriculiformis*	provenance		5	12	Yes
"	Oct 89	*Lysiloma sabicu*	prog/prov	15	1	36	Yes
"	Oct 89	*Simarouba berteroana*	prog/prov	4	1	36	No
"	Oct 89	*S. glauca*	progeny	18		36	No
Nan Marron	Jun 89	*Acacia auriculiformis*	provenance		5	12	Yes
" "	Jun 89	*Leucaena* spp.	spp/varietal		6	12	Yes
Paillant	May 91	*Grevillea robusta*	prog/prov	30	4	--	No
Passe Catabois	Nov 90	*Lysiloma sabicu*	progeny	14		12	No
Prèvilé	Nov 88	*Catalpa longissima*	progeny	3		12	No
"	Nov 88	*Simarouba glauca*	progeny	3		12	No
Previle	Nov 88	*Colubrina arborescens*	progeny	3		12	Yes
Roche Blanche	Jul 91	*Azadirachta indica*	provenance		14	6	No
Viard	May 89	*Pinus* spp.	spp/provenance		28	36	No
"	May 89	*Cupressus* spp.	spp/provenance		2	36	No

Table 3 (cont.).

LOCATION	EST. DATE	SPECIES	TRIAL TYPE	NO. OF FAMILIES	NO. OF PROV.	MOST CURRENT STATISTICS (months)	YIELDING SEED
			CATEGORY 3a				
Bérault	Apr 89	*Cedrela odorata*	provenance	8		36	No
Bombard	Jun 89	*Catalpa longissima*	progeny	16		12	No
"	Jun 89	*Acacia auriculiformis*	provenance		5	12	Yes
Lapila	Aug 91	*Acacia auriculiformis*	prog/pro	10	8	--	No
"	May 89	*Catalpa longissima*	progeny	23		12	Yes
"	May 89	*Enterlobium cyclocarpum*	provenance		3	12	No
"	Oct 89	*Cedrela odorata*	prog/pro	2	6	36	Yes
			CATEGORY 3b				
Kalompré	Mar 90	*Colubrina arborescens*	progeny	20		12	No
"	Mar 90	*Catalpa longissima*	progeny	20		12	No
Madame Si	Jun 90	*Catalpa longissima*	progeny	20		--	No
"	Jun 90	*Colubrina arborescens*	progeny	20		--	No
Osedi	May 90	*Catalpa longissima*	progeny	18		--	No
"	May 90	*Colubrina arborescens*	progeny	18		--	No
Passe Catabois	Jul 90	*Catalpa longissima*	progeny	21		--	No

3. Progeny/provenance Trial Recommendations

3.1 The progeny and provenance trials that are approaching half their rotation age (i.e., half the time to reach merchantable age) should be evaluated and converted to improved seed sources. The evaluation of the progeny and provenance trials is a fundamental step in correctly managing the orchards. The trials test the genetic worth of the tree families and provenances in the orchards. The priority is to evaluate the trials in categories 1 and 2 of Table 2, which require assessment at 3 and 5 years. This does not include the two provenance trials of *Gliricidia sepium* that have been harvested for a preliminary assessment and should be assessed at 6 years for a final evaluation.

The primary objective of evaluating the genetic tests is to gain information necessary to manage the orchards as a source of improved seed. A secondary objective is to improve the progeny or provenance trials as a source of seed. The seed orchards are designed to yield seed of broadly adapted genotypes whereas the progeny trials, after culling the inferior families and individuals, should yield seed better adapted to local conditions. The provenance trials require the elimination of those provenances poorly adapted across sites to avoid breeding with the top performing provenances. Seed should not be collected from the trials, especially the provenance trials of the exotic species, until the trials have been rogued of inferior genotypes. A suggestedmethodology is provided in ANNEX 1.

For several species, the most significant contribution that PLUS can make is at the provenance level of selection, particularly for the exotics. The majority of the screening trials (mostly species trials) have failed the Haitian farmer for a multitude of reasons: the genetic base of the species was poorly sampled in the test, the trials were not managed and measured long enough or the results were never understood in a way that made market sense to the farmer.

3.2 Measuring the major progeny and provenance trials should resume immediately according to schedule so that the data from different sites can be compared on an equivalent age basis and rigorous economic estimates can be adjusted for regional differences. Since many of the genetic tests are located on sites typical of those farmed in Haiti, this is one of the better opportunities for SECID to evaluate the economic worth of the species measured. The closer the trial is to the actual rotation age of the species (i.e., the age that the species is normally harvested to maximize returns on investment), the more valuable and accurate the data are for both genetic and economic evaluation.

3.3 All progeny and provenance trial results should be published in the order of species importance determined by PADF and CARE. These may or may not be the same species that were important during the period of the AOP and AFII. For example, *Gliricidia sepium* may be determined to be more important from the standpoint of sustainability than *Cassia siamea*. Documentation of the results for the *Gliricidia sepium* trials would take precedent. Statistically valid conclusions should be documented to minimize costly mistakes in seed procurement by PADF and CARE, maintain progress in tree improvement and avoid the tendency to " go back to square one" in terms of what works in Haiti. If not, the chances are good that the benefits of genetic gain and better adapted germplasm will never reach the Haitian farmer now or in the future. One of the major goals of the project would never be realized.

3.4 Vegetative techniques should be used to propagate and distribute superior genotypes of certain species. This is appropriate for *Gliricidia sepium*, *Catalpa longissima*, *Cedrela odorata* and *Cordia alliodora*. Other species may fall in this category, but are yet determined at this time. Genetic gains can be doubled if vegetative propagation can be used instead of seeds (Dvorak, 1989).

Assessments at 3 years (for the faster growing polewood species) and 5 years (for the slower growing timber species) can be used to identify good individuals for the second generation of selection; such species as chenn (*Catalpa longissima*), sed (*Cedrela odorata*) and lila etranjè (*Gliricidia sepium*) are reproduced vegetatively to maximize gain. Selections of the 60 best trees in the best families or provenances should be made and branch cuttings collected to distribute to PADF and CARE communities.

Regions of the country are deficient for a certain species. Here lies an excellent opportunity to combine introduction with improvement by distributing improved vegetative material to qualified farmers selected by PADF and CARE. The vegetative material should come from superior families or provenances from individuals selected for thinning in the progeny and provenance trials. Distribution of improved germplasm is more costly than seed; however, the expected gains are worth the time and money. Innovative strategies involving community members are encouraged. Both propagation and delivery of germplasm for such species can be integrated into a training program or as part of an overall strategy to increase the germplasm quality of economically important species in a given region. Seed from second generation orchards should produce trees that are 20 to 40% more productive that what could be obtained from unimproved natural stands (Dvorak, 1989).

3.5 The neem provenance trial at Roche Blanche should be managed intensively and measured regularly. The role of neem in local pest management programs will no doubt increase in Haiti as in the rest of the world. An important consideration is the narrow genetic base of the adult population in Haiti. This should be expanded and improved not only for local use, but the possibility of increasing exports. Use of pesticides from local sources are certainly more sustainable for the Haitian farmer than expensive imported chemicals.

C. ARBORETA

1. General Observations

1.1 An arboretum is a useful means to introduce tree species into a region and increase local awareness of the diversity of useful tree species. It is also used as a preliminary study on the relative differences in survival and growth rate among species.

1.2 The arboreta contain a number of exotic tree species generally overlooked by the AOP and AFII as potential agroforestry candidates. These include *Derris indica*, *Pterocarpus macrocarpus*, *Toona ciliata*, *Leucaena salvadorensis*, *Tabebuia heterophylla*, *Albizia falcataria*, *Terminalia ivorensis* and others. Several of these appear promising.

1.3 Several native species in the arboreta are becoming rare in the Haitian landscape. These include fruit species (*Chrysophyllum cainito*, *Manilkara zapota*, and *Omphalea triandra*); palms (*Pseudophoenix lediniana*, *P. vinifera* and *Attalea crassispatha*), and shade/timber trees (*Licaria triandra*, *Trichilia hirta*, *Mastichodendron foetidissimum*, *Prunus occidentalis*). For many Haitian farmers, these arboreta may be the only chance to see these species.

1.4 Several of the arboreta are being managed in association with food crops. This affords SECID an opportunity to study the limitations of different species when cultivated with traditional agricultural methods. Naturally, the tree species are growing at differing rates and will require selective thinning to maintain species diversity. The contribution of arboreta, in terms of conservation biology and environmental education, is difficult to measure in economic terms. However, the differences in commercial and non-commercial benefits among species can be assessed at one site, providing an excellent opportunity for PLUS to analyze options available to the farmer.

2. Status of the arboreta

All the arboreta were visited with the exception of the Grand Plaine sites. Similar to the orchards and progeny/provenance trials, the arboreta are in varying stages of development depending on the site conditions and management intensity of the arboretum owner. The arboreta at Fauché and Marmont are particularly well managed. These two trials were measured at 12 months prior to the suspension of the project in 1991. The arboretum sites at Sudre and Paillant were established just prior to the suspension and have never been measured. The mortality appears to be higher due to the shallower soils, though they are too young to determine whether or not they will survive as arboreta. The arboretum at the agricultural school in Terrier Rouge is performing amazingly well considering the degree of summer drought common to this area. A summary of the arboreta is provided in **Table 4**.

Table 4. Summary of AFII/PLUS arboreta in Haiti.

LOCATION	OWNER	EST. DATE	NO. OF NATIVE SPECIES	NO. OF EXOTIC SPECIES	MOST CURRENT STATISTICS (months)
Marmont	Convention Baptiste d'Haiti	Aug 90	9	16	12
Fauché	Dr. A. Gattereau	Jul 90	14	6	12
Terrier Rouge	Center Agricole de St. Barnabas	Nov 90	7	16	6
Paillant	Mr. Jacques Deschamps	Apr 91	12	22	--
Sudre	Mr. Willy Delia	Sep 91	15	11	--
Grande Plaine	UNICORS	Sep 91	7	12	--

3. Recommendations

3.1 The arboreta should be measured during 1993/1994 to observe the survival and growth rates of the less common native species, the newly introduced exotics and the relative difference in growth rates among the agroforestry candidates. An analysis of survival and growth rates should be conducted at 2 or 3 years prior to a thinning that will be necessary to preserve species diversity. Such a thinning is required to avoid the faster growing species dominating the arboretum.

3.2 Seed should not be collected from the arboreta, except for experimental purposes. Various degrees of hybridization occur between species resulting in seed that is not pure and variable in field performance.

3.3 The arboreta should be incorporated as a learning tool in the environmental awareness programs of PADF and CARE.

V. PRIORITIES IN RESEARCH AND DEVELOPMENT OF GERMPLASM IMPROVEMENT DURING PLUS (1993-94)

An important element of sustainability is the preservation and improvement of the gene pool of tree species found useful by the hillside farmer. This must be a primary consideration prior to meeting the challenge of optimizing agricultural productivity and natural resource conservation. Furthermore, greater attention will be focused on the constraints of the farmer to become self-sufficient in seedling propagation, including sources of germplasm. The emphasis of the Project Paper on sustainable, demand-driven interventions challenges PLUS to take the lead by answering the following questions:

1) How will the supply and quality of germplasm be sustained?

2) What is the most appropriate on-farm propagation method for each species that takes advantage of improved genotypes given the limited resources available to the farmer?

3) What are the rational land-use alternatives that mix short-term benefits of cash cropping versus long-term benefits of tree cropping?

4) What are the appropriate tree species to meet market demands and how does the market influence the decision-making process of the farmer in species selection?

The focus of PLUS on sustainability forces difficult decisions to be made regarding tree improvement activities. Clearly, these activities are not sustainable if the necessary support and responsibility in achieving project goals rests solely within the scope of bi-lateral assistance. At the same time, given the level of past investment in the conservation and improvement of forest resources, it seems prudent to capitalize on the important milestones that have been accomplished and facilitate farmer access to these resources. The following roles and responsibilities of SECID and PADF/CARE are recommended.

A. SECID

1. Role and Responsibilities

1.1 Manage a current database of tree information, including improved tree germplasm sources for major species and evaluative field data. A critical link in the flow of information from tree improvement research to PADF and CARE extension activities is database management. The goal is to maintain an information base that is easily accessible and delivered in a format that is easy to understand. No germplasm project can afford to lose important information, such as seed origins or the field evaluations separating "winners" from "losers", if headway is to be made toward increasing on-farm productivity. Database management is a specialized job and increases the effectiveness of the SECID research unit. It is highly recommended that SECID hire a full-time database manager, responsible for the organization and storage of data and possessing the myriad of analytical skills required in meeting the information needs of PADF and CARE.

