

AGENCY FOR INTERNATIONAL DEVELOPMENT
 WASHINGTON, D.C. 20523

DATE:

9/20/88

MEMORANDUM

TO: AID/PPC/CDIE/DI, room 209 SA-18
 FROM: AID/SCI, Victoria Os: *VO*
 SUBJECT: Transmittal of AID/SCI Progress Report(s)

Attached for permanent retention/proper disposition is the following:

AID/SCI Progress Report No.

2. E-86

PR - 1st ^{ty sign 84} full report Jan 1 - Dec 31 1983

PR - Jan 1 - July 31 1984

PR - prepared ^{re} Jul 85 (ltr Jul 14, 1985)

1985 PR - 10/8/85 (Jan 1 - Jan 30, 1985)

Attachment

1986 PR - 15 Sept 86 - (Jan 86 - 31 Sep 86)

SCI



United States
Department of
Agriculture

Forest
Service

Forestry Sciences Lab
3200 Jefferson Way
Corvallis, Oregon 97331
(EPA Tel: 503-757-4392)

Reply to

4040 Coop Research

Date

September 26, 1986

L. E. O. C.

Dr. James Hester
LAC/DR/MA
Main State Building
Agency for International Development
Washington, DC 20523

Dear Jim:

Enclosed is a copy of the latest Progress Report for the Caribbean pine project. It is finally drawing to a close. Meetings with counterparts in Puerto Rico this week should help a lot in deciding what format the FINAL REPORT will take.

While in Puerto Rico, I will talk to Dave Harcharik and Loran Ford about the "Case Book" idea I refer to in the Progress Report. With their comments and those of the counterparts, I should have a rough sample copy to you by late October or early November. Any ideas you have on the high visibility approach would be appreciated.

Sincerely,

mp for Leon H. Liegel

LEON H. LIEGEL
Soil Scientist

LKL:mp



Rec'd in SCI JUN 24 1988



United States
Department of
Agriculture

Forest
Service

Forestry Sciences Lab
3200 Jefferson Way
Corvallis, Oregon 97331

4040 Coop Research

Reply to: September 17, 1986

Date

Dr. James Hester
LAC/DR/MA
Main State Building
Agency for International Development
Washington, DC 20523

Dear Cooperator:

Enclosed is a copy of the first 1986 Progress Report for our ongoing US-AID sponsored research with Caribbean Pine. Major accomplishments thus far in 1986 were completing various travel/training exercises, especially the meeting of project technical counterparts in Puerto Rico at the Symposium on Tropical Forest Management.

A big task still ahead is completing analysis of the field data and synthesizing the results. Some of Jamaica's data will be presented to counterparts in Puerto Rico. Editing data for inconsistencies is now complete for all countries.

Our draft FINAL REPORT is due 31 December 86. Discussions at the Puerto Rico meeting will determine the format and style of writing this report will take.

Very grateful for everyone's time in helping out with logistics for all travel/training activities,

LEON H. LIEGEL
Soil Scientist

LHL:mp
enclosures



1986 PROGRESS REPORT

for

U.S. Agency for International Development
Project AID/SCI/E2/06:
Growth and Site Relationships of Caribbean Pine...
in Jamaica, Costa Rica, Trinidad, and Venezuela

Project ID No. AID/SCI/E2/06

Principal Investigator Dr. Leon H. Liegel, Soil Scientist
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Co-Investigators

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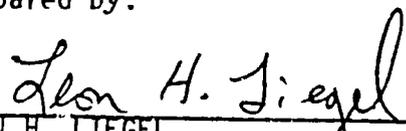
Mr. Richardo F. Bellandi
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Overall Project Objectives

Synthesize and publish growth and yield data from unthinned, unmanaged Caribbean pine plantations; determine how volume growth correlates with soil and site variables; develop a broad data base that local forest managers can use to promote more intensive and integrated forestry development; and establish more formal linkages between all forestry institutions involved in the study by providing training and by conducting cooperative research.

Prepared by:


LEON H. LIEGEL

15 September 86
DATE

GENERAL NEWS AND PROGRESS

This progress report primarily covers administration and training concerns either completed since January 86 or in progress before 30 September 86. All field activities were finished in 1985 and were reviewed in earlier reports. Some preliminary growth and yield (G & Y) data from Jamaica are summarized herein. Data from Costa Rica, Trinidad, and Venezuela have been keypunched and edited for inconsistencies, but summaries will not be available until December 86. Data summary and statistical analyses are being coordinated by the biometrics staff, USDA Forest Service, Southern Forest Experiment Station, New Orleans, LA.

INDIVIDUAL COUNTRY TRAINING ACTIVITIES

The largest training effort underway is funding project technical counterparts and other individuals to attend the Forests of Tropical America Symposium in Puerto Rico, September 21-27. After the meeting, project counterparts travel to Venezuela where they will visit the savanna Caribbean Pine plantings in Estado Monagas. Their visit is hosted by CONARE (Compania Nacional de Reforestacion), September 29-October 3; it will include stops at G & Y plots established for the Caribbean Pine project in 1984, on both CONARE and CVG (Corporacion Venezolana Guayana) land holdings.

All travel and per diem costs associated with trips to Puerto Rico and Venezuela will be paid from project funds. Names and affiliations of individuals for these trips are listed in Appendices 1-4.

Other training accomplished with project funds was sending two Jamaicans to the Forestry Department at North Carolina State University, August 3-9 (Appendix 5). Trainees obtained "hands-on" experience with large diameter increment borers and laboratory equipment used to process wood samples for wood specific gravity determinations.

After the Puerto Rico meeting, one Costa Rican will travel to Colombia, September 29- October 5 (Appendix 2). He will visit Carton de Colombia land holdings and field research stations where management of tropical natural forests is being conducted.

One forester from Trinidad has been selected to attend the 1-month Forest Resource Administration and Management Course, September 30 to October 25. The travel/study course starts at the University of Michigan campus and ends in New York City. Classroom discussions and field trips will be used to evaluate the principles of integrated resource management to meet diverse forest management objectives. Stateside examples will be supplemented with the personal experience of all course participants.

Coordinating travel associated with these training activities is no small task. Special thanks is given to staff of the Office of Information, Cooperation, and Development, United States Department of Agriculture (USDA-OICD), Washington, DC, for their assistance in these efforts. Two individuals providing valuable support are Mr. Gregory Garbinsky and Ms. Carol Conditt. Also remembered are the many individuals at U.S. Embassies abroad and at the cooperator agencies, who successively handled those never-ending "last-minute" emergencies that occurred before training/travel activities ever began.

JAMAICA PRELIMINARY DATA SUMMARY

A copy of Mr. Andy Roby's M.S. thesis from the University of Oxford, relating to analysis of Caribbean pine G & Y data from Jamaica, was obtained and forwarded to all country counterparts. Mr. Roby supervised most of the field work for data taken in G & Y plots established in 1983. His thesis abstract is quoted here:

The object of this thesis is to study the growth and yield of Pinus caribaea var. hondurensis on different sites in Jamaica and to try and establish correlations between site factors and the production of timber. Data on growth, soils and rainfall were collected during an attachment in Jamaica to be processed for this thesis.

The influence of certain site factors, notably water availability, soil aeration and nutrients, are reviewed and their apparent influence on P. caribaea var. hondurensis growth discussed.

The literature on forest soils of Jamaica is reviewed and the latest data collected commented on. Briefly, soil texture was found to be variable though on the whole large amounts of small sized particles were found. Drainage and aeration were good due to steep slopes and good structure and rooting was rarely impeded. Nutrient elements were not found to be in short supply, and soil reaction was generally slightly acidic with the exception of the Limestone soils.

Forty-two research plots were established across the range of soil types and age classes, trees were measured, site descriptions were made, soil samples taken and the resulting data processed. Volume tables were constructed for each plot to calculate plot volume and figures for Mean Annual Increment (MAI) were derived. Site index, the dominant height at age 15 years, was taken to be the best reflection of site quality, though with reservations for the limestone soils.

Growth, as measured by dominant height and site index, was correlated with a number of soil variables, rainfall and Mean Daily Temperature (MDT) in a multiple regression programme. None of the soil variables were correlated with growth, suggesting that the nutrient elements assessed were not generally limiting growth. Rainfall was the most highly correlated variable but not high enough to be used solely as a growth predictor. It was felt that the rainfall data was too imprecise to yield good growth relationships and that the collection or assimilation of water-balance data may have confirmed the influence of water availability on the growth of Caribbean pine in Jamaica. Also texture and associated rooting depths are likely to be influential in the availability of water to the trees. Foxtail incidence was not well correlated with any of the soil and climatic data, and the influence of site on this trait has not been clarified by this study.