1.2 Supervise the management of the major seed orchard sites to maximize germplasm production capacities, including the roguing of seed orchards and upgrading the progeny and provenance trials by selective thinning.

1.3 Assess the major provenance and progeny trials at 3 and 5 years and select families or provenances for broad adaptability and economically important traits. This should identify the losers and be continually updated in a process to select the top performers across trial sites. Summary sheets (see **ANNEX 2**) for each species should be update periodically and contain significant, concise information pertaining to tree improvement. This information would be available for use by NGOs.

1.4 Coordinate within PLUS the necessary information for the efficient utilization of improved sources of tree seed, including peak fruiting seasons, quantities of available germplasm and recommendations based on evaluation of the major progeny and provenance trials. The flow of information should be facilitated by an ad hoc committee comprising PADF, CARE and SECID personnel that meets regularly. This committee would be responsible for planning germplasm procurement and handling and integrating research findings with extension oriented activities.

A partial summary of the SECID field activities associated with the management of the seed orchards and progeny/provenance trials is provided in ANNEX 3. The major tasks fall into the following categories: **Monitoring,** including interventions necessary to maximize improved seed production in the orchards and the management of the progeny/provenance trials; **Evaluation,** including mensuration, phenological observations of the germplasm trials and statistical analyses; **Experimentation** of on-farm propagation techniques and sources of germplasm; and **Documentation.** These activities concern specific trials and are presented to help prioritize the schedule of activities concerned with tree improvement. Once a strategy is formulated by the PLUS participants for 1993-1994, it will be necessary to adjust the schedule to complete the tasks. It does not include the administrative overhead nor the database requirements to support such activities. Estimated field costs associated with the implementation of activities are attached.

2. SECID Staffing Needs

2.1 M.S. Level Forester - There is an immediate need to fill the vacuum resulting from the elimination of the international staff position of the Seed and Germplasm Improvement Specialist. It is recommended that the position be filled by a locally hired candidate with the qualifications and scope of work as summarized in **ANNEX 4.** This is necessary to continue the management of seed orchards and progeny/provenance trials, evaluate the progeny and provenance trials, maintain the tree germplasm database and integrate activities with PADF/CARE.

2.2 **Field Assistants** - To minimize a loss of information, maintain a level of continuity and focus required in the meticulous data collecting tasks associated with the goals of germplasm improvement, SECID should maintain two of the former field staff familiar with the history of the orchard and provenance/progeny trial network. These two individuals have also mastered the basic methods in trial design, measurements and management associated with tree improvement research. The team of three would be responsible for the working data management and statistics required as a tool to manage the orchards and the genetic tests (e.g., key-punching, validation of data, analyses of variances). Delivery of information to meet PADF and CARE requests would be in coordination with the database manager.

2.3 **Short-term Consultants** - In addition, it is suggested that at least one short term consultant be hired in early 1993 to screen the qualifications of the recruit and verify the understandings among PADF, CARE and SECID as to the objectives and methods of tree germplasm improvement. Further along in 1993 and 1994, it is suggested that short-term consultants experienced in tropical tree improvement methodologies, seed orchard management, and low-input propagation techniques be employed periodically to ensure that international standards of improved seed production are met, that the germplasm team is expedient in meeting the germplasm research needs of PADF and CARE and to re-define roles and responsibilities as

PLUS evolves.

B. PADF and CARE

1. Roles and Responsibilities

1.1 Encourage the appropriate match of on-farm propagation and tree management techniques with species. The distribution of improved germplasm will have a greater impact if coupled with simple, low-input techniques appropriate for each tree species and the necessary silvicultural interventions required to maximize economic profit. Innovative propagation methods that increase survival and decrease establishment costs have been observed often enough by the author to indicate these methods are practical and in use already. The knowledge of selected farmers that practice sustainable methods of tree cultivation should be explored by PADF and CARE and incorporated in training material.

1.2 Handle and distribute improved tree germplasm to farmers. PLUS should capitalize on the PADF Seed Center capabilities of properly storing seed of certain species to control seed quality and alleviate supply constraints resulting from poor seed crops and varying regional demands. Maintaining the quality of seed will require verification of seed source and supervision of proper seed handling procedures. Staff at PADF are already trained in these procedures; the critical issue remains whether PADF will be able to meet demands of other NGOs, including those of CARE.

Sources of improved tree germplasm should be selected in coordination with the SECID germplasm improvement team. This would include superior candidate trees and the data supporting the adaptation of improved families and provenances from the trial assessments. All responsibilities for negotiating seed purchase and coordinating seed handling procedures should remain with qualified PADF and CARE staff. The PADF and CARE personnel held responsible for seed procurement and planning would meet regularly with the SECID germplasm team.

1.3 Develop alternative germplasm supplies available to the farmer. The long-term goal is to develop farm-level management of improved germplasm. This should complement the distribution of seed by PADF and CARE.

A good portion of the candidate trees selected during 1988 - 1991 occur in the regions that PLUS will continue to focus its activities. A supply of improved germplasm is available to local communities from these tree candidates, but which candidates are worthy of the extra effort required to collect seed is a question that can be answered only through progeny testing. Once family performance in progeny trials is confirmed, the project is in a position to selecting the candidates as sources of germplasm for local use.

At least two objectives should receive careful consideration at the community level: 1) to improve the germplasm collection methods of the farmers and 2) to establish local sources of improved germplasm for species that are deficient or in demand. A similar approach could be employed for food crops. For certain species that are easily introduced by vegetative techniques (e.g., *Gliricidia sepium*), key communities or farmer groups should be targeted to establish improved genetic lines into the region. This strategy would also be appropriate for premier timber species, such as *Catalpa longissima* and *Cedrela odorata*, when targeting areas where the species has been over-exploited and high quality seed-bearing adults are lacking. The reintroduction should be done correctly and with improved germplasm. It's an investment that rewards dividends many years after the project has left.

As a **catalyst** in facilitating germplasm flow, PLUS should make communities aware that the provision of a full range of germplasm needs demanded by the Haitian farmer is not possible nor is it wise for such dependency relationships to develop. Gradually, PLUS should encourage local communities to take on greater responsibility in the management of improved germplasm sources as training promoting such activities are developed by PADF and CARE.

1.4 Develop enterprise-generating training material. The focus of training is not only to demonstrate improved technologies, but how these improvements are designed to increase local opportunities to generate income. Training should address methods to improve the utilization of forest resources (e.g., solar fruit and lumber dryers) and maximize their contribution to the farm production unit. This would include strengthening the information linkages between farmer and urban market and exploring the cash cropping options available with improved genotypes of native species or exotic species better suited to agroforestry systems.

2. Staffing Needs

2.1 PADF - The majority of the extension activities associated with improved germplasm should fall under the direction of the Agroforestry Specialist, Mme. Elia Beliard. Her past experience in forestry research make her particularly suited to the task of incorporating SECID's germplasm improvement research with PADF's extension protocols. She is also in charge of supervising the Seed Center. Mr. George Marcellus and an assistant are directly in charge of the daily tasks associated with seed handling and testing procedures.

The current level of staffing appears adequate to manage the flow of tree seed at the PADF Seed Center. It is difficult to predict the magnitude of seed to be handled during 1993-1994. It is anticipated that local seed handling needs for certain species will increase. This may be accompanied by a decrease in seed flow through the Seed Center, though additional management support in the regional areas will be required for record keeping and maintenance of proper seed handling procedures. Additional support will also be necessary if PADF selects to play a major role in the handling of crop seed.

2.2 CARE - The technical assistant to the CARE Project Coordinator should be supported by the services of an assistant that **is solely responsible for record keeping of seed sources and feedback information of on-farm performance**. This is the only way to identify superior seed and is necessary to avoid costly mistakes in seed purchases and win the confidence of the farmer in the quality of seed that CARE distributes. This person would be the logical intermediary between the four CARE regions in the Northwest and potential seed suppliers, including the PADF Seed Center.

The integration of SECID, PADF and CARE activities focusing on improved tree germplasm is summarized in **Table 5**.

Table 5. Integration of germplasm improvement activities in PLUS program.[3]

PLUS TASK	SECID	PADF/CARE
DATABASE MANAGEMENT AND DOCUMENTATION		
Maintain database of germplasm sources	1	2
Seed orchard and genetic trial data	1	2
Asses genetic trials	1	2
Species summary sheets for in-country sources of germplasm and evaluations	1	2
Data and literature support of training information	2	1
ORCHARD AND TRIAL MANAGEMENT		
Manage for maximum seed production	1	2
Monitor seed orchards for seed production (timing and quantity)	1	2
Coordinate timing of seed collections	2	1
Negotiate germplasm purchases from orchards	2	1
Monitor progeny/provenance trials	1	2
EXTENSION		
Handle improved tree germplasm	2	1
Create awareness of improved sources of tree germplasm	1	1
Monitor on-farm sources of tree germplasm	1	1
Evaluate low-input propagation techniques	1	1
Prioritize training information	2	1

[3] 1 = Primary executing role, 2 = Secondary supporting role

C. SYNTHESIS OF DATA BY SECID AND INTEGRATION BY PADF/CARE

As stated earlier, it is worthless to continue field testing of tree germplasm (in progeny and provenance trials) if the information gained from the trials is not used in a manner that achieves the goals of PLUS. This puts the responsibility on SECID to deliver digestible packages of worthy technical information with PADF and CARE participants as the intended client.

The following examples are the type of germplasm information that is immediately available to PLUS. They are presented to help PLUS realize the importance of research focused on screening germplasm prior to delivery to the farmer. They also demonstrate benefits to be expected from continued germplasm research activities.

1. *Gliricidia sepium* in a hedgerow

Gliricidia sepium, known locally as *piyon* or *lila etranjè*, is used in Haiti mostly as a living fence. It is beginning to serve an important role as a hedge and gully-plug species, helping the farmer keep fertile soil on hillsides. Piyon is a poor seeder. Consequently, PADF and CARE have had to purchase the seed abroad, at exorbitant prices (up to $60 US/kilo) to meet their production goals. Perhaps this would be worth it if the seed lots were improved or adapted to conditions in Haiti. Many times they are not.

An example of the risks involved in distributing untested commercial seed is shown in **Figure 5**. A large *G. sepium* seed order was purchased by PADF from Honduras (COHDEFOR 41/87) in 1987 and distributed to local nurseries in Haiti. Seedlings from the Lilavois nursery were planted in a hedgerow trial as a "control" to test against 20 other provenances from Central

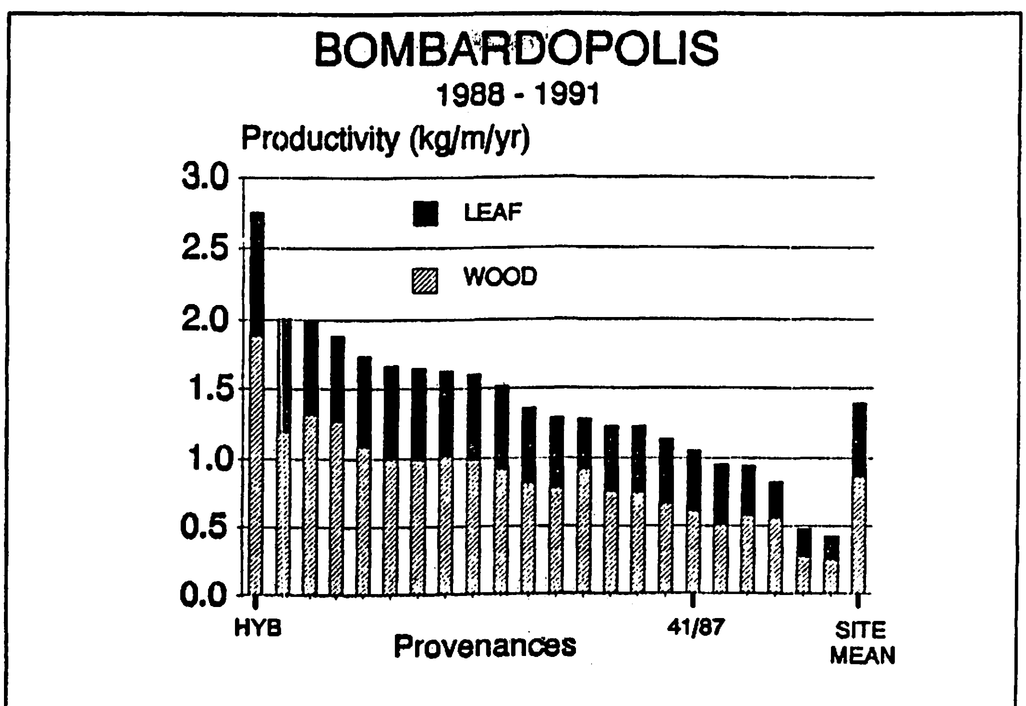


Figure 5. Comparison of *Gliricidia sepium* provenances in an alley cropping trial. The control, 41/87, is a commercial seed lot from Honduras. The top performer is an improved genotype from IITA, Ibadan, Nigeria.

America, Nigeria and Thailand. After three harvests (a seedling and two coppice harvests) over a period of thirty-three months, the commercial seed lot ranked seventeenth in total biomass production and eighteenth in leaf biomass production. The biomass yields were 160% less than the most productive accession, an improved genetic line (HYB) from Nigeria, and less than the site average for all provenances.

A couple of lessons should be learned from this example. First, provenance tests are an important and relatively quick method to assess differences in germplasm quality. PLUS cannot afford to overlook this phase of research since the risks of distributing poorly adapted germplasm are too great. Poorly adapted germplasm limits the productivity of the farmer and this should be avoided if possible. Second, the 2-3 fold difference in productivity between the commercial seed lot and the improved seed lot may be what is required for farmer adoption of sustainable land-use interventions utilizing *G. sepium*. This is what PLUS is seeking: " **to maximize the productive potential of Haitian hillside agriculture**". Even greater improvements are expected with second generation selections and the establishment of clonal seed orchards, as was done for *G. sepium* at Lapila (near Pignon) in 1991. Distribution to farmers can follow varied strategies (seed from orchards in Haiti, seed from IITA, stem cuttings from selected provenances in the trials, establishment of improved living fences with key farmers, etc.). Third, the assumption that gains in tree productivity translate to increases in farmer income should be considered carefully by SECID's agricultural economist and agronomist. What type of gains in productivity benefit the farmer and are these ecologically sustainable? According to the farmer, are more productive hedgerows worth it if their proper management competes for scarce labor or limits the space and moisture available for cash crops?

2. *Cedrela odorata* in a farmer's field

Of the many premier timber species in Haiti, *Cedrela odorata* is a favorite among Haitian farmers. The large tree provides many useful services to the farmer: excellent shade for the courtyard garden, ingredients for folk medicine, fuelwood and a cash saving's as a lumber tree. Unfortunately, the low survival and growth rate of the species has had disappointing results among Haitian farmers.

A first step in solving this problem was made in 1989 through a series of provenance trials. Two provenance trials included Haitian seed lots that were tested against seed lots from Central America. **Figure 6** illustrates the differences in the survival curves of the seed lots.

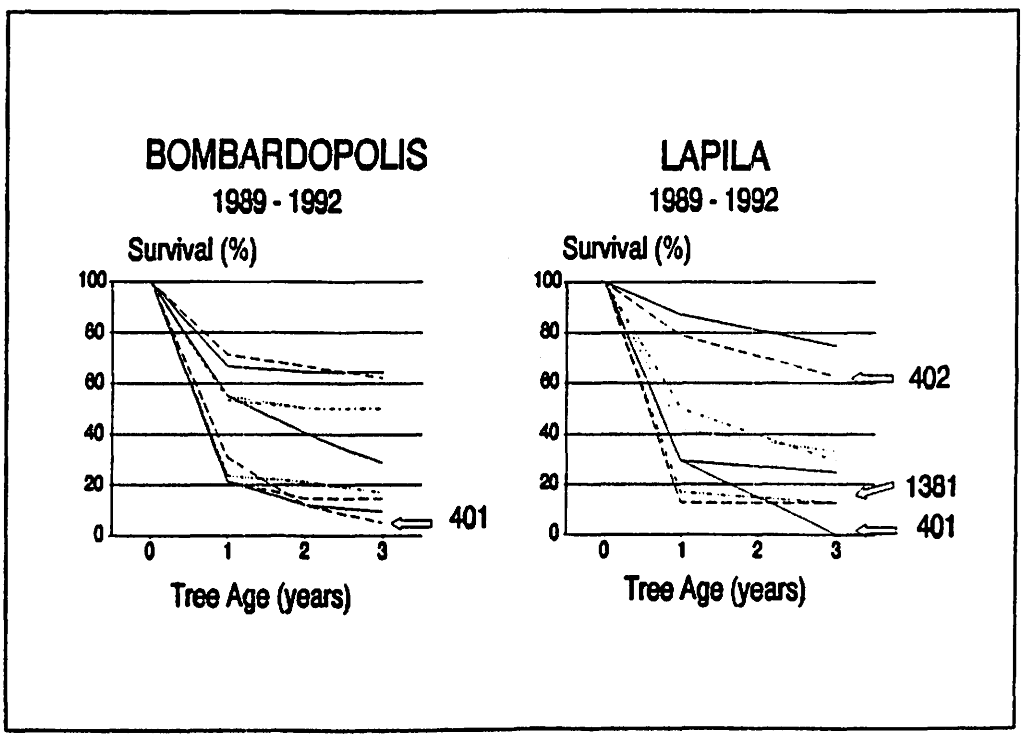


Figure 6. Survival curves of *Cedrela odorata* after 3 years comparing Haitian seed lots (401, 402, 1381) with Central American seed lots.

The Haitian seed lots generally exhibit the lowest survival rates of the provenances that have been tested so far. The poorest preforming seed lot in both trials (No. 401) is from an isolated tree conveniently located in the plains near Petit Goâve. This tree has been harvested many times in the past by seed collectors selling seed to USAID projects. Seed collected from another candidate (No. 402) located in a healthy stand of **Cedrela** ranked second in survival at Lapila (it was not tested at Bombard). The differences again point to the importance of proper seed collections and the identification of superior seed sources through testing prior to on-farm distribution. However, knowing which provenances exhibit high survival is not enough. Of what use is a tree if it survives, but is not productive?

The *C. odorata* provenances exhibit wide differences in their growth rates. The Haitian seed lots are not preforming as well as the Central American sources, growing at 30-50% the rate of the provenances from Honduras, Belize and Nicaragua after 3 years (**Figure 7**).

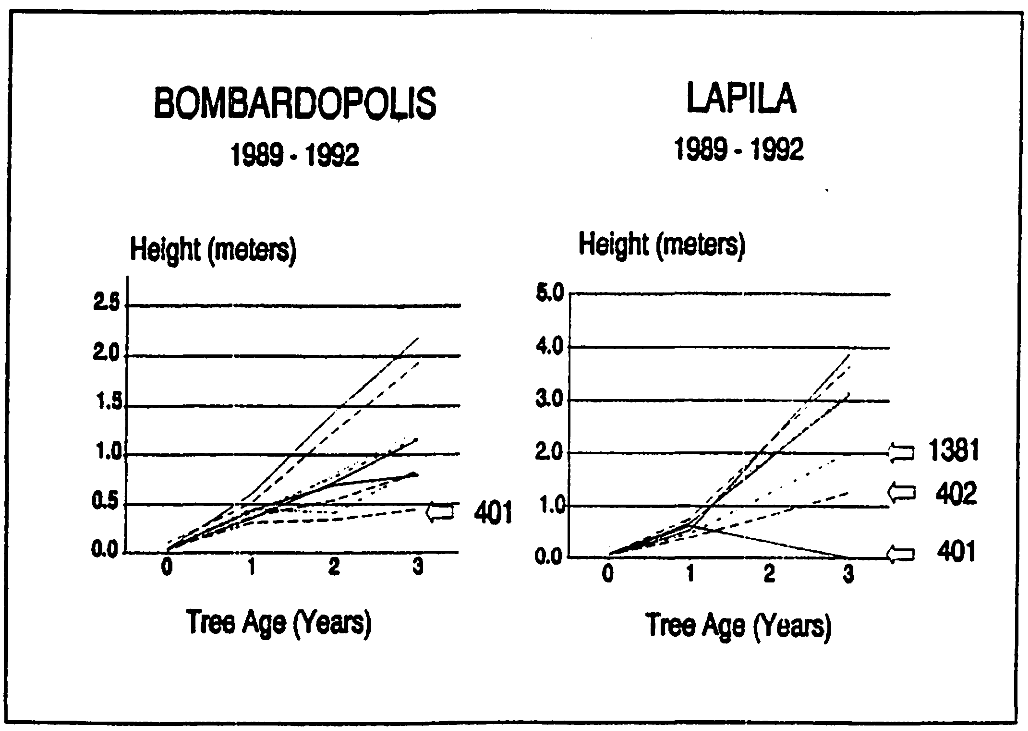


Figure 7. Height comparisons of *Cedrela odorata* provenances after 3 years. The Haitian seed lots grow 30-50% slower than the top Central American provenances.

One of the top seed lots of *Cedrela odorata* in these trials (No. 68-88) was also a commercial seed lot from COHDEFOR in 1987. The fact remains that adequate field testing is the surest method to eliminate the guesswork involved in seed procurement, even when the seed is collected from local sources.

3. The introduced *Colubrina arborescens* tree at Paredon.

Colubrina arborescens, locally known as *bwa kapab*, is a preferred species for house timbers. A Catholic father, Père Bloque, probably introduced the first large leaf variety of *Colubrina arborescens* (which grows faster and larger than the small leaf variety) in the Paredon region several decades ago by planting a single tree in back of the Catholic church (P. Campbell, pers. comm.). This tree was selected in 1988 (No. 306), harvested and propagated with progeny of other superior trees of the same species. A progeny trial was established in 1989 on a marginal site located in the Plateau Central. After 3 years, No. 306 preformed ranked 6th in height growth, exhibiting 30% less growth than the top family from Marchant (near Camp Perrin) and less than the site average for the species (**Figure 8**).

When I was asking farmers in the Paredon area the source of their *bwa kapab*, they directed me to the only large tree in the area. This was tree No. 306 which was the tree that Père Bloque planted. From this one tree, farmers would collect a few wildings and plant it on their land. Apparently this is how *bwa kapab* has spread as a useful tree in this community.

The lesson of the story is that one never knows the long-term effects of planting a single tree. PLUS can play a key role in providing the Père Bloques of Haiti the best available germplasm and benefit the farmers many years after the project or the expatriate personnel have left the local area.

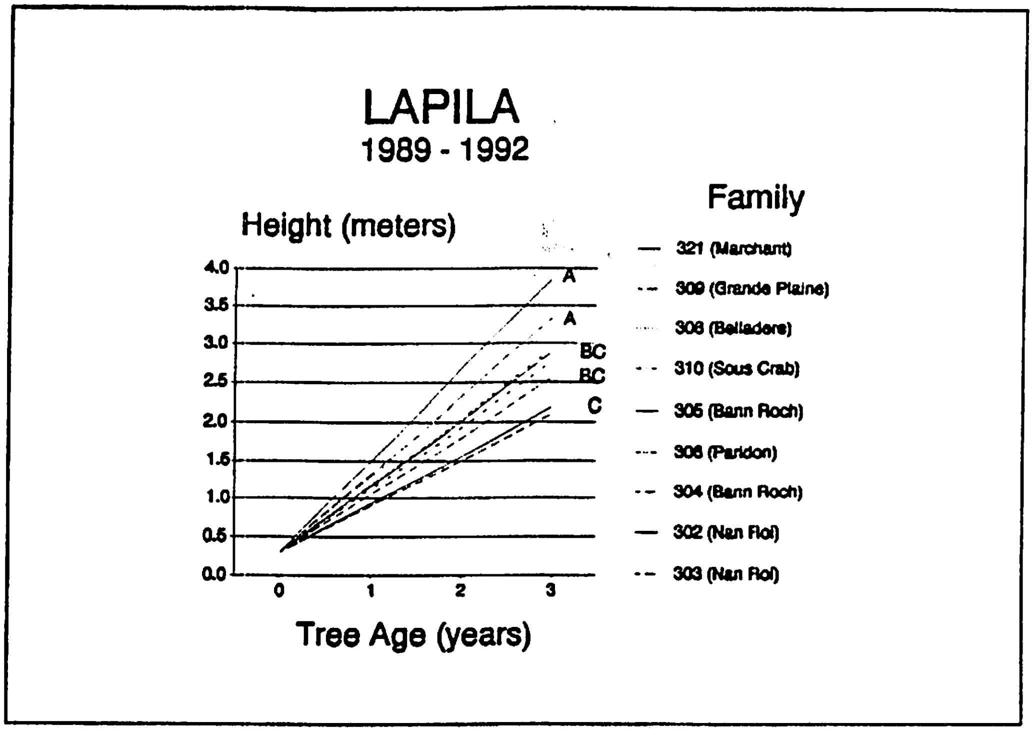


Figure 8. Height comparisons of *Colubrina arborescens* half-sib families. The Paredon family ranked 6th, significantly less than the 3 top families from Marchand and Belladère regions after 3 years of growth. Height means followed by the same letter are not different according to the Waller-Duncan test, $\alpha = 0.05$.