Finally, any implications for forest management in Jamaica arising from this study are noted in the last chapter.

One major task for all project counterparts at the Puerto Rico meeting is to review Mr. Roby's conclusions in detail. Final data analyses can then be suggested using parallel or divergent methodologies, depending on each country's short- or long-term needs in marketing or research.

Preliminary data summaries using US Forest Service Southern Station editing and analytical software were received in mid-July. These analyses centered on establishing functions for predicting height/diameter relationships at any specified tree height, based on relascope data obtained for each G & Y plot. Volume functions will be developed between now and 31 December 86.

Specific data findings will be presented to country counterparts at the Puerto Rico meeting. Some summary data are now listed:

Number of plots established:	42
Age range:	8-25 years
Mean plot outside bark diameter, breast height:	13.6 - 29.6 cm (8 yrs) (23 yrs)
Mean plot total heights:	9.2 - 27.7 m (8 yrs) (20 yrs)
Mean annual volume increments	8.9 - 50 m ³ /ha/yr (14 yrs) (23 yrs)

Using major soil regions within the country, mean annual height (MAIH) and mean annual diameter (MAID) increments for all or dominant/codominant (DOM) plot trees only can be summarized:

Soil/Geology Regions	MAIH ALL	MAIH DOM	MAID ALL	MAID DOM
	-----m-----		-----cm-----	
Cuffy Gully (Conglomerates)	1.2	1.3	1.4	1.6
Halls Delight (Calcareous Shales)	1.3	1.4	1.6	1.8
Limestone	1.1	1.2	1.5	1.6
Several Series (Metamorphics)	1.1	1.3	1.4	1.6
Valda (Porphyry & extrusives)	1.1	1.3	1.4	1.7

Still to be explored are relating G & Y data to Fertility Capability Classes (FCC), based on physical/chemical soil data collected for each plot. These data were obtained via plot soil samples analyzed at the Tropical Soils Laboratory, Department of Soil Science, North Carolina State University, Raleigh, NC. An initial 14 FCC groups have been reduced to 4 since low soil K and overall high acidity do not seem to be limiting tree growth.

UPCOMING WORK/ANALYSES

Discussions at the Puerto Rico meeting will determine scope and content for individual country final reports, due 31 December 86. Also to be decided is whether publication of results should be technical or non-technical in format, to promote most rapid use and dissemination of information to management planners, within and outside cooperator countries.

One idea is developing a non-technical "Case Book" for the Caribbean Pine project in each country. Total booklet length would be about 20 pages. The format consists of a line drawing or high quality photo on one page and a simply worded text on the opposite page to describe project goals/objectives, project participants, location of field plots, summary of soils/geology regions studied, and data obtained. Such a booklet could be used as a "high visibility" tool to promote country project accomplishments.

Only one more progress report is anticipated, that for FINAL RESULTS, some time after 31 December 86.

Appendix 1

Caribbean pine project sponsored training/travel of Jamaican foreign nationals for FY 86, in Puerto and elsewhere in the Caribbean.

Name	Employer Address	Birthdate	Place of Birth	Passport No.	Training Activity/Dates	Cost
Keith Porter	Jamaica Dept. of Forestry & Soil Conservation 144 Constant Spring Rd Kingston 8, JAMAICA Tel: 809:924-2125				Puerto Rico Forestry Meeting, Sept. 21-28; Venezuela pine plantings, 29 of Sept. to 4 Oct. 86	Per diem and incidental expenses, meeting fee of \$35, airfare: Kingston -Miami-San Juan-Caracas- Maturin, Venezuela- Caracas-Kingston.
Owen Evelyn	FIDCO PO Box 557 Kingston 10, JAMAICA Tel: 809-929-7271				(Same as for Porter above)	(Same as for Porter above)
Calvin Cottrell	(Same employer as Porter)				Puerto Rico Forestry Meeting only; 21-28 Sept.	Airfare only between Kingston-Miami-San Juan and return (per diem and meeting fees paid to Forest Dept. via local Kingston US-AID mission).

Appendix 2

Caribbean pine project sponsored training/travel of Costa Rican foreign nationals for FY 86, in Puerto and elsewhere in the Caribbean.

Name	Employer Address	Birthdate	Place of Birth	Passport No.	Training Activity/Dates	Cost
Pablo Camacho M.	Instituto Tecnológico de Costa Rica Apartado 159 Cartago, COSTA RICA Tel: 506-515333				Puerto Rico Forestry Meeting, Sept. 21-28; Venezuela pine plantings, Sept. 29-Oct. 4	Per diem and incidental expenses, meeting fee of \$35, plus airfare between San Jose and San Juan and San Juan -Caracas-Maturin, Venezuela-Caracas and San Jose.
Freddy E. Rojas	(Same employer as Camacho)				Puerto Rico Forestry Meeting, Sept., 21-28; Colombia forest plantings, Sept. 28-Oct. 5	Per diem and incidental expenses, meeting fee of \$35, plus airfare between San Jose-San Juan-Cali, Columbia-San Jose.

Appendix 3

Caribbean pine project sponsored training/travel of Trinidad foreign nationals for FY 86, in Puerto and elsewhere in the Caribbean.

Name	Employer Address	Birthdate	Place of Birth	Passport No.	Training Activity/Dates	Cost
Dr. Bal Ramdial Chief Conservator	Trinidad Forest Div. Private Bag 30 Port-of-Spain TRINIDAD Tel: 809-622-4860				Puerto Rico Forestry meeting, Sept. 21-23; Venezuela pine plantings, Sept. 29-Oct. 4.	Per diem and incidental expenses, meeting fee of \$35, plus airfare between Port-of-Spain San Juan -Caracas -Maturin -Venezuela - Port-of-Spain.
Kenny Singh	(Same as Ramdial above)				(Same as Ramdial above)	(Same as Ramdial above)
Lyndon Kaseram	(Same as Ramdial above)				Stateside Forest Resource Administration and Management Course, Univ. of Michigan Sept. 30 -Oct. 25.	\$4000 Course fee plus airfare from Trinidad on Sept. 28 to Ann Arbor, MI and return trip from New York City to Trinidad on Oct. 25.

Appendix 4

Caribbean pine project sponsored training/travel of Venezuela foreign national for FY 86, in Puerto and elsewhere in the Caribbean.

Name	Employer Address	Birthdate	Place of Birth	Passport No.	Training Activity/Dates	Cost
Ricardo Bellandi	COWARE Apartado Postal 17015 El Conde- Zone Postal 101 Caracas, VENEZUELA Tel: 582-781-1397				Puerto Rico Forestry meeting, Sept. 21-28.	Per diem and incidental expenses, meeting fee of \$35, plus airfare between Caracas and San Juan.

Appendix 5

Caribbean pine project sponsored training/travel of Jamaican foreign nationals for FY 86, in the United States

Name	Employer Address	Birthdate	Place of Birth	Passport No.	Training Activity/Dates*	Cost
Cedric George	FIDCO PO Box 557 Kingston 10, JAMAICA Tel: 809-924-2125				Forestry Dept. North Carolina State University; wood density field/lab work, Aug. 3-9.	Round trip airfare between Kingston and Raleigh-Durham, plus per diem and incidental expenses
Keith D. Porter	Jamaica Dept. of Forestry & Soil Conservation 144 Constant Spring Rd. Kingston 8, JAMAICA Tel: 809-924-2125				(Same as George above)	(Same as George above)

*Appreciation is given to staff of the Tree Improvement Cooperative, NCSU Forest Department, especially to Dr. J. B. Jett, for hosting this training activity.

1985 PROGRESS REPORT

for

U.S. Agency for International Development
Project AID/SCI/E2/06:
Growth and Site Relationships of Caribbean Pine...
in Jamaica, Costa Rica, Trinidad, and Venezuela

Project ID No.

AID/SCI/E2/06

2. E-06

Principal Investigator

Dr. Leon H. Liegel, Soil Scientist
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Apartado 159
Cartago, Costa Rica

Mr. Seepersad Rammarine
Asst. Conservator, Res.
The Forest Division
Pleasantville
San Fernando, Trinidad

Mr. Richardo F. Bellandi
Sección de Investigaciones
CONARE
Apartado Postal 17015
El Conde-Zona Postal 101
Caracas, Venezuela

Overall Project Objectives

Synthesize and publish growth and yield data from unthinned, unmanaged Caribbean pine plantations; determine how volume growth correlates with soil and site variables; develop a broad data base that local forest managers can use to promote more intensive and integrated forestry development; and establish more formal linkages between all forestry institutions involved in the study by providing training and by conducting cooperative research.