VI. CONCLUSIONS

The Seed and Germplasm Improvement Project activities of the AOP and AFII represent a milestone in the development of forest resources in Haiti. The arboreta, orchards and genetic tests are excellent examples of how conservation can and should be integrated with the development goals of USAID. However, past accomplishments must be continued forward to win the struggle against the deterioration of Haiti's forest resources and decline in farmer productivity. Genetic erosion may be less obvious than soil erosion, but is nevertheless a real threat to sustainable hillside agriculture in Haiti.

PLUS is challenged to make good of the past investments in the orchards and genetic tests and pass the benefits on to the hillside farmer. Selecting and breeding genetically improved material is only a first step; it must be possible to distribute and propagate the germplasm with methods at a reasonable cost. Achieving the immediate rewards does not require that we lose sight of the long-term goals of genetic conservation and tree improvement in Haiti. Broadening the genetic base of useful trees is a necessary part of the continuing efforts to stabilize the livelihoods of farmers dependent on such resources. But it does require commitment. The words of Bruce Zobel and John Talbert (1984) are sufficient: " either conduct the program correctly, with total support in manpower, facilities and equipment or do not do it at all."

VII. LITERATURE CITED

Dvorak, W. 1989. Review of the tree improvement program in Haiti 1988-1989 and outline of tree improvement activities for 1990-1994. CAMCORE, Raleigh, NC., 52 p.

Fielberg, L. and Soergaard, B. 1975. "Historical Review of Seed Orchards." For. Comm. Bull. No. 54. Her Majesty's Stationary Office, London.

Ford, L.B. 1986. Report to USAID/Haiti. USDA Forest Service, July 8-18, 1986, 10 p.

Henderson, A., Aubry, M., Timyan, J., and Balick, M. 1991. Conservation status of Haitian palms, *Principes* 34(3), 134-142.

Palmer, J. 1985. Evaluation of the Agroforestry Outreach Project, USAID No. 521-0122, USAID Mission/Haiti, 22 p.

Raymond, Ralph. 1989. Haiti Seed and Germplasm Improvement Project Data Management System, International Resources Group, Ltd., 31 p.

Rios, B. 1986. Trip Report No. 12. USDA/FS/Caribbean National Forest, October 5, 1986, 18 p.

Stewart, J., Dunsdon, A.J., Hellin, J.J. and Hughes, C.E. 1992. Wood biomass estimation of Central American dry zone species, Tropical Forestry Paper 26, Oxford Forestry Institute, University of Oxford, 83 p.

Theobald, W. 1989. *Cocos nucifera* and lethal yellowing status in Haiti, Florida Department of Agriculture, 9 p.

Timyan, J. 1988. Review of seed and germplasm improvement activities, May-December, 1988, International Resources Group, Ltd. (USAID No. 521-0122-C-00-7077-000), 52 p.

Timyan, J., John, S.E.T., and Cough, Paul. 1989. Final report of activities, International Resources Group, Ltd. (USAID No. 521-0122-C-00-7077-000), 100 p.

Timyan, J. and Vaval, F. 1993. Effects of seed treatment methods on germination of *Simarouba glauca* var. *latifolilia* Cronq., pp. 80-87 In D.G.W. Edwards (ed.) Proc. IUFRO Project Group P2.04-00 Symposium "Dormancy and barriers to germination", 23-26 April, 1991, Victoria, British Columbia, Canada. Forestry Canada.

Timyan, J. and Reep, S. (in press). Conservation status of *Attalea crassispatha*, the rare and endemic oil palm of Haiti, submitted to *Biological Conservation*

USAID. 1985a. Seed selection and collection program, Memorandum (May 24,1985 from Wendy King to AOP Technical Staff), 5 p.

USAID. 1985b. US strategy on the conservation of biological diversity. An interagency task force report to Congress. United States Agency for International Development, Washington D.C., 54 p.

USAID. 1992. Productive Land Use Systems - Amendment to Contract 521-0217, USAID, Washington D.C., 22 p.

Vozzo, J. 1988. Debriefing and Trip Report - Seed Technology, International Resources Group, Ltd., 17 p.

Zobel, B. and Talbert, J. 1984. Applied Forest Tree Improvement, John Wiley & Sons, p. 491.

METHODOLOGY TO EVALUATE 3 AND 5 YEAR PROGENY/PROVENANCE TRIALS AND UTILIZATION OF THE DATA FOR TREE IMPROVEMENT.

1) Pre-trial visit to prepare for measurement (including a weeding to clean up the rows for more accurate and efficient measurements)

2) Measurement of 3 year trials for survival, vertical height (for some trees such as *Lysiloma sabicu*, stem length is required), diameter at breast height (for some species, such as the low forking *Gliricidia sepium*, stem basal diameter at 0.3 m is required), crown diameter, height of the primary fork and form category.

3) Data entry in Lotus 123; conversion of *.WK1 or *.WK3 to a *.dat file, by methods outlined in Raymond (1989).

4) Plotting the data for a particular parameter (e.g., height) on Y axis as a function of family number on the X axis, to check for outliers and possible data entry errors.

5) Generate descriptive statistics for survival, vertical height of all trees, damages and height of trees not damaged by human causes. Publication of these statistics in the bound volumes by species and trial site.

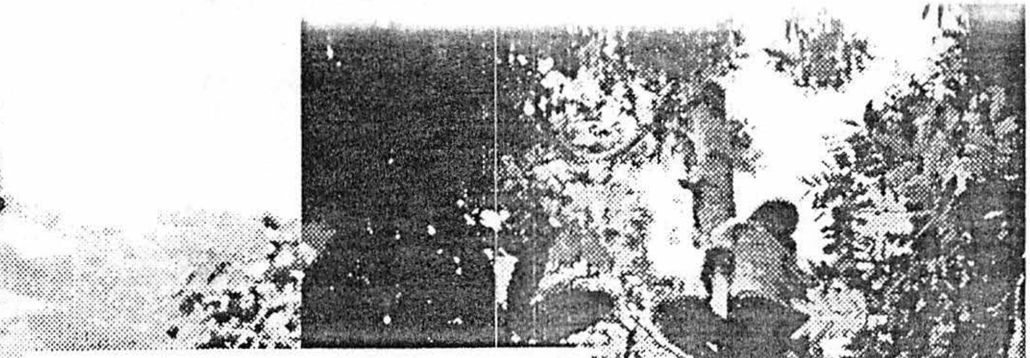
6) Generate inferential statistics by conducting analysis of variances (ANOVA) and test the null hypothesis that no family or provenance differences exist. Depending on the experimental design, a method is selected to perform analyses of variance, while respecting the assumptions of the statistical model. Most of the designs are unbalanced as a result of missing values (i.e., mortalities and human induced damages) and eliminated plots. The complicated statistical procedures are handled by SAS utilizing the methods outlined by Raymond (1989). Run comparison of means tests; the Waller-Duncan's test for balanced designs; the Tukey's Highly Significant Difference (HSD) test for unbalanced designs.

7) Based on the statistical differences, the top families or provenances are selected; within each family or provenance, the elite trees are selected. If no differences are detected, a conservative strategy would be to broaden the genetic diversity of the trial and select only at the individual level. If differences are detected, no more than 50% of the families should be eliminated and the number of individuals should be kept as balanced as feasible, after first considering the proper spacing for maximum seed production.

8) Summarize results and discuss with PADF and CARE the recommended follow-on activities for improving the species in Haiti. Progressive thinnings are designed to remove the inferior individuals within each family and provenance, while preserving the genetic breadth of the species population that is adapted for the particular site conditions present at the progeny trial. This is the beginning of developing a **land race**, ideally suited for the regional differences that occur in Haiti.

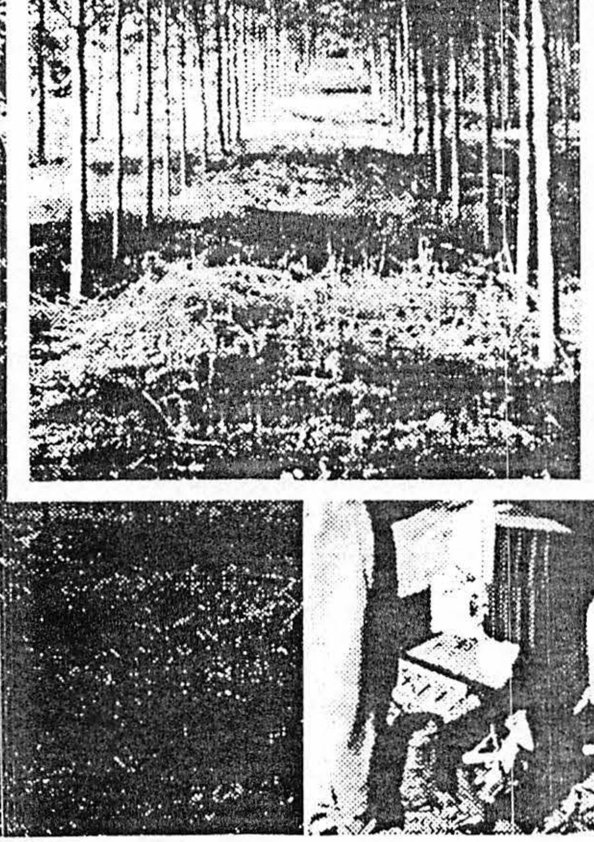
Based on the elimination of the losers in the progeny trials, approximately 50% of the families are eliminated from the seedling seed orchards. The selected families represented in the seed orchards are those families that perform the best for important parameters such as height growth (as an indicator of vigor), stem diameter, form, disease resistance and so on **across sites**. In most cases, significant genotype x site interactions will occur, in which case a number of parameters will be analyzed to identify the family differences. Generally, these parameters are correlated and height is the overall best single indicator of adaptation at an early age. The main objective to be achieved in the seedling seed orchards is **broad adaptability**, eliminating those families that exhibit variable inter-site performance or inferior survival and growth across all tested sites, regardless of site quality. Selecting for broad adaptability decreases the amount of genetic gain, while conserving a broad genetic base from which future breeding strategies can be employed.

9) Select plus tree individuals within progeny trials for vegetative propagation of the following species: *Catalpa longissima*, *Cedrela odorata*, *Cordia alliodora*, and *Gliricidia sepium*. A combination of air-layering, stooling and branch cuttings should be explored. Establish second generation multiplication sites in cooperation with PADF and CARE communities located in important regions of forest resource production and use (e.g., Deuxième Plaine de Petit Goâve for *Catalpa longissima*, Passe Catabois for *Gliricidia sepium*, Maniche for *Cordia alliodora*, etc.). Investigate the possibility of selecting farmers that already form a woodworking or sawyer guild.



ANNEX 2

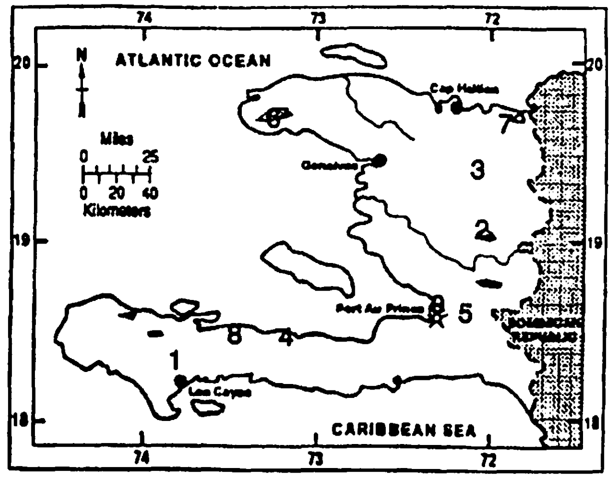
SUMMARY OF TREE IMPROVEMENT IN HAITI



AUTHOR'S NOTE TO THE READER

This section is not complete in the number of species presented nor the information that will be available once further data analyses have been preformed on the progeny and provenance trials. The summary sheets provide information available at the time of publishing this document. The format is designed to provide the reader with a status of the species as it occurs in Haiti.