Prepared by:

Leon H. Liegel
LEON H. LIEGEL

10-8-85
DATE

Rec'd in SCI: JUN 24 1988

INTRODUCTION

This progress report covers project field activities completed from January 1 to June 30, 1985 and administrative matters completed or discussed through September 1985.

As careful scrutiny of the cover page shows, my mailing address is new: I am no longer surrounded by the sun, sea, and sand of Puerto Rico but by the mist, moss, and mountains of Oregon. On May 13 I transferred to the USDA Forest Service's Pacific Northwest Research Station at Corvallis, Oregon. Under an Interagency Agreement, I am assigned to the U.S. Environmental Protection Agency (EPA) national research program on acid rain. My new duties concentrate on determining the role of forest soils in reducing acid rain effects on soil chemical properties and associated lake water chemical properties. Authorization was granted, however, for my continuing to manage the Caribbean pine project.

Project correspondence will be sent out on stationery bearing the USDA Forest Service Pacific Northwest Research Station letterhead. All material and news coming to me about the project should be sent to the EPA Environmental Research Lab-Corvallis address, appearing on the cover sheet for this report.

GENERAL NEWS AND PROGRESS

A "no-cost" project extension through December 1986 was requested in February 1985. The extension would allow:

- more time to complete training of selected cooperator institution personnel,
- more time to identify and choose equipment/supply alternatives for cooperator institutions, and
- greater flexibility in completing growth and soil data analyses which were delayed several months for various reasons.

Extension authorization is expected in late October or early November.

Field work for growth and yield (G & Y) is now complete in all four cooperator countries. Soil samples have been taken in all countries but Trinidad and were forwarded to the North Carolina State University's Tropical Soils Program lab for analyses. Status of field and laboratory analyses and fertility capability classes (FCC's) for the soil data are summarized in Table 1.

Several papers were recently prepared that incorporate field data and observations made from the Caribbean pine project (Table 2). Appreciation is extended to the administrative and technical counterparts at each cooperator institution, as well as field and contract personnel, who contributed to the collection and interpretation of these data.

COUNTRY ACCOMPLISHMENTS

Costa Rica

I was in Costa Rica between March 8-22, training Forest Department staff from the Instituto Tecnológico de Costa Rica (ITCR) and conducting G & Y and soils field work. Between March and May, over 40 plots were established. Soils were collected from all plots; lab analyses are still pending (Table 1).

Special appreciation is given to several people who facilitated field work in Costa Rica: Humberto Perez and Jorge Rodriguez, in Heredia, and Francisco Lega, in Turrialba, for Scott Paper Company de Costa Rica, S.A. and Dr. Ivan Trubacek of Scott International Incorporated, Philadelphia, Pennsylvania.

Project funds totaling about \$6000 were used by ITCR to contract people for field work. Another \$1,400 was used to provide air transportation and monthly maintenance for the coinvestigator, Pablo Camacho, to attend a 3-month short course in forest biometrics from July to September 1985, at the Commonwealth Forestry Institute (CFI), Oxford University, United Kingdom.

Forest Engineer, Olman Murillo, a professor in the ITCR Forest Department, made a significant contribution to the project; he assembled all known references relating to Caribbean pine planting in Costa Rica. Anyone interested in obtaining a copy should request it directly from me.

Jamaica

Growth and yield data have been processed and edited by USDA Forest Service biometrics staff in New Orleans, Louisiana. Several FCC groupings have been tried for the soils data. Correlations of soil data with G & Y data will begin soon.

Andy Roby, who led field work in Jamaica in 1983-84, is still working on G & Y data for his master's thesis at CFI in Oxford. He should complete this work by the end of October 1985. Mr. Roby and Pablo Camacho of Costa Rica compared notes on their respective data sets at Oxford, including comparison of their volume estimates with those generated by computer programs of the USDA Forest Service staff in New Orleans. Results of this comparison are still pending.

Owen Evelyn and Michael Bernhard, both of FIDCO (Forest Industries Development Corporation) in Jamaica, attended the North Carolina State University Forest Department 3-week short course on tree improvement for tropical tree species, March 1985. Their attendance was not sponsored by project funds. However, the knowledge they gained will be used to interpret results and make management recommendations from data collected in the project.

Wood core work to assess Caribbean pine specific gravity (1984 calendar year report) could not be started for logistical reasons. No rescheduling of similar work is planned.

The local coinvestigator, Donald Thompson, will return to the United Kingdom in December 1985. No replacement for his position in the project has been named yet.

Trinidad

From October 1984 through May 1985, 41 G & Y plots were established with the efforts of local coinvestigator, Seepersad Ramnarine, and his research staff. Soil samples are being collected (Table 1).

Two soil augers have been ordered and will be forwarded to aid field soil sampling work. Other equipment needs are being identified; selected items will be purchased and forwarded to the Forest Division in late 1985.

The U.S. Embassy's Commercial Officer, Mr. Guido Cammillo Fenzi, retired in September. Since late 1983, Mr. Fenzi was very instrumental to the project by forwarding reports and data sheets to Mr. Ramnarine from Puerto Rico. His replacement is Mr. Edward Olson who has promised to assist the project as did Mr. Fenzi.

Venezuela

Chemical and physical data now exist for soils collected in the 46 G & Y plots established in late 1984. Initial FCC groupings are still pending (Table 1).

Three CONARE (Compania Nacional de Reforestacion) personnel attended a 1-month short course on forest harvesting in Chile, March-April 1985. The course included 2 weeks of classroom sessions and 2 weeks of field visits to harvesting operations of Pinus radiata.

Air transportation, lodging/tuition, and miscellaneous expenses for the course were paid with project funds. All training and equipment needs identified for Venezuela have now been met.

Mr. J.J. Cabrera Malo, administrative contact for the project in Venezuela, retired from CONARE. His replacement is Anibal Luna Lugo.

OTHER ACTIVITIES

Puerto Rico

Soil sampling was completed for over 30 Caribbean pine plots in Puerto Rico; field and laboratory sampling procedures were almost identical to those used in the Caribbean pine project. A slight modification was that soil sampling depths were 0-30 and 31-100 cm instead of 0-20 and 21-100 cm.

Most G & Y plots were initially measured in 1975; they were remeasured in 1984-85 with the help of Mr. M. Zakir Hussain, a doctoral candidate in Yale University's Tropical Resources Institute (TRI) program. Mr. Hussain has completed preliminary site index curves for the combined 1975/84-85 data sets. He is now correlating G & Y data with FCC groupings from the soils data base.

Miss Asmeen Khan, a master's degree candidate in Yale University's TRI program, collected wood cores to determine specific gravity for the same plots assessed by Mr. Hussain. Analyses and conclusions on their joint efforts will be completed in 1986.

Results of provenance, tree improvement, spacing, and other research studies on Caribbean pine in Puerto Rico were summarized for a IUFRO meeting on tree genetics and tree improvement, held in Zimbabwe, Africa, April 1984. These papers have now been published (Table 3). Other research on Caribbean pine in Puerto Rico was summarized (Table 3).

Elsewhere

Assessing suitability of Caribbean pine wood for stable shavings has been cancelled. Work on this subject may be started if other interested researchers and funding are located.

Surinam Forest Service personnel were indirectly briefed on progress with the project through a visit by George Gibson of CFI. He visited Surinam in January 1985 after stopping in Puerto Rico to revisit Caribbean pine plots that he had assessed in 1979 (see Silvicultura reference, Table 3). Caribbean pine is no longer actively planted in Surinam. However, overall project results may indicate how Surinam's existing pine resource can be utilized and managed more effectively.

CONARE in Venezuela has begun a 4-year project to plant 180,000 ha to Caribbean pine in the eastern savannas. Total project cost is estimated at 86.3 million (U.S.) dollars. Of this amount, 40% will come from an Inter-American Development Bank loan; the Government of Venezuela will cover the remaining 60%. A target of 12,000 ha has been set for planting in 1986. The magnitude of this planting endeavor emphasizes the importance of the US-AID Caribbean pine project in determining whether local microsite factors of soil and environment influence growth and yield.

Budget/Planning

The proposed budget for Fiscal Year 1986 is outlined in Table 4. The majority of funds are targeted for training foreign nationals from Trinidad/Tobago and Jamaica in the United States and Puerto Rico. Training goals for cooperator personnel from Venezuela and Costa Rica have essentially been met.

Determining suitable publication outlets for project information is now underway. At least two papers are planned for each country: one summarizing G & Y data and another outlining soils data and correlations with G & Y data.

Table 1. Status of field and laboratory data summarization in the Caribbean pine project, September 1985: D = Done, IP = In Progress, P = Pending.