Species: *Acacia auriculiformis*
Authority: A. Cunn. ex Benth
Family: Leguminosae (Mimosoidadeae)
Common names: akasia (Cr.), northern black wattle (En.)
Uses and Importance: Broad ecological amplitude (wide soil pH range), soil stress tolerant, fuelwood, nitrogen fixing, rough construction wood
Limitations: Coppices poorly, elevation limit 600 m in Haiti, low forking and crooked stems on most sites, heavy branches prone to wind damage, irritating seed and wood processing, seed requires scarification for optimal germination
Natural Range: Papua New Guinea, N. Australia
Peak Fruiting Period: February-March
Seeds/kilogram: 30,000
Low-input Regeneration: Direct seed, transplant wildings (birds feed heavily on seed and distribute seed naturally; light natural regeneration)



Germplasm sources of *Acacia auriculiformis* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1990. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

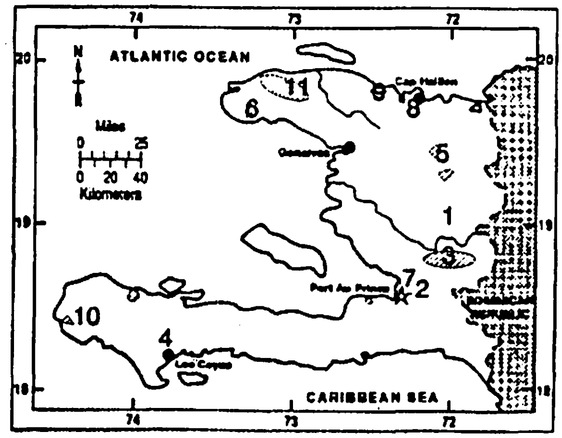
Map No.	Location	Est. Date	Landowner (Caretaker)	Trial Type	1992 Status[1] Growth	Seed	Stats	Silvics
1	Laborde	Apr 91	Plantel Fanfan/ (Homer Fanfan)	seed orchard	1	No	12	1
2	Marmont	Aug 90	CBH/(M. Rutledge)	seed orchard	1	Yes	12	1
3	Lapila	May 91	Dr. Guy Theodore/	seed orchard	3	No	–	3
	"	Jun 91	(Leveki)	provenance	1	No	19	3
	"	May 89		provenance	1	Yes	36	1
4	Paillant	May 91	Jacques Deschamps	seed orchard & arboretum	3	No	–	3
2	Sapatè	Sep 91	Dr. Sylvain	seed orchard	4	No	–	3
5	Roche Blan	Apr 89	Double Harvest/ (Jan Bosma)	provenance	1	Yes	36	1
6	Bombardopolis	Jun 89	CARE/(Judicael)	provenance	3	Yes	12	1
7	Terrier Rouge	Nov 90	Centre Agricole Barnabas/(Nicky Delva)	seed orchard & arboretum	4	No	6	3
6	Nan Marron	Jun 89	Ileus Aciel	provenance	3	Yes	12	1
8	Arnault	Aug 89	Harold Jn Baptiste	arboretum	1	Yes	12	1
9*	Cazeau	1983-86	ex Rigaud/Torchon	thinned stand	1	Yes	40	1
2*	Thomazeau	1985	Ecole Nationale	roadside stand	3	Yes	–	1

[1] GROWTH STATUS: 1 = > 60 % survival and > 2 m/yr height increment; 2 = < 60 % survival and > 2 m/yr height increment; 3 = > 60 % survival and < 2 m/yr height increment; 4 = < 60 % survival and < 2 m/yr increment. SILVICS: 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring selective thinning 1994/1995; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Summary of Species in Haiti:

Oldest trees distributed by PADF and CARE are most likely progeny of a small stand of trees planted at Cazeau by Double Harvest in 1983, from seed of uncertain origin, perhaps India. During 1988-90, 17 plus trees were selected throughout Haiti; 8 were harvested and included in the establishment of progeny/provenance trials in 1989 and 1990. In 1990, a rangewide provenance collection (10 accessions) from Australia and Papua New Guinea was imported from the CSIRO Tree Seed Center in Australia. These were propagated from seed in a series of provenance and seedling seed orchard designs at several locations. The trials are too young to verify significant differences in survival and form. The superior form observed in the plus tree selections is likely to be a response to favorable soil conditions; these soils are located in pockets throughout the Plateau Central and the Northwest where the tree has superior form similar to *Eucalyptus camaldulensis*. A significant form response to local site conditions should be explored further for optimal species-site matching requirements.

Species: *Cassia siamea*
Authority: Lam.
Family: Leguminosae (Caesalpinioideae)
Common names: kasya (Cr.), Siamese cassia (En.)
Uses and Importance: Broad ecological amplitude, fast growth, fuelwood, posts, turnery, tannin, good coppicer, tolerates shade and provides deep shade
Limitations: Not tolerant of combination of low rainfall (< 1000 mm/yr) and alkaline soils, elevation limit ~700 m in Haiti, foliage and pods variable toxicity to animals, not known to fix nitrogen in soil, leaf spot fungal attacks in nursery, deep shade excludes understorey cropping
Natural Range: SE Asia from S India to Thailand/Malaysia.
Peak Fruiting Period: December-February
Seeds/kilogram: 40,000
Low-input Regeneration: Direct seed, transplant wildings



Germplasm sources of *Cassia siamea* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1991. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

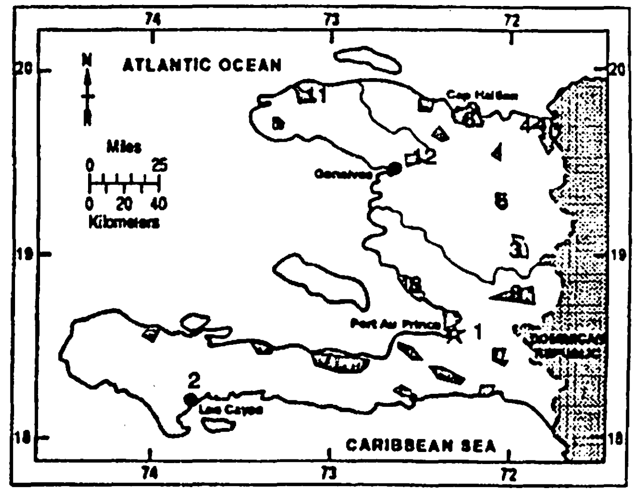
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 Status[1] Growth	Seed	Stats (mos)	Silvics
1	Marmont	Aug 90	CBH/(Rutledge)	orchard/arboretum	1	Yes	12	1
2	Roche Blanc	Mar 89	ODH/(Bosma)	provenance	1	Yes	36	1
3	Mirebalais	Apr 89	Immanuel Mission/ (Stephan)	provenance	1	Yes	36	1
4	Haut Camp	Mar 89	Alexandre Brutus/ (Merci Dieu)	provenance	3	No	36	2
5	Lapila	May 89	Guy Theodore/(Leveki)	provenance	3	Yes	42	1
6	Bombardopolis	Jun 89	CARE/(Judicael)	provenance	3	No	41	1
7*	Cazeau	1983-86	ex Rigaud/Torchon	improved stands	1	Yes	40	1
8	Crocra	Nov 89	Maurice Laroche	provenance & stand	1	Yes	12	1
9*	Bayeux	1940s	Government of Haiti	introduction stands		Yes		
10*	Franklin	1940s	Government of Haiti	introduction stands		Yes		
11	Barbe Pangnol			plus trees		Yes		

[1] **GROWTH STATUS:** 1 = > 60 % survival and > 2 m/yr height increment; 2 = < 60 % survival and > 2 m/yr height increment; 3 = > 60 % survival and < 2 m/yr height increment; 4 = < 60 % survival and < 2 m/yr increment. **SILVICS:** 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring selective thinning 1994/1995; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Summary of Species in Haiti:

This species is exotic to Haiti. The oldest stands are believed to be the former SHADA plantations at Bayeaux and Franklin, planted in the early 1940s. Most *Cassia siamea* in Haiti are likely descended from these stands. An effort was made in 1988 to import as many seed lots from international sources as possible, including SE Asia where it is native (which was unavailable at the time). These seed lots, though not strictly considered provenances, were established in 1989 as "provenance" trials to test for genetic differences among seed sources. Also, 37 plus trees were selected throughout Haiti, many of which were harvested, propagated from seed and established in several seedling seed orchards and progeny trials. The analysis of 12 and 36 month old survival and height data show no differences among seed sources tested in Haiti. It should be noted that the 10 imported accessions were from countries where *Cassia siamea* is exotic. The probability is high that the genetic variability sampled in the trials does not represent the true range within the species. There is significant form x site interaction in this species (like *Acacia auriculiformis*), with the best form being exhibited on basaltic soils (e.g., Barbe Pangnol in the Northwest) and deep sandy alluvial soils (e.g., Cazeau near Port-au-Prince). The tree forks low and is heavily branched on shallow and rocky sites.

Species: *Catalpa longissima*
Authority: (Jacq.) Sims
Family: Bignonaceae
Common names: chenn (Cr.), yokewood (En.)
Uses and Importance: Excellent lumber species, light shade favors understorey crop compatibility, traditional silviculture practiced in Haiti, strong coppicer on moist and well drained sites where it grows rapidly; vegetative propagation methods
Limitations: Site specific to gravelly and sandy alluvial soils characteristic of seasonal drainage areas and coastal plains; seasonally defoliated by caterpillar, beetles and spider complexes (which it tolerates)
Natural Range: Hispaniola, Jamaica
Peak Fruiting Period: June/July, November
Seeds/kilogram: 500-600,000
Low-input Regeneration: transplant wildings (seed is widely wind dispersed); air layering and stooling recommended for plus tree propagation



Germplasm sources of *Catalpa longissima* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1991. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

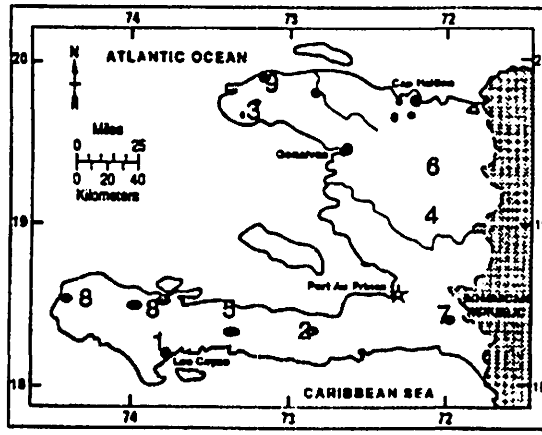
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 Status[1] Growth	Seed	Stats	Silvics
1	Roche Blanche	Oct 88	Double Harvest /(Jan Bosma)	seed orchard	1	Yes	36	1
2	Haut Camp	May 89	Alexandre Brutus/ (Merci Dieu)	seed orchard	3	No	36	2
3	Marmont	Aug 90	Convention Baptiste d'Haiti/(Mark Rutledge)	seed orchard & arboretum	3	No	12	2
4	Terrier Rouge	Nov 90	Centre Agricole Barna-bas/(Nicky Delva)	seed orchard & arboretum	3	No	6	1
5	La Jeune	Jun 91	George Gesner	seed orchard	2	No	--	3
2	Laborde	Mar 89	Homer Fanfan	progeny trial	1	Yes	36	1
5	Lapila	May 89	Dr. Guy Theodore/ (Leveki)	progeny trial	3	No	12	3
6	Crocra	Dec 89	Maurice Laroche/	progeny trial	3	Yes	12	2
7*	2ème Plaine de Petit Goâve			plus trees		Yes		
8*	Vinier de Arcahaie			" "		"		
9*	Ouanaminthe			" "		"		
10*	Lascahobas			" "		"		
11*	Jean Rabel			" "		"		
12*	Passe Reine			" "		"		

[1] GROWTH STATUS: 1 = > 60 % survival and > 1 m/yr height increment; 2 = < 60 % survival and > 1m/yr height increment; 3 = > 60 % survival and < 1 m/yr height increment; 4 = < 60 % survival and < 1 m/yr increment. SILVICS: 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring selective thinning 1994/1995; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Summary of Species in Haiti:

This species is native to Haiti and is considered an important lumber species. During the period between 1988-1991, 127 plus trees were selected throughout Haiti. Progeny were established during this time in seed orchards, progeny trials and arboreta. The species coppices well on most sites where it is naturally found and is managed by farmers in association with understorey crops, notably plantains and sweet potato of the alluvial plains. Vegetative propagation is successful by either air-layering or stooling methods; this allows for significant gains in superior form and growth, as well as the conservation of plus tree germplasm. The species is defoliated seasonally by caterpillar and beetles. No differences among half-sib families have been detected for resistance to defoliators.