Countries	Field Growth/Yield Plots	Field Soil Sampling	Soil Chemical Lab Work	Preliminary Soil Fertility Groupings	Preliminary Growth & Yield Computer Data Summaries
Costa Rica	D	D	P	P	P
Jamaica	D	D	D	D	D
Trinidad	D	IP	P	P	P
Venezuela	D	D	D	IP	P
Puerto Rico*	D	D	D	D	D-1975 P-1984-85

*Puerto Rico is not a direct recipient of grant funds but serves as a comparison against which to measure Caribbean pine growth and yield data obtained from other countries.

Table 2. Recent papers that incorporate field data and observations from the Caribbean pine project, through August 1985.

Authors	Date and Publication Information
Leon H. Liegel	Issues of plantation forestry in watershed management on small Caribbean islands in the 1980's. In: Lugo, A.E.; Brown, Sandra, eds. Watershed management in the Caribbean. Proc. Second Workshop of Caribbean foresters; 1984 March 19-23; Kingstown, St. Vincent. Rio Piedras, PR: U.S. Department of Agriculture, Forest Service, Institute of Tropical Forestry, and Man and the Biosphere; 1985: 147-154.
L.H. Liegel, Roy Jones, Guy Symes, Bal Ramdial, and J.J. Cabrera Malo	US-AID Supports study of Honduras pine in the Caribbean. J. Forestry 83(6): 376-377; 1985.
Charles R. Venator, Leon H. Liegel, and James P. Barnett	Bare-root versus container production of pines in the American Tropics. Paper presented at International Symposium on Nursery Management Practices for the Southern pines, 1985, August 4-9, at Auburn University. Auburn, Alabama (paper will be published in Proc. of meeting).

Table 3. Some recent papers summarizing Caribbean pine research in Puerto Rico.

Authors	Date and Publication Information
Leon H. Liegel	In: Barnes, R.D.; Gibson, G.L. eds. Provenance and genetic improvement strategies in tropical forest trees; 1984 April 9-14; Mutare, Zimbabwe. Oxford, United Kingdom; Commonwealth Forestry Institute; 1984, pages:
	Density effect on <u>Pinus caribaea</u> growth at 18-20 years in Puerto Rico, p. 560-561.
	Growth and performance in young <u>Pinus caribaea</u> provenance trials in Puerto Rico on eight sites, p. 320-321.
	Growth and performance in young <u>Pinus oocarpa</u> provenance trials in Puerto Rico on eight sites, p. 324-325.
	Growth and selection traits of Mt. Pine Ridge, Belize, plus-tree progeny in Puerto Rico at 11.6 years, p. 554-555.
	Height and diameter growth correlations with soil variables for normal-branched and foxtail <u>Pinus caribaea</u> provenances in Puerto Rico, p. 322-323.
	Hurricane susceptibility of <u>Pinus caribaea</u> and <u>Pinus oocarpa</u> provenances in Puerto Rico, p. 318-319.
	Normal-branched and foxtail <u>Pinus caribaea</u> height and diameter growth correlations with several foliage variables in Puerto Rico, p. 358-359.
	Overall growth of early-distributed Mountain Pine Ridge <u>Pinus caribaea</u> seed sources in Puerto Rico, p. 562-563.
	Regional assessment of <u>Pinus caribaea</u> growth and yield on diverse soils in selected countries of the Caribbean Basin, p. 356-357.
	Ten-year growth results of <u>Pinus caribaea</u> and <u>Pinus oocarpa</u> provenance trials in Puerto Rico, p. 326-327.
	Growth, form, and flowering of Caribbean pine families in Puerto Rico. <i>Commonw. For. Rev.</i> 64(1): 67-74; 1985.
	Results of 5- to 6-year-old provenance trials of <u>Pinus oocarpa</u> Schiede on eight sites in Puerto Rico. <i>Silvae Genetica</i> 33(6):223-230; 1984.

Table 3. (cont.)

Authors	Date and Publication Information
L.H. Liegel, R.D. Barnes, and G. Gibson	Status, growth, and development of unthinned Honduras pine plantations in Puerto Rico. Turrialba 34(3):313-324; 1984.
L.H. Liegel, W.E. Balmer, and G.W. Ryan	Growth and selected assessment traits of <u>Pinus caribaea</u> and <u>Pinus oocarpa</u> provenance trials in Puerto Rico. <u>Silvicultura</u> 29:107-111; 1983.
L.H. Liegel, W.E. Balmer, and G.W. Ryan	Honduras pine spacing trial results in Puerto Rico. South. J. Appl. For. 9(2): 69-75; 1985.

Table 4. Estimated Fiscal Year 1986 budget for Caribbean pine project AID/SCI/E2/06.

Budget Items	(dollars)
Personnel (salary & benefits)	
GS-2 Secretary	8,000
GS-3 Draftsman	1,500
Materials & Equipment	5,000
Photographic work for publications	1,500
Training/Consultation	22,000
Subtotal	<u>38,000</u>
PASA Overhead (25%)	9,500
Total	<u>47,500</u>

Southern Forest Experiment Station
Institute of Tropical Forestry
P.O. Box AQ
Río Piedras, Puerto Rico 00928



U.S. FOREST SERVICE
INSTITUTE OF TROPICAL FORESTRY
RÍO PIEDRAS, PUERTO RICO

Forest
Service

1530

April 26, 1985

2. E. 06

Dr. James Hester
LAC/DR/MA
Main State Building
Room 2252
Agency for International Development
Washington, DC 20523

Dear Dr. Hester:

As we discussed on the telephone about two weeks ago, my transfer with the U.S. Forest Service to Corvallis, Oregon will necessitate some changes in completing project 2 E-06, Growth & Site Relationships of Caribbean Pine. Prior request and verbal authorization for delaying project completion until December 1986 will, fortunately, make these changes minor in nature. The original extension was requested to allow three of the cooperator institutions more time to complete training activities in the United States or elsewhere (c.f. my 1530 letter to you, February 25, 1985).

A tentative scenario for the rest of the project is as follows:

May - October 1985

Liegel becomes acquainted with new job at Corvallis, Southern Station biometrics completes processing of cooperator country growth and yield data (Jamaica and Venezuela data at New Orleans already; that from Costa Rica and Trinidad taken and being forwarded to Liegel now).

North Carolina State University (NCSU)-Tropical Soils Program-completes soils analyses (soils for Jamaica processed, those for Venezuela being worked on, those for Costa Rica and Trinidad being shipped now to NCSU).

November 1985 - February 1986

Country reports drafted and sent to technical counterparts for approval/reworking.

March - July 1986

Country reports reworked.

August - November 1986

Country reports finalized and sent out to appropriate journals for publishing; draft final report to AID for review.

December 1986

Final AID Progress report submitted.

Rec'd in SUI JUN 14 1985



As the work schedule indicates, "service work" will be done for the grant by SO biometrics and the NCSU Soils Department between May to October 1985. Training of personnel for cooperator institutions will continue, even after my transfer to Corvallis. I will coordinate all training activities and budget revisions though G. Garbinsky at USDA-OICD.

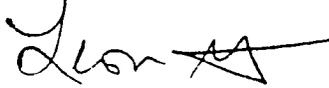
If there are any questions on this work plan, please write me at my new address:

Leon H. Liegel
Envir. Protection Agency
200 S.W. 35th Street
Corvallis, OR 97333

D. E. O'G

The FTS telephone numbers at the EPA lab are: 420-4600 or 420-4609. Ask for the Acid Rain research-Soil Survey team extension.

Sincerely,



LEON H. LIEGEL
Research Soil Scientist

- xc: D. Harcharik, Director USFS International Forestry
- G. Garbinsky, USDA-OICA, WO
- L. Desselle, FM-SO
- R.P. Schultz, AD-SO
- D. Boelter, AD-South, PNW

Rec'd in SOI JUN 24 1988



United States
Department of
Agriculture

Forest
Service

Institute of Tropical Forestry
P.O. Box AQ
Rio Piedras, Puerto Rico 00928
Tel. 763-3939

6310

February 12, 1985

2. E. 06

Dr. Irvin M. Asher
Science Program Director
Office of the Science Advisor
U.S. Agency for International Development
Washington, D.C. 20523

L

Dear Dr. Asher:

Project AID/SCI/E2/06, "Growth and Site Relationships of Caribbean Pine Plantations Located on Diverse Soils in Jamaica, Surinam, Trinidad, and Venezuela," ends December 31, 1985. This letter is a formal request to seek a no-cost extension of the PASA project through December 1986 because of circumstances that have arisen since the project proposal was submitted in 1982. Briefly summarized, these circumstances are:

1. Excellent cooperative research ties have been established in all countries thus far, including Costa Rica which has replaced Surinam. However, monies marked for institution building and training of foreign nationals have not been spent as fast as anticipated. In-country administrative procedures have delayed arranging and implementing formal coop agreements to execute expenditures for training activities. Extending the PASA agreement for another year would allow cooperator institutions more time to spend money on training and other activities that have not yet been accomplished (see attached budget table).
2. Because of the excellent working relationships that have been developed with forestry cooperator and other institutions in all countries, several activities are now underway that were not included in the original project work plan. The most important of these is assessing wood specific gravity or density in all field plots where growth and yield plus soils data have been or remain to be collected. This work is a tremendous undertaking, but all of my technical counterparts are eager to begin it because quantitative data obtained will determine whether the local pine resource is best suited for structural lumber or only posts and poles. Extending the project another year would allow additional field work to be completed. Such field work would also serve in all instances as training activities for local personnel.
3. When my project proposal was submitted in 1982, I assumed that one or two staff vacancies in my work unit would be filled shortly thereafter. However, two vacancies in hardwood silviculture that occurred in 1980 still have not been filled and will remain unfilled indefinitely. Time that I use to carry on and write up final results from non-pine work limits the time available for my working on the Caribbean pine project. Therefore, extending the PASA project for another calendar year will enable me to accomplish all work that



Table 1.-- Projected and actual expenditures by cooperator countries in US-AID Caribbean Pine Project (AID/SCI/E2/06) for training, institution-building, and equipment.

Country	Projected (December 1985)	Actual (April 1985)
	----- \$ Expenditures -----	-----
Costa Rica	8,000	4,400
Jamaica	16,000	5,700
Trinidad	16,000	3,550
Venezuela	16,000	17,400

PROGRESS REPORT

for
U.S. Agency for International Development
Project AID/SCI/E2/06:
Growth and Site Relationships of Caribbean Pine...
in Jamaica, Costa Rica, Trinidad, and Venezuela

Project ID No. AID/SCI/E2/06

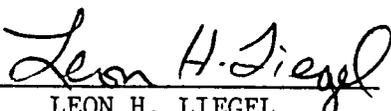
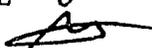
Principal Investigator Dr. Leon H. Liegel, Soil Scientist
USDA Forest Service
Southern Forest Experiment Station
Institute of Tropical Forestry
P.O. Box AQ
Rio Piedras, Puerto Rico 00928 Tel. 809-763-3939
(FTS) 8-753-4335

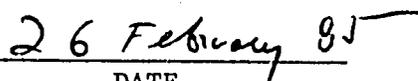
Co-Investigators

Mr. Donald Thompson Senior Research Officer Jamaica Forest Service 2 South Odeon Rd. Kingston 10, Jamaica	Ing. Pablo Camacho Mora Inst. Tecnológico de Costa Rica Apartado 159 Cartago, Costa Rica
Mr. Seepersad Ramnarine Asst. Conservator, Res. The Forest Division Pleasantville San Fernando, Trinidad	Mr. Ricardo F. Bellandi Seccion de Investigaciones CONARE Apartado Postal 17015 El Conde-Zona Postal 101 Caracas, Venezuela

Project Overall Objectives Synthesize and publish growth and yield data from unthinned, unmanaged Caribbean pine plantations; determine how volume growth correlates with soil and site variables; develop a broad data base that local forest managers can use to promote more intensive and integrated forestry development; and establish more formal linkages between all forestry institutions involved in the study by providing training and by conducting cooperative research.

Prepared by:


LEON H. LIEGEL



DATE

INTRODUCTION

This is the second full report of accomplishments for the Caribbean pine research project. It supplements a progress report for the first half of calendar year 1984. Accomplishments for early 1984 are reviewed briefly; major emphasis is on activities finished in late 1984 and upcoming activities in 1985. Project technical and administrative contacts are shown respectively on the outside front cover and in Table 1.

Established objectives of the project are:

- determine which soil physical and/or topographic and climatic variables exert greatest influence on growth and yield (G & Y) of Caribbean pine;
- determine whether soil properties influencing growth of Caribbean pine are located in surface (20 cm) or subsurface (21 to 100 cm) horizons;
- assess influence of soil properties and climatic/topographic variables on foxtailing, form, stem taper, bark thickness, and other growth traits for P. caribaea growing on diverse sites;
- collect and interpret both new and existing growth data so that local and regional site index curves, diameter distributions, and taper functions can be developed for Caribbean pine; and
- provide a data base that can be used by local managers, foresters, ecologists, and economists for rational decision making about plantation alternatives in cooperator countries.

To achieve these objectives, a 3-year project with four distinct stages began in December 1982:

- 1- collecting, analyzing, and synthesizing existing but non-published Caribbean pine research data;
- 2- identifying and completing forestry training/consultation activities for local technical and scientific staff of cooperator institutions;
- 3- conducting new field research to augment existing but non-published soil/site interpretations for Caribbean pine; and
- 4- publishing and disseminating results from synthesis and new field research activities.

COUNTRY ACOMPLISHMENTS

Jamaica

Growth and yield plots were established at 42 sites, with soil samples taken in each plot. As a cooperative venture with the Rural Physical Planning

Table 1.- ADMINISTRATIVE CONTACTS FOR CARIBBEAN PINE PROJECT

Trinidad

Dr. Bal Ramdial, Head Conservator
Forest Division
Ministry of Agriculture, Lands, and
Food Production
Port-of-Spain, Trinidad
Tel. 62-23217
26-24860

Jamaica

Mr. Roy Jones, Head
Department of Forestry and
Soil Conservation
144 Constant Spring Road
Kingston 8, Jamaica
Tel. 925-7469

Mr. Guy Symes, Director
Forest Industries Development Corporation
(FIDCO)
P.O. Box 557
Kingston 10, Jamaica
Tel. 929-7272

Venezuela

Dr. J.J. Cabrera Malo
CONARE
Apartado Postal 17015
El Conde-Zona Postal 101
Caracas, Venezuela
Tel. 781-13-97
781-53-42

Costa Rica

Ing. Julio Cesar Calvo A., Director
Depto. de Ingenieria Forestal
Instituto Tecnologico de Costa Rica
Apartado Postal 159
Cartago, Costa Rica
Tel. 51-53-33

Division of the Ministry of Agriculture, 16 soil pits were also dug. Soils in the pits will be classified according to criteria of USDA Soil Taxonomy so that inferences about classification, genesis, and morphology can be made. Soil samples from the pits were collected and are being analyzed locally in Jamaica. Their physical and chemical properties will be compared with those found in plot soil samples being analyzed at the Tropical Soils Section of the Soil Science Department at North Carolina State University (NCSU) in Raleigh, North Carolina.

Mr. Andy Roby, formerly employed as a Forest Officer by the Forest Industries Development Corporation (FIDCO) returned to the United Kingdom (UK) in August. He was the primary local counterpart, sponsored by the UK Overseas Development Corporation, who supervised taking plot and soils data. Mr. Roby is now working on a Master of Science degree in Forestry at the Commonwealth Forestry Institute at Oxford University. He is using project G & Y data for his thesis project. He will analyze Caribbean pine volume production from all plots and develop managerial guidelines for FIDCO regarding future exploitation and cutting practices.

Miss Lecia Foster of the Forest and Soil Science Department (the Department) in the Ministry of Agriculture attended a week long meeting on integrated pest management at the Univ. of Georgia in Athens from June 18 to 21. Afterwards, she spent two weeks visiting other university and U.S. Forest Service insect/disease research projects in the Southern United States. Her entire trip was a professional training activity sponsored by project funds.

Upcoming activities in 1985 include finalizing a field sampling scheme for assessing wood specific gravity of Caribbean pine in Jamaica. Wood core analysis will be paid with project funds and will include unextracted specific gravity (water displacement method) and probably fiber (tracheid) length. Two employees of the Department are scheduled to attend the third meeting of IUFRO working group S1.07.09 on Forest Plantations in the Neotropics, to be held at CATIE in Turrialba, Costa Rica, June 24 to 28. The major topic will be fuelwood research and development projects in the Caribbean and Latin America. The selected Department individuals will attend the meeting as a project training activity. Two FIDCO employees will attend a 3-week short course on tropical tree improvement at NCSU's Forestry Department, March 11-29. Project funds are not sponsoring this training, but logistical support was given in identifying the training alternative and encouraging attendance by Department or FIDCO personnel.