Species: *Cedrela odorata*
Authority: L.
Family: Meliaceae
Common names: sed (Cr.), West Indian cedar (En.)
Uses and Importance: Lumber, furniture and cabinet wood, medicinal, honey tree, shade tree for coffee.
Limitations: Site sensitive resulting in low survival and erratic growth; prefers sandy loams near ravines at low altitudes; minimal rainfall ~ 1200 mm; maximum 2 months drought; natural range 200-800 m elevation.
Natural Range: Caribbean, Central and South America
Peak Fruiting Period: October-March
Seeds/kilogram: 40,000
Low-input Regeneration: Branch cuttings from selected mother tree during the fruiting season; stumps and striplings from raised beds.



Germplasm sources of *Cedrela odorata* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1990. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

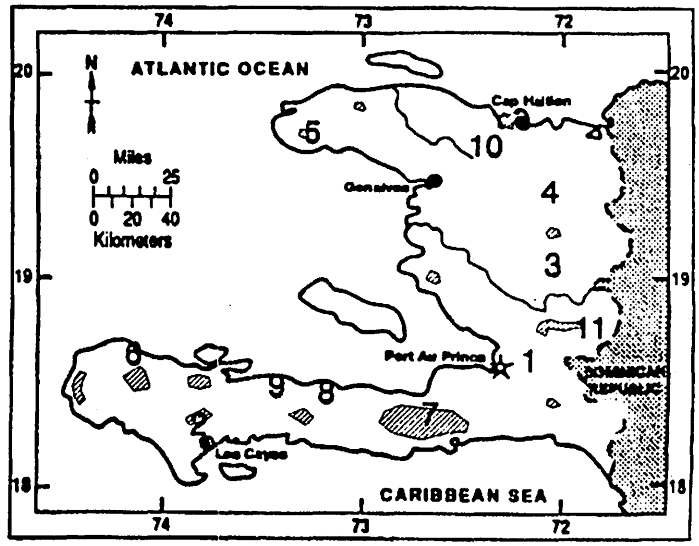
Map No.	Location Trial	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 STATUS[1] Growth	Seed	Stats (mos.)	Silvics
1	Laborde	Mar 89	Homer Fanfan	provenance	1	No	36	1
1	Berault	Apr 89	Alexis	provenance	1	No	36	1
2	Labordette	May 89	Sauveur Jn Francois	provenance	4	No	36	2
3	Bombardopolis	Jun 89	CARE/(Judicael)	provenance/progeny	4	No	41	2
4	Marmont	Aug 90	CBH/(Mark Rutledge)	arboretum	3	No	12	2
5	Arnault	Aug 89	Harold Jn Baptiste	species	3	No	12	2
6	Lapila	Nov 89	Guy Theodore/WCRF	arboretum	2	No	42	2
7*	Fond Verrettes			plus trees		Yes		
8*	Guinodée, Pestel			" "		"		
	Moline, Dame Marie			" "		"		
2*	Mouleron			" "		"		
9*	Dos d'Ane, Jean Rabel			" "		"		

[1] **GROWTH STATUS:** 1 = > 60 % survival and > 1 m/yr height increment; 2 = < 60 % survival and > 1m/yr height increment; 3 = > 60 % survival and < 1 m/yr height increment; 4 = < 60 % survival and < 1 m/yr increment. **SILVICS:** 1 = Stand requiring selective thinning during 1993/1994; 2 = Stand requiring thinning during 1994/1995;

Germplasm Improvement Summary of Species in Haiti:

This species is native to Haiti and occurs now mostly in remote regions of Haiti receiving at least 1200 mm of rainfall per year. Individuals are scattered and isolated as a result of extreme exploitation of the species for high quality lumber. The species is monoecious (male and female flowers occur on same tree) and deciduous. There are at least 2 varieties in Haiti, as distinguished by the bark and wood characteristics. The sed rouj (red cedar) variety is the most common and yields the preferred lumber for furniture. During 1988-1991, a total of 36 plus trees of this variety were selected in Haiti. The sed blan variety may be an introduced variety and seems to be less site sensitive with higher survival and faster growth. 7 plus trees of this variety were selected during 1988-1991. The progeny of several plus trees of the sed rouj variety were established in provenance trials and arboreta during 1989-1991. During the same period, 11 provenances were introduced from Central America and tested in Haiti for differences in survival and height growth. The provenances from Belize (OFI 23/77), Honduras (OFI 52/79 & COHDEFOR 6888) and Nicaragua (OFI 36/78) are performing significantly better than the provenances from Haiti, Guatemala (OFI 42/79), Costa Rica (CATIE 2532) and Colombia (OFI 25/80) in both survival and height growth. Differences in leaf phenology among the introduced provenances have been observed, indicating a potential for the selection of provenances optimally matched with the agronomic calendar of understory crops. Long-term considerations for provenance selection should include wood quality, insect resistance (particularly to *Hypsipyla grandella* Zellar), leaf phenology and wind resistance.

Species: *Colubrina arborescens*
Authority: (Mill.) Sarg.
Family: Rhamnaceae
Common names: kapab, grigri, bwa ple (Cr.), coffee colubrina (En.)
Uses and Importance: House timbers, including posts, rafters, rough construction; excellent agroforestry species with straight, self-pruning, and narrow crown; coppices; wide genetic diversity.
Limitations: Large leaf varieties sensitive to severe droughts (> 3 months) and soil depth causing basal sprouting and die-back; goats prefer foliage; small leaf varieties adapted to dry and rocky coastal regions are precocious seed producers and smaller in height (6 m); variable seed germination.
Natural Range: So. Florida, Caribbean and Central America
Peak Fruiting Period: March-June,
Seeds/kilogram: 50,000
Low-input Regeneration: Transplant wildings from beneath mother tree; bare-rooted seedlings from raised beds.



Germplasm sources of *Colubrina arborescens* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1990. Location numbers refer to table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

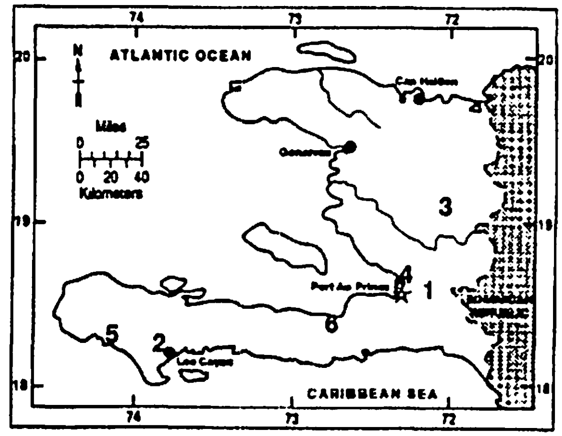
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 STATUS[1] Growth	Seed	Stats (mos.)	Silvics
1	Roche Blanc	Oct 88	ODH/(Bosma)	orchard	1	Yes	36	1
2	Haut Camp	Mar 89	Alexandre Brutus/ (Merci Dieu)	orchard	3	Yes	36	2
2	Laborde	Apr 91	Plantel Fanfan/ (Homer Fanfan)	orchard	4	No	12	3
3	Marmont	Aug 90	CBH/(Rutledge)	orchard & arboretum	1	Yes	12	2
4	Lapila	May 91	Dr. Guy Theodore/(CRWF)	progeny	3	Yes	12	2
5	Bombardopolis	Jun 89	CARE/(Judicael)	progeny	2	Yes	36	1
6	Gelin	Oct 88	Pasteur Marcsin	progeny	1	Yes	12	1
7	Kalompre	Mar 90	Sauveur Jn Francois	progeny	3	No	12	2
8	Paillant	May 91	Jacques Deschamps	orchard & arboretum	na	No	na	3
9	Arnault	Aug 89	Harold Jn Baptist	species	4	No	12	2
2*	Camp Perrin			plus trees		Yes		
7*	Trouin-Bainet			" "		"		
6*	Morvan-Jeremie			" "		"		
10*	Plaissance			" "		"		
11*	Belladere			" "		"		

[1] **GROWTH STATUS:** 1 = > 60 % survival and > 1 m/yr height increment; 2 = < 60 % survival and > 1m/yr height increment; 3 = > 60 % survival and < 1 m/yr height increment; 4 = < 60 % survival and < 1 m/yr increment. **SILVICS:** 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring selective thinning 1994/1995; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Improvement Summary of Species in Haiti:

This species is native to Haiti and is important as a source of house timbers. There are several varieties in Haiti, including the variety reportedly introduced by FAO in northern Haiti during the mid-70s. In general, the large leaf varieties are adapted to the mid-elevation mountain areas where rainfall is between 1200 - 2500 mm/yr; the small leaf varieties occur near the coast on rocky, calcareous soils where rainfall is less than 1000 mm/yr. During 1988-1991, 59 plus trees (6 small leaf and 53 large leaf) were selected. The progeny of 31 of these trees were propagated and established in seedling seed orchards, progeny trials and arboreta throughout Haiti. Trials established on droughty sites (Lapila near Pignon and Nan Marron near Bombardopolis) indicate that the small leaf varieties out preform the large leaf varieties where drought extends greater than 2 months. The latter exhibit terminal die-back (causing crooked stem growth) and basal sprouting in response to moisture stress. Half-sib families from Camp Perrin and Belladere are outperforming those from Trouin and Jeremie in height growth.

Species: *Cordia alliodora*
Authority: (Ruiz & Pav.) Oken
Family: Boraginaceae
Common names: chenn kapawo, chenn nwa, bwa soumi (Cr.), onion cordia (En.)
Uses and Importance: excellent construction, lumber, furniture, posts, coffee shade, medicinal, honey tree
Limitations: Low elevations (0-500 m) requiring ~ 1000 mm annual rainfall; maximum 2 months drought however less site sensitive than *Catalpa longissima*.
Natural Range: South & Central America, Caribbean
Peak Fruiting Period: March-April
Seeds/kilogram: 95,000
Low-input Regeneration: Air-layering or stooling on selected plus tree candidates for maximum genetic gain and survival.



Germplasm sources of *Cordia alliodora* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1991. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

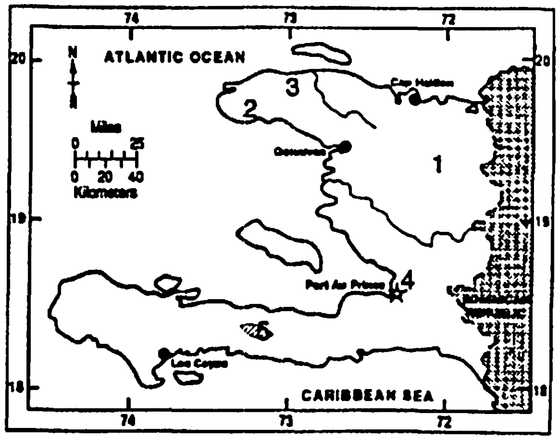
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 STATUS[1] Growth	Seed	Stats (mos.)	Silvics
1	Roche Blan	Mar 89	Double Harvest/	provenance	1	Yes	36	1
2	Berault	Apr 89	Alexis/	provenance	1	Yes	36	1
2	Pemel	May 89	Gaspard Brice/	provenance	1	Yes	36	1
3	Marmont	Aug 90	CBH/(Rutledge)	orchard & arboretum	3	No	12	2
4*	Cazeau	Sep 83	ex. Torchon/Rigaud	species	1	Yes	72	1
5*	Port-a-Piment, Roche-a-Bateau			wild individual trees		Yes		
6*	Fauche - Petit Goave			wild individual trees		*		

[1] GROWTH STATUS: 1 = > 60 % survival and > 1 m/yr height increment; 2 = < 60 % survival and > 1m/yr height increment; 3 = > 60 % survival and < 1 m/yr height increment; 4 = < 60 % survival and < 1 m/yr increment. SILVICS: 1 = High growth stand, requires selective thinning during PLUS (1993/1994); 2 = Low growth stand, requires thinning during or post-1994; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Improvement Summary of Species in Haiti:

The genus *Cordia* is native to Haiti, but occurrence in the wild is rare. Scattered individuals of *Cordia* sp., perhaps *C. alliodora* have been sighted along the coastal regions of Grand Goave, Petit Goave, Roche-a-Bateau, and Piment. The wood is reportedly indistinguishable from that of *Catalpa longissima*. The earliest introduction of provenances for testing in Haiti was in 1984 when Operation Double Harvest introduced a single provenance of *C. alliodora* from San Carlos, Costa Rica. 4 plus tree candidates were selected from this provenance in 1989 for F1 testing in arboreta and a seedling seed orchard in Marmont. An additional 6 provenances were introduced by International Resources Group, Ltd. in 1988. After 3 years, the COHDEFOR 7444 provenance from northwest Honduras is showing trends to be the slightly better adapted than the Costa Rican provenances across sites in Haiti though for economic criteria (e.g., merchantable lumber) it is too early to draw conclusions. It is also the provenance that is yielding seed at an early age (e.g., 3 years), retains branches longer and is in full leaf at the onset of the growing season while the Costa Rican provenances are leafless or in the process of leaf budding. However, significant variation in height growth occurs within each provenance as well as across sites (i.e., significant site x provenance interactions) suggesting that selection at both the individual and provenance level merits consideration for breeding land races in Haiti. No significant differences in survival has been observed among provenances. As in *Cedrela odorata*, differences among provenances are readily observable in the bark, branching pattern and leaf phenology. This species has excellent potential as an agroforestry candidate, with superior vertical form, self-pruning lateral branches and a narrow crown that allows a high degree of flexibility in spacing arrangements with understory crops. It coppices readily and the merchantable:total biomass volume ratio for quality lumber yield approaches the highest of any species so far tested in Haiti. It appears to be less site sensitive than *Catalpa longissima*.