Trinidad

I visited and worked with the Forestry Division from September 28 to October 4. Mr. Seepersad Ramnarine and I spent two days reviewing local soil and geology maps and data on Caribbean pine plantings in the different forest coupes. We identified 49 potential sites for establishing field plots. Of these we selected two, at Long Stretch (Comuto) and Valencia for the purpose of training local professional and technical staff in setting up G & Y plots and sampling the soils within them. Both plots were finished and completed data sheets will serve as guides for local Division personnel in conducting the remaining field research.

During the 2-day training, considerable time was spent reviewing criteria for selecting plus or phenotypically superior trees for tree improvement work. This work was done in preparation for the arrival of Dr. F. Mergen, a forest geneticist from Yale University, who will spend three weeks in March 1985 making suggestions about tree breeding and tree improvement programs. With the cost of Caribbean pine seed at \$300 or more per kilo and the extensive local pine resource in Trinidad, local pine seed production for reforestation is a priority concern.

To strengthen local expertise in tree improvement principles and practices, the project will sponsor one Division employee's attendance at a 3-week short course at NCSU in March 1985. Two previous courses held at NCSU on the same topic have been very successful for tropical foresters. One other upcoming training activity in 1985 will be sponsoring another Division employee to attend a 1-week conference on Southern pine nursery management at Auburn, Alabama in August. Pine seedlings are produced in containers at present in Trinidad but bare-root production should not be ruled out for more intensive planting efforts in the future.

Contacts were made at the U.S. Embassy to facilitate sending small equipment items to the Division from Puerto Rico and expediting off-island training of Division personnel in the United States. The primary contact is Mr. Guido Cammillo Fenzi, First Secretary.

Dr. S. Griffith of the Univ. of the West Indies Soil Science Department was briefed about overall project objectives. He agreed to make on-site descriptions of soils at selected field plots and to try and find local masters degree or honors university students who could contribute to correlating local soils data with volume production of Caribbean pine. Of particular interest is comparing Fertility Capability Classification (FCC) classes with the Storie/Searl index of ranking productivity of different soils. The Storie system was developed by Dr. R.F. Storie in the late 1930's in the United States. The index system was adapted to Trinidad conditions by Searl in the 1960's; it uses physical rather than chemical properties to rate soil productivity.

Venezuela

I visited and worked with personnel of CONARE (Corporacion Nacional de Reforestacion) between October 4 to 18. We established 46 G & Y plots and collected soils in each one. Plantations measured ranged in age from 4 to 15 years old and included some of the oldest stands established in the Eastern Savanna region. Areas measured included Cachipo, Chaguaramas, Guayamure and Centella. Some plots were also established on lands belonging to the Corporacion Venezolana Guayana (CVG) at Uverito. Personnel from CVG helped in locating and establishing field plots. Soils from the plots were forwarded to NCSU for analyses. Time did not allow any field work at Nirgua, between Caracas and Merida, in upland areas. Mr. R. Bellandi will sample this area in 1985, according to procedures used in all other field plots.

One special field trip was made to the area of Amansaguapos, about 1 1/2 hours South of Puerto Ordaz. At the request of CVG administration, I helped assess the site for its suitability as a seed stand or clonal orchard for seed

production. About 100 ha was planted in the area by FAO in 1968. Although growth of the trees was good in the wetter environment (\pm 1600 mm) than that found around Chaguaramas/Uverito (1000 mm), cone production was poor; access was almost impossible, even with jeep vehicles; and soils were very shallow and clayey. Thus, the site was judged unsuitable for seed production. Subsequent field visits and talks by CONARE and CVG personnel with Dr. B.J. Zobel of NCSU in December showed that initial Caribbean pine seed production efforts should be concentrated in the uplands around Nirgua, and not in the lowland savannas until phenology of Caribbean pine in the lowlands is thoroughly studied.

The sending of three CONARE personnel to a 4-week short course on forest harvesting in Chile was rescheduled from November 1984 to March-April 1985. The course was developed especially for CONARE by forestry staff from the University of Chile in Santiago. It will include two weeks of classroom sessions and two weeks of practical field demonstrations on harvesting Pinus radiata in Chile. Similarity of afforesting native savanna areas in Chile and Venezuela and the common language of both countries favored developing the harvesting training in Chile rather than elsewhere in Latin America or in the United States.

Costa Rica

Arrangements were made with administrative staff of the Technological Institute of Costa Rica (Instituto Tecnológico de Costa Rica-ITCR) to include ITCR in the Caribbean pine project. The administrative contact is Ing. Julio Cesar Calvo A., Director of the Forest Engineering Dept.; Ing. Pablo Camacho Mora is the technical contact. Drafts of a cooperative agreement for the proposed work were exchanged in late 1984. The final version will be signed before field work begins in March 1985. A budget for local field, administrative, and training activities for ITCR are shown in Table 2.

Initially, 40 field plots will be established. This is comparable to the number of plots already established in Jamaica and Venezuela and planned for Trinidad. Later, about 20 additional plots will be established by ITCR personnel so that the entire range of volcanic ash, alluvial, and other soils are sampled for response of Caribbean pine growth and yield on local soils in Costa Rica.

OTHER ACTIVITIES

Project proposals were exchanged with Dr. A.A. Moslemi, Dean, Department of Forest Products at the Univ. of Idaho, in Moscow, Idaho. Dr. Moslemi is principal investigator for another AID Science Advisor grant (AID/SCI/-17) which is investigating the compatibility of wood with cement for several forest species in Honduras. The target product is cement-bonded panels; species included in the project are P. caribaea as well as P. tecunarii, P. maximinoides, P. oocarpa and locally grown sugar cane. I advised Dr. Moslemi that a) Trinidad had an earlier FAO project to study suitability of pine fiber for cement board and b) promised to forward him results from that project and citations regarding wood specific gravity in young trees from Trinidad.

Table 2.- PROPOSED BUDGET FOR CARIBBEAN PINE PROJECT IN COSTA RICA BY
 INSTITUTO TECNOLOGICO DE COSTA RICA

<u>Budget Item</u>	<u>\$ (U.S. Dollars)</u>
Contracting technical and field personnel	1453.70
Non-personnel services, including per diems	3605.55
Materials	421.05
10% administrative overhead	554.00
Training activities (external to Costa Rica)	<u>1965.70</u>
Total	8000.00

31

Interviews were held with race horse owners, trainers, and others in Trinidad, Venezuela, and Puerto Rico regarding the use of pine wood for stable shaving. Pine shavings are preferred over other bedding materials such as straw and processed cane fibers. Materials available in Puerto Rico all come from door, window, and furniture factories and are almost always too dusty. Because of the large amount of raw pine resource in Trinidad and Venezuela and the ongoing Caribbean Basin Initiative, developing an non-traditional wood product (i.e. pine shavings) might be a possible money making venture for country forest agencies and/or private investors. Formulating a research and development or practical research project is now being investigated with Dr. Moslemi and Doctors Andrew J. Baker and John I. Zerbe of the U.S. Forest Service's Forest Products Laboratory in Madison, Wisconsin.

Soil chemical and physical properties for determining FCC categories of soils sampled in Jamaica and Venezuela were completed at NCSU. Dr. Stanley W. Buol of NCSU's Soil Science Department is making the preliminary groupings for all samples that were collected. Correlations will then be sought between soil groupings and Caribbean pine growth and volume data that are being processed at the Forest Service's Southern Station office in New Orleans, Louisiana.

The article submitted to the Journal of Forestry entitled "US-AID Supports Study of Honduras pine in the Caribbean" was accepted for publication as a research note. It will appear in early 1985 and will acquaint a general stateside audience with the project; it will also provide up-to-date estimates of total areas planted to Caribbean pine in all cooperator countries. Coauthors are Liegel and administrative contacts for the project.

Another manuscript is being prepared for the IUFRO Nursery Operations Working Group (S3.202.03) international symposium on nursery management practices on Southern pines at Auburn, Alabama in August 1985. Its title is "Bare-root versus container production of Caribbean pine in the American tropics." Research and operational plantings with Caribbean pine will be discussed. Focal point of the paper will be the large-scale successful bare-root plantings by CONARE and GVG in Venezuela's Eastern Savannas.

The one page "news release" on the project that was sent to over 100 regional and international journals in early 1984 was published in at least 14 (Table 3). A half-dozen responses were received from active or retired forestry researchers who volunteered information about their own experiences with Caribbean pine in other countries. All respondents were added to the project's mailing list to receive progress reports.