Species: *Gliricidia sepium*
Authority: (Jacq.) Walp.
Family: Leguminosae (Papilionoideae)
Common names: lila etranje, piyon (Cr.), mother of cocoa (En.)
Uses and Importance: Living fence materials, drought hardy, fast growth, fuelwood, posts, green manure (nitrogen fixer), shade, good coppicer, fodder
Limitations: Poor seed production, damaged easily by browse, lateral coppice habit discourages alley cropping, lowland species with elevation limit in Haiti ~700 m, variable toxicity to animals.
Natural Range: Central America
Peak Fruiting Period: March-May
Seeds/kilogram: 4,500-6000
Low-input Regeneration: branch and stem cuttings during the flowering season from January-March; direct seed; coppice and pollard.



Germplasm sources of *Gliricidia sepium* in Haiti. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 Status[1] Growth	Seed	Stats	Silvics (mos)
1*	Lapila	May 91	Theodore/(CRWF)	clonal orchard	1	No	19	2
		Jun 87		provenance	1	Yes	–	1
2	Bombard	Oct 88	CARE/Judicael	provenance	1	Yes	33	1
3	Barbe Pangnol	Oct 88	CARE/Delcius	provenance	1	Yes	28	1
4*	Cazeau	Jun 87	ex. Torchon & Rigaud	provenance & arboreta	1	Yes	28	1
5*	Fond-des-Negres			living fences		Yes		

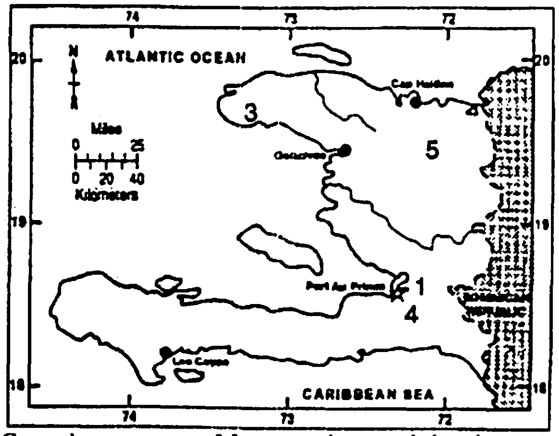
[1] GROWTH: 1 = > 2 meters/yr height increment and > 60% survival; SILVICS: 1 = Lopping schedule at 4 - 6 month interval; 2 = Stand requiring selective thinning 1993/1994

Germplasm Summary of Species in Haiti:

This species is considered naturalized in Haiti where the distribution is common only in local areas like Fond-des-Negres as a living fence: mostly it is seen as an occasional tree around human settlements. Among the many introductions of the species in Haiti, 7 Costa Rican provenances from CATIE were introduced at Cazeau by Operation Double Harvest and established as a seed production area in 1987. These same provenances were established in the Maissade area by Save the Children and near Pignon by Pan American Development Foundation. In 1988, 26 provenances from the Oxford Forestry Institute collection, were introduced in a collaborative effort between International Resources Group, Ltd. and CARE. These were established at two trials in the Northwest to test differences among provenances. The National Forestry Project of the Ministry of Agriculture established trials during this time.

The species seeds poorly in Haiti; sites such as Lapila, that receive a severe drought period during the period of flowering (Feb - March), favor seed production. Early trial evaluations show considerable variation within the species, between provenances from the same country of origin and significant genotype x environment interaction. The 62/87 HYB (high yield bulk, a composite of 4 Costa Rican provenances developed in Nigeria) is the most stable top biomass performer so far tested; other promising accessions are 13/82 (Matagalpa, Nicaragua), 25/84 (Intibuca, Honduras), 30/84 (Esteli, Nicaragua) and 60/87 (Retalhieu, Guatemala). Significant differences exist in biomass production, coppice habit and phenology, indicating the potential for selecting an alley cropping ideotype in Haiti.

Species: *Leucaena leucocephala*
Subspecies: glabrata (Rose) Zárate
Authority: (Lam.) de Wit
Family: Leguminosae (Mimosoideae)
Common names: delin etranje, lusina, (Cr.), leucaena (En.)
Uses and Importance: Fast growth and good coppicing ability, drought hardy, fuelwood, posts, green manure (nitrogen fixer), shade, good coppicer, fodder, rough construction
Limitations: Prolific seed production, browsed heavily, mimosine toxicity, lowland species with elevation limit in Haiti ~800 m (Psyllids are a problem outside the Caribbean and Central America.)
Natural Range: Mexico & Central America
Peak Fruiting Period: February - March
Seeds/kilogram: 20,000
Low-input Regeneration: direct seed; coppice and pollard.



Germplasm sources of *Leucaena leucocephala* subsp. *glabrata* in Haiti. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

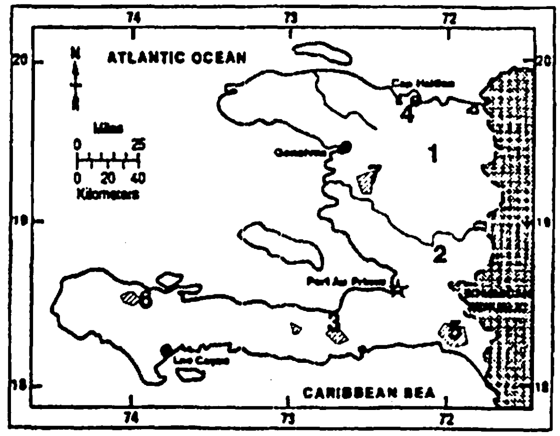
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Varieties	1992 Status[1] Growth (mos)	Seed	Stats	Silvics
1*	Roche Blanche	Nov 88	ODH/Bosma	K636, K584, KX3	1	Yes	12	1
2*	Cazeau	1978-85	ex. Torchon/Rigaud	K8, K28, K67	1	Yes	--	1
2*	Bon Repos	1982	Ambroise	K8, K28				
3	Nan Marron	Jun 88	Ileus	K8, K636, KX3, K387, K584	1	Yes	12	1
	Bombardopolis	1982-86	CARE/Judicael	K8, K28	1	Yes	--	1
4	Viard	May 88	Wynne	K636, KX3	3	Yes	--	2
5	Lapila	May 91	Theodore/CRWF	K387, K605, K584 KX3, K636	1	Yes	12	1

[1] GROWTH: 1 = > 2 meters/yr height increment and > 60% survival; 3 = < 2 meters/yr height increments and > 60% survival
SILVICS: 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring selective thinning 1994/1995.

Germplasm Summary of Species in Haiti:

This species was probably introduced to Haiti in the late 70's. Operation Double Harvest at Cazeau was one of the first introduction sites, planted with K8, K28 and K67 accessions from NFTA in Hawaii. Most of the leucaena planted in hedgerows is descended from these varieties, as well as the plantations of leucaena established in the Cul-de-Sac plain by ODH (1981-1985). In 1988, International Resources Group, Ltd. introduced K636, K605, K584, and K387 along with an interspecific hybrid KX3 (*L. diversifolia* (K156) x *L. leucocephala* (K8)) from NFTA. A near relative, *L. leucocephala* subsp. *leucocephala*, locally known as *delin*, is widespread as a weed. Despite the species known self-compatibility, gene exchange between the subspecies is possible and could play a role in the development of genotypes less desirable than the giant variety. Natural outcrossing of *L. leucocephala* subsp. *glabrata*, as the pollen parent, with *L. diversifolia* is common where the two species co-exist, and produces a hybrid which has been observed to be more productive, in terms of kilogram biomass/meter hedgerow, than the *L. leucocephala* subsp. *glabrata* (K8) parent in an alley cropping trial at Barbe Pangnol in the Northwest. Individuals of the KX3 are preforming better than either parent species at an elevation of 1400 m.

Species: *Lysiloma sabicu*
Authority: Benth.
Family: Leguminosae (Mimosoideae)
Common names: taveno (Cr.), sabicu (En.)
Uses and Importance: Premier lumber, posts, green manure (nitrogen fixer), shade; drought hardy and tolerates alkaline conditions.
Limitations: Poor seed production and high seed predation; slow growth and low forking on shallow soils, elevation limit in Haiti ~800 m.
Natural Range: Central America & Caribbean
Peak Fruiting Period: January-April
Seeds/kilogram:
Low-input Regeneration: Bare-rooted seedlings from raised beds.



Germplasm sources of *Lysiloma sabicu* in Haiti. Cross hatched areas show regions where plus trees were selected 1988-1991. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

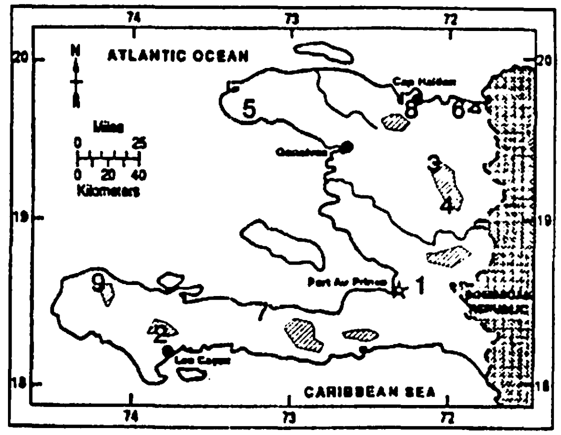
Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 Status[1] Growth	Seed	Stats (mos)	Silvics
1	Lapila	Oct 89	Theodore/CRWF	progeny	1	Yes	43	1
2	Mirebalais	Oct 89	Immanuel Mission/ (Stephan)	seed orchard	1	Yes	36	1
3	Fauche	Jul 90	Gattereau	arboretum	1	No	12	1
4	Crocra	Nov 89	Laroche	progeny	1	No	12	1
5*	Thiotte			plus trees		Yes		
3*	Trouin			" "		"		
6*	Jeremie			" "		"		
7*	Dessaline			" "		"		

[1] GROWTH: 1 = > 1 meters/yr height increment and > 60% survival; SILVICS: 1 = Lopping schedule at 4 - 6 month interval; 2 = Stand requiring selective thinning 1993/1994

Germplasm Summary of Species in Haiti:

This species is native to Haiti and is considered a premier lumber tree. The light shade and nitrogen fixing ability are excellent traits as an agroforestry species. Important populations of the species occur in the Morne-a-Brile region near Trouin, south of Thiotte on the road to Grand Gosier, the Dessaline area of the Artibonite and the Guinodée watershed in the Grand Anse. Fifty superior trees were selected 1988 - 1991; the progeny of 21 of these have been established in seed orchards, progeny trials and arboreta throughout Haiti during 1989 - 1991. Twelve month analyses of height growth detected no difference among half-sib families at Crocra.