Table 3.- JOURNALS THAT HAVE PUBLISHED A "NEWS NOTE" ON THE CARIBBEAN
PINE PROJECT

Chile Forestal
Chilean Forestry News
Ciencia Forestal
Florida Forester
Forestry Abstracts
Forest Ecology and Management
Interciencia
ISTF News
Revue Forestiere Francaise
Silvae Genetica
South African Forestry Journal
Turrialba
Venezuela Forestal
World Wood

PROGRESS REPORT

2. E. 06

for

U.S. Agency for International Development
Project AID/SCI/E2/06

Growth and Site Relationships of Caribbean Pine Plantations

January 1 - July 31, 1984

Prepared by:


LEON H. LIEGEL

25 Sept. 84
Date

Research Soil Scientist
Institute of Tropical Forestry
Southern Forest Experiment Station
Rio Piedras, Puerto Rico 00928

Rec'd in SCI: JUN 11 1984

This report describes events and progress on the Caribbean pine project during the first seven months of 1984. July was included because two significant activities terminated in that month. The report is in three parts: General Progress, Specific Progress (by country), and Future Activities, to facilitate review.

General Progress

Information on the project was distributed to over 100 regional and international journals as a 1-page "news release", soliciting help and information from others also working with Caribbean pine. Thus far, notices of the project have been printed in ISTF news, Forestry Abstracts, Ciencia Forestal (Mexico), Chilean Forestry News and Chile Forestal, Forest Ecology and Management, Revue Forestiere Francaise, and Venezuela Forestal.

Others sent information on the project via the 1983 calendar year Progress Report were: over 40 individual researchers in both hemispheres; US-AID missions in Haiti, Ecuador, and Costa Rica; the U.S. Department of Commerce; and the University of Idaho.

A manuscript entitled "US-AID Supports Study of Honduras pine in the Caribbean" was edited by peers and is now in final editorial process at New Orleans. Coauthors are Liegel and agency heads in cooperator countries: Jones and Symes (Jamaica), Ramdial (Trinidad), and Arellano (Venezuela). The outlet is a "note" in the Journal of Forestry, to acquaint a general stateside audience with the project and to release up-to-date estimates of total areas planted to Caribbean pine in all cooperator countries.

Growth and yield field data collected in Jamaica between October 1983 and March 1984 are now being analyzed by the Forest Service Biometrics section at New Orleans. Soil chemical and physical analyses of Jamaican soils have been delayed at North Carolina State University (NCSU) Tropical Soils Laboratory, in Raleigh, because of staff reductions. A cooperative agreement is now being prepared to have pending and future samples analyzed at the NCSU lab on a "cost" basis.

Additional Caribbean pine growth and yield plots were established in St. Lucia (2) and Dominica (1) by local forestry personnel, using the same techniques as those used in grant cooperator countries. Plantation inventory data from St. Vincent, although collected by different field techniques, can also be integrated. Data from St. Vincent were collected in conjunction with another US-AID funded project which has inventoried that island's natural and planted forests.

Officials from the Technological Institute of Costa Rica, Cartago, have agreed to participate in the project, in place of Surinam. A cooperative agreement is now being drafted to outline research responsibilities between the U.S. Forest Service and the Cartago Institute.

Specific Progress

Venezuela

The Corporación Nacional de Reforestación (CONARE) supported leave for one of its employees, Mr. Ricardo Bellandi to attend NCSU between January 10 and July 17, 1984. While at NCSU, tuition, book expenses, and round-trip airfare for Mr. Bellandi were paid with grant monies. Mr. Bellandi completed course work in tree genetics, tree improvement, and statistics. He also finished a detailed tree improvement plan for CONARE plantation holdings in Venezuela. Successful implementation of the plan in Venezuela will provide benchmark guidelines for tree improvement activities in other cooperator countries.

On the return trip to Venezuela, Mr. Bellandi stopped in Puerto Rico and visited the Institute of Tropical Forestry. He saw the Río Piedras laboratory, nursery, and office facilities as well Caribbean pine spacing, international provenance trial, and seed orchard plantings in eastern Puerto Rico. Most plantings were growing at rates much greater than those seen in Venezuela.

Jamaica

In Jamaica, 42 growth and yield plots were established by March 1984; soil samples were collected for all plots and nine soil pits (to 1 meter depth) were also dug so that detailed soil descriptions could be made.

Local cooperators decided that breast height wood specific gravity data should also be collected to supplement the detailed growth and yield and soils data that had been taken. Two 12 mm increment borers were purchased and forwarded to Jamaica, one to reside with the Forest Industries Development Corporation (FIDCO) and the other with the Department of Forestry and Soil Conservation. All trees on 1 of the 42 plots were sampled to determine minimum sampling intensity required for the remaining plots. Wood samples will be analyzed at NCSU's Forestry Department.

In conjunction with specific gravity field sampling, 20 trees were felled (down-trees) at one plot to obtain measurements that could be compared with relaskope estimates of single-tree volumes. Analysis of these data will determine accuracy of relaskope-derived data.

The Forest Department approved a trip by Miss Alecia Foster to visit the United States and obtain one month of training in forest insect and disease research. She attended an integrated pest management symposium in Athens, Georgia, June 18-21. Afterwards she visited U.S. Forest Service insect and disease installations in Asheville, N.C., Pineville, Louisiana, and the University of Florida, at Gainesville. Miss Foster's expenses for this training were paid with grant monies.

Trinidad

A suitable mechanism is still being sought to develop a cooperative agreement with the Forest Division in the Department of Agriculture, Lands, and Food Production. A future visit will hopefully put this part of the project on

track. If an official agreement is not feasible, then other means must be used to complete training and institution-building components of the grant, as well as anticipated field work.

Surinam

Local officials were sent the 1983 Progress Report and publications on Caribbean pine research in Puerto Rico. Reciprocal correspondence regarding actual Surinam holdings of Caribbean pine at this time and status of local pine research efforts is still pending.

Future Activities

Field work for Venezuela is scheduled for September 3-27. On the way to Venezuela, a stop will be made in Trinidad to schedule future field work and summarize local research data on Caribbean pine. Field work for Costa Rica is tentatively scheduled for March-April, 1985.



United States
Department of
Agriculture

Forest
Service

Institute of Tropical Forestry
Southern Forest Experiment Station
PO Box AQ
Rio Piedras, Puerto Rico 00928
Tel. 809-763-3939

Reply to 1530 Interdepartmental

Date 5 April 84

2. E. 06

Dr. James Hester
LAC/DR/MA
Main State Building, Room 2252
Agency for International Development
Washington, D.C. 20523

L

Dear Dr. Hester:

Enclosed are two copies of the corrected Progress Report on the Caribbean Pine project. Please eliminate the other two forwarded to your office on 1 March 84.

I now have had oral and written communication with CATIE about becoming a participant in the grant. Henry Tschinkel also wrote. In essence, CATIE would like to participate but its ongoing commitments with fuelwood and other forestry projects will not allow it at this time or in the immediate future. Therefore, Henry suggested that I consider one of the other forestry schools: the Instituto Tecnologico de Costa Rica, which might benefit more from an infusion of a few thousand U.S. dollars than would CATIE. If this sounds alright, I will go ahead and explore the possibilities in more detail. Evidently, there is someone on the staff of this school who just returned from a graduate program in the U.S. and submitted, as a thesis, work on plantations (of all species) in the country.

Sincerely,

LEON H. LIEGEL
Research Soil Scientist

Rec'd in Sci. JUN 24 1988



PROGRESS REPORT

for
U.S. Agency for International Development
Project AID/SCI/E2/06:
Growth and Site Relationships of Caribbean Pine. . .
in Jamaica, Surinam, Trinidad, and Venezuela

January 1-December 31, 1983

Prepared by:

Leon H. Liegel 30 March 84

Leon H. Liegel Date
Research Soil Scientist
Institute of Tropical Forestry
Southern Forest Experiment Station
Rio Piedras, Puerto Rico 00928

INTRODUCTION

This is the first full report on accomplishments for the Caribbean pine research project. There was no report for the first half of calendar year 1983 because work involved only short visits to cooperator countries plus a professional meeting in Brazil.

Established objectives of the project are:

- determine which soil physical and/or topographic and climatic variables exert greatest influence on growth and yield of Caribbean pine;
- determine whether soil properties influencing growth of Caribbean pine are located in surface (20 cm) or subsurface (21 to 100 cm) horizons;
- assess influence of soil properties and climatic/topographic variables on foxtailing, form, stem taper, bark thickness and other growth traits for P. caribaea growing on diverse sites;
- collect and interpret both new and existing growth data so that local and regional site index curves, diameter distributions, and taper functions can be developed for Caribbean pine; and
- provide a strong data base that can be used by local managers, foresters, ecologists, and economists for rational decision making about plantation alternatives in cooperator countries.