Species: *Simarouba glauca* var. *latifolia*
Authority: DC.
Family: Simaroubaceae
Common names: bwa blan, frenn (Cr.), princess tree (En.)
Uses and Importance: Lumber, posts, poles, furniture, medicinal and oil from seed. Excellent agroforestry species with straight bole, fast growth and adapted to shallow soils.
Limitations: Minimal rainfall ~ 1000 mm; maximum 2 months drought; up to 1000 m elevation; seed coat requires cracking or kernel extracted for optimal germination.
Natural Range: Caribbean and Central America
Peak Fruiting Period: April-June
Seeds/kilogram:
Low-input Regeneration: Transplant wildings from beneath mother tree or other trees where birds drop seed after eating fruit; bare-rooted seedlings from raised beds.



Germplasm sources of *Simarouba glauca* var. *latifolia* in Haiti. Cross hatched areas represent regions where plus trees were selected 1988-1990. Location numbers refer to the table below.

Current (*) and proposed germplasm sources in Haiti. The sources are arranged in descending order of importance in terms of genetic diversity and potential for germplasm improvement.

Map No.	Location	Date Est.	Landowner/ (Caretaker)	Trial Type	1992 STATUS[1] Growth	Seed	Stats (mos.)	Silvics
1	Roche Blanc	Oct 88	Double Harvest/ (Jan Bosma)	orchard	1	No	36	1
2	Laborde	Apr 91	Plantel Fanfan/(Homer Fanfan)	orchard	3	No	12	3
3	Lapila	May 89	Dr. Guy Theodore/	progeny	3	No	12	2
		Oct 89	CWRF	progeny	4	No	12	2
4	Marmont	Aug 90	CBH/(M. Rutledge)	orchard & arboretum	2	No	12	2
5	Bombardopolis	Oct 89	CARE/(Judicael)	orchard	3	No	36	2
2	Haut Camp	Mar 89	Alexandre Brutus/ (Merci Dieu)	orchard	3	No	36	2
6	Terrier Rouge	Nov 90	CAB/(Raphael)	orchard & arboretum	3	No	6	3
7	Paillant	May 91	Jacques Deschamps	orchard & arboretum	na	No	na	3
3	La Jeune	Jun 91	G. Gesner	orchards	na	No	na	na
8	Crocra	Nov 89	Maurice LaRoche	progeny	4	No	12	2
9	Gelin	Oct 88	Pasteur Marcsin	progeny	1	No	12	1
2*	Maniche area			plus trees		Yes		
3*	La Jeune area			plus trees		*		

[1] GROWTH STATUS: 1 = > 60 % survival and > 1 m/yr height increment; 2 = < 60 % survival and > 1m/yr height increment; 3 = > 60 % survival and < 1 m/yr height increment; 4 = < 60 % survival and < 1 m/yr increment. SILVICS: 1 = Stand requiring selective thinning 1993/1994; 2 = Stand requiring thinning 1994/1995; 3 = Early establishment phase, vulnerable to weeds & loss of plot ID markers.

Germplasm Improvement Summary of Species in Haiti:

This species is native to Haiti and occurs in areas of the country that generally receive at least 1200 mm of rainfall per year and not exceeding 1000 m elevation. The species is dioecious (male and female flowers occur on separate trees). Important wild populations of the species occur in the La Jeune area of the Plateau Central, the Maniche area of the southwest, the Grand-Anse and areas of Bainet and Jacmel. During 1988-1991, a total of 79 plus trees were selected throughout Haiti. The progeny of 35 of these trees were propagated and established in seedling seed orchards, progeny trials and arboreta throughout Haiti. In drier areas, a less common species, *Simarouba berteroana*, appears to be better adapted and reportedly yields a superior lumber. There is evidence that the two species hybridize. *S. glauca* grows more uniform on shallow soils than most other lumber species. No half-sib families have exhibited significant differences in height growth and form across sites, indicating that the populations in Haiti are quite uniform and improvement may be difficult by selecting only from open pollinated mother trees. Trees reach reproductive age between 5-7 years.

Time table of SECID monitoring and evaluation tasks in germplasm improvement during 1993-94. Task categories: M = monitoring, E = evaluation, X = experimentation, and D = Documentation.

DATE	LOCATION	MAN-DAYS	CATE-GORY	TASK
Jan 93	SECID	20	D	Germplasm sources in Haiti for selected species
Jan 93	Bombard & Passe Catabois	10	X	Select top *Gliricidia sepium* provenances and individuals; propagate at Passe Catabois; finalize trial management schedule with CARE Feb/93 - Nov/94 (including Barbe Pagnol trial)
Jan 93	Viard	1	M	*Grevillea robusta* orchard
Jan 93	Cap Haitian	10	M	*Catalpa longissima*/*Lysiloma sabicu* progeny trial 3 yrs.
Jan 93	Terrier Rouge	1	M	Set maintenance schedule of orchards for 1993/94
Feb 93	Mirebalais	4	M	Selective thin *Cassia siamea* trial for seed production
Feb 93	Roche Blanche	8	M	Selective thin *Leucaena leucocephala* (K605, K636, KX3), *Cassia siamea* and *Acacia auriculiformis* trials
Feb 93	Roche Blanche	4	X	Select *Cordia alliodora* for thinning/air layer; stool *Catalpa longissima* sprouts
Feb 93	Cayes area	20	X	Select *Cordia alliodora*, *Catalpa longissima*, *Cedrela odorata* and *Swietenia* spp. for thinning; air-layer
Mar 93	Paillant	2	M	Weed orchards and *Grevillea robusta* progeny/provenance trial
Mar 93	Lapila	10	M/E	Weed and measure orchards at Lapila; thin *Leucaena leucocephala* trials; flowering status of *Gliricidia sepium* orchard
Apr 93	Paillant	8	M	Measure orchards and *Grevillea robusta* progeny/provenance trial
Apr 93	Laborde	2	X	Install vegetative propagation trial; thin Laborde and Bérault

Apr 93	Passe Catabois	10	X	Install *Gliricidia sepium* clonal seed orchard; measure *Lysiloma sabicu* trial 3.5 yrs
May 93	Roche Blanche	6	X	Install vegetative propagation trial; thin *Cordia alliodora*
May 93	SECID	20	D	Evaluation of *Gliricidia sepium* trials at Bombard and Barbe Pagnol
Jun 93	SECID	4	D	Summary of layering results
Jul 93	Passe Catabois	6	M	Weed and survival check of *Gliricidia sepium* orchard
Jul 93	Fauché	4	M	Thin arboretum
Aug 93	Marmont	10	M/E	Measure and thin orchards and arboretum
Aug 93	Laborde	4	M	Weed vegetative propagation trial
Aug 93	Roche Blanche	2	M	Weed vegetative propagation trial
Oct 93	Roche Blanche	6	M/E	Measure and rogue *Catalpa longissima* and *Colubrina arborescens* at 3/5 yrs.
Jan 94	Laborde	4	M/E	Measure vegetative propagation trials and orchards
Feb 94	Passe Catabois area	10	E	On-farm evaluation of germplasm sources and propagation methods of selected tree species
Feb 94	Roche Blanche	2	M/E	Measure vegetative propagation trial
Feb 94	Marmont	6	X	Stool *Eucalyptus* spp.
Feb 94	Mirebalais area	8	E	On-farm evaluation of germplasm sources and propagation methods of selected tree species
Mar 94	Cayes area	10	E	On-farm evaluation of germplasm sources and propagation methods of selected species
Mar 94	Cayes area	20	E	5 yr. evaluation of Laborde, Pémel, Bérault and Haut Camp orchards and provenance/progeny trials
Apr 94	Roche Blanche	8	E	5 yr. evaluation of provenance trials
Apr 94	Labordette	4	E	5 yr. evaluation of provenance trial
May 94	Lapila	18	E	3/5 yr. evaluation of provenance/progeny trials
May 94	Mirebalais	4	E	5 yr. evaluation of provenance trial

Jun 94	Bombard	10	E	5 yr. evaluation of provenance/progeny trials
Sep 94	Mirebalais & Lapila	6	E	5 yr. evaluation of orchard and progeny trials; selective thin progeny trial
Oct 94	Roche Blanche	6	M/E	Rogue and measure 5 yr. *Simarouba* spp. orchard
Oct 94	Bombard	30	E	Final evaluation of *Gliricidia sepium* alley cropping provenance trial
Nov 94	Barbe Pangnol	40	E	Final evaluation of *Gliricidia sepium* alley cropping provenance trial
Nov 94	SECID	30	D	Final document of 5 yr. results of SECID provenance and progeny trials
Dec 94	SECID	30	D	Final document of *Gliricidia sepium* provenance trials

Field cost associated with PLUS 1993/94 tree germplasm improvement activities.

DATE	LOCATION	DESCRIPTION	FIELD COSTS (H $)	PER DIEM
Jan 93	Bombard & Passe Catabois	*Gliricidia sepium* propagation + travel	100	260
Jan 93	Viard	Weeding orchard	200	
Jan 93	Cap Haitian	Travel		460
Feb 93	Mirebalais	Travel		
Feb 93	Cayes area	Select and initiate layering experiment + travel	50	520
Mar 93	Sapatè & Lapila	Weeding orchards and trials + travel	650	240
Apr 93	Paillant	Travel		400
Apr 93	Laborde	Thin + establish layering trial + travel	100	300
Apr 93	Passe Catabois	Establish clonal seed orchard + travel	75	260
May 93	Roche Blanche	Weeding + establish layering trial	400	
Jul 93	Passe Catabois	Weeding clonal seed orchard + travel	100	156
Aug 93	Marmont	Travel		400
Aug 93	Laborde	Weeding + travel	75	120
Aug 93	Roche Blanche	Weeding	100	
Jan 94	Laborde	Travel		120
Feb 94	Passe Catabois area	Travel		260
Feb 94	Marmont	Travel		240
Feb 94	Mirebalais area	Travel		320
Mar 94	Cayes area	Travel		600
Apr 94	Labordette	Travel		160
May 94	Lapila & Mirebalais	Travel		456
Jun 94	Bombard	Travel		260

Oct 94	Bombard	Labor + travel	126	780
Nov 94	Barbe Pangnol	Labor + travel	180	1040
		Total	2156	7352

POSITION: LOCAL-HIRE GERMPLASM IMPROVEMENT SPECIALIST

* Base: Greater Port-au-Prince area
* Duration: 2 years

DUTIES AND RESPONSIBILITIES

The Germplasm Improvement Specialist will serve as the SECID research counterpart to PADF's staff member in charge of seed handling and purchases and a technical assistant assigned by CARE. The Specialist will be responsible for planning and implementing daily activities associated with 1) the technical management of improved sources of tree germplasm, 2) assessment of progeny and provenance trials, and 3) the coordination of information necessary for efficient distribution of improved germplasm by PADF and CARE.

The Germplasm Improvement Specialist will:

* Assess a core of 16 progeny trials, representing 5 native multiple purpose tree species, for 3 and 5 year measurements and make recommendations to PADF and CARE on the selection of superior tree candidates for local seed collections.

* Assess a core of 14 provenance trials, representing 5 exotic multiple purpose tree species for 3 and 5 year measurements, and make recommendation to PADF and CARE on the selection of superior seed sources in Haiti or abroad.

* Supervise the management required to rogue (eliminate inferior families and provenances) the orchards and provenance trials to improve the stands for mass selection and maximum seed production.

* Estimate the quantity of seed available to PADF and CARE from 1) rogued orchards, 2) non-rogued orchards, 3) rogued progeny and provenance trials, 4) non-rogued progeny and provenance trials, 5) superior parent trees and 6) improved seed stands.

* Identify the constraints in the flow of improved germplasm from sources to farmers and make recommendations to PADF and CARE.

* Assist in the interpretation and compilation of tree data for PADF and CARE training material.

* Supervise 2 technicians in field activities of data collection and analyses of orchards, progeny/provenance trials and arboreta.

QUALIFICATIONS

* M.S. degree in forestry or agroforestry, preferably supplemented by training in tree or crop improvement research;

* At least three years of experience in natural resource management, agroforestry or agronomy related research in Haiti;

* Knowledge and familiarity with regional agronomic calendars, the biology of the major native and exotic tree species and traditional agroforestry practices in Haiti;

* English language: Good reading comprehension in English is essential to learn of past activities in documents, to make up deficiencies in SAS, dBase, Lotus, Wordperfect, etc. and to keep current with project communications.

* Demonstrated capacity to perform inferential statistics with SAS or related computer software;

* Demonstrated computer skills, including database management;

* Ability to interact effectively as a SECID team member and build solid working relations with PADF and CARE;

* Capacity to be on the road greater than 50% of the working time during peak seasons.