To achieve these objectives, a 3-year project with four distinct stages was implemented:

- 1) collecting, analyzing, and synthesizing existing but non-published Caribbean pine research data;
- 2) identifying and completing forestry training/consultation activities for local technical or scientific staff of cooperator institutions;
- 3) conducting new field research to augment existing but non-published soil/site interpretations for Caribbean pine; and
- 4) publishing and disseminating results from synthesis and new field research activities.

Because the project was funded in December 1982, instead of July 1982 as expected, adjustments in the original activity and work schedule were made (Annex 1). An overall planning meeting was essential for each country to: determine local personnel availability for duration of the grant, agree on specific training and equipment needs for the cooperator institution, and to develop a suitable cooperative agreement for the intended research activities. The Forest Service executes cooperative agreements as a means of outlining responsibilities and mutual goals between itself and cooperating agencies or institutions for a set period of time (Annex 2). International forestry research by the Institute of Tropical Forestry (ITF) is authorized by P.L.-307 and supported by P.L.-113.

Results from the planning meetings showed that Jamaica should be scheduled for intensive field research in late 1983; local personnel and program changes might have precluded field work there in 1984 and 1985. Thereafter, remaining field work was purposely staggered out over 4- to 6-month periods, allowing analyses and interpretation of most new field data before proceeding to the next country.

REPORT FORMAT

This report has two major sections: 1983 Accomplishments and 1984 Projected Activities. Within each section, accomplishments or activities are discussed by order of countries visited and time of occurrence.

For each country, activities are grouped into categories such as travel dates, office work, field trips, training/consultation, technology transfer, and other activities. When necessary, category activities are grouped or omitted. For each country, significant problems that arose or might arise are discussed along with alternative solutions.

Under 1984 Projected Activities are some alternatives for replacing Surinam. Since the grant's inception in December 1982, political circumstances within Surinam and existing U.S. Department of State restrictions have precluded any travel or cooperative work there. During the remainder of the grant, such restraints will evidently continue.

Expenditures thus far have mostly been for travel and per diem to cooperator countries (Table 1). In calendar year 1984, considerable expenditures will be made for training and short courses attended by staff from cooperator institutions (Table 2). Purpose and intent of these training exercises are explained more fully under 1984 Projected Activities.

PART I:

1983 ACCOMPLISHMENTS

TRINIDAD

Travel Dates - January 8-13

This was a general planning meeting to: determine technical counterparts for the project's duration, assess extent of existing but non-published Caribbean pine research data, determine supplemental information or help available from other non-forestry agencies, and decide acceptable terms/clauses for the cooperative agreement.

Office Activities

A tentative cooperative agreement (Annex 2) between the Southern Forest Experiment Station and the Trinidad/Tobago Forest Division was drafted with

Table 1

Major grant expenses incurred in 1983 for
Caribbean Pine research project

Kind of Expense	\$ Amount
Travel /per diem to Trinidad & Venezuela	\$ 1,759.00
Travel/per diem to Brazil	1,681.00
Travel/per diem to Jamaica (2 trips)	1,219.00
	<u>3,798.00</u>
	8,457.00
Equipment (left there) for field work in Jamaica	1,281.00
Film + Supplies + Misc.	<u>932.00</u>
Subtotal	10,670.00
Jamaica Forest Dept. Equipment (from country allotment)	<u>402.00</u>
Total	\$ 11,072.00

the help of Dr. Bal Ramdial, Conservator; Selwyn Dardaine, Assistant Conservator; N. Lackhan; and S. Ramnarine. Dr. Ramdial designated Mr. S. Ramnarine as local technical counterpart for the project; he replaced Mr. K.D. Musgrave, named in the original grant proposal.

Significant issues raised by Dr. Ramdial were:

- using his country's training/consultation allotment on traveling scholarships or short-term training activities for several junior staff members instead of post-graduate training for one individual; and
- agreeing that inclusion of breast height wood density determinations for local plantings would be beneficial, though such testing was not included in the original proposal.

The Forest Division has considerable unpublished data on Caribbean pine. Of particular interest are data from local permanent sample plots (PSP's) and spacing studies. However, detailed analyses of these data could not be made because Mr. Ramnarine had only recently made appointed Deputy Conservator of Research and was not yet totally familiar with the research data filing system.

Other important office discussions were with:

- Dr. N.A. Ahamad, Head, Soil Science Dept. at the University of the West Indies (UWI); his staff are available to describe soils at field plots using USDA soil taxonomy terminology and can provide sampling equipment for taking bulk densities.
- R.M. Saundar, Head, Physics Dept. at UWI; he could become involved in doing local strength or bending properties on Caribbean pine wood.
- Economics/Commercial Officer at U.S. Embassy in Port-of-Spain; he explained how both Trinidad and Venezuela had become aggressive wood importing countries for U.S. plywood and other materials during the U.S. recession but that several ideas were being followed to include U.S. firms in developing wood based industries in Trinidad.

Field - January 9

Mr. Dardaine took me out to visit Caura and Cleaver recreation sites near Port-of-Spain. During the ride he explained in detail ongoing FAO and other donor forestry and watershed projects.

Library

I located several important local documents on soils, 40-year rainfall, and wood property studies that will help in analyzing future field data from Trinidad. With the help of Dr. Ramdial I obtained and forwarded to ITF about 40 reprints of various technical papers from at the 11th Commonwealth Forestry Conference held in Trinidad in 1980; published proceedings contain only summaries of individual papers.

Training/Consultation and Technology Transfer

For the professional staff, I gave two slide talks on a) 20-year Spacing Results of Caribbean Pine in Puerto Rico and b) Hurricane Resistance of Caribbean Pine in Puerto Rico Greater than that of Oocarpa Pine.

Possible training or travelling-scholarship activities identified were:

- 1) Seed training at U.S. Forest Service Lab. in Macon, Georgia;
- 2) Nursery techniques for containers at Pineville, La. with U.S. Forest Service;
- 3) trip to Forest Products Lab. in Madison, Wisconsin to discuss new ideas for utilizing small waste pieces from teak and mahogany sawn wood; and
- 4) visit to U.S. Virgin Islands to see how local craftsmen utilize branches, slabs, etc. in making products for the tourist market.

Problems

Dr. Ramdial and assistants frequently fail to receive letters and materials sent from Puerto Rico. Telephone calls helped solve some emergency travel scheduling problems, but not all. Since mid-1983, copies of all correspondence are sent to at least three other people besides Dr. Ramdial and Mr. Ramnarine.

Although a draft coop-agreement was sent in March 1983, Cabinet approval has not yet been obtained. Until official agreement is obtained, international short-term training options seem entirely impossible as do scheduled long-term field work with Forest Division personnel. Some alternatives to expedite approval are given under 1984 Projected Activities.

VENEZUELA

Travel Dates - January 13-22

This was a general planning meeting to decide acceptable clauses/terms for a coop agreement, determine extent of unpublished Caribbean pine data, and make field trips to different areas of the savanna pine plantings.

Office Activities

About two work days were spent acquainting various Corporacion Nacional de Reforestacion (CONARE) personnel with all phases of the Caribbean pine project, at field offices in Maturin and Chaguaramas. Terms for a coop agreement were drafted with the help of Dr. Ronnie de Camino and Mr. Ricardo Bellandi. One afternoon was spent with administrative and technical personnel of CVG (Corporacion Venezolana Guyana), discussing their Caribbean Pine plantings which now number about 60,000 ha; CONARE and other holdings total about 88,000 ha. Agreement was reached with CVG personnel to include some field plots on their land which is adjacent to CONARE holdings.

Library

Dr. de Camino provided me with copies of 15 M.S. and Ph.D theses and internal CONARE reports describing various aspects of pine plantings in eastern Venezuela. All reports and publications will help in determining location and intensity of field sampling and in correlating new growth and yield data with older data and environmental factors.

Field Trips

The most rewarding part of the CONARE visit were 5 days dedicated to field travel. A two-hour truck trip from Maturin to Chaguaramas on January 14 revealed graphic differences in soils, topography and rainfall between the two cities. On Saturday Jan. 15, I spent the entire day making soil borings with Dr. Wilfredo Franco of the Univ. of Merida and his M.S. student, Jorge Acostas, who is sponsored by CONARE. Thus far, Mr. Acostas' borings to 2 m depth show more similarity in underground soil profiles than previously known. Past planting failures in the area may be due to poor nursery stock, late planting, or after-planting droughts rather than "poor site" factors.

On Sunday, Jan. 16, I spent a day with Dr. Chuck Hodges, a pathologist with the U.S. Forest Service in Hawaii, assessing die-back on Caribbean pine on CONARE and CVG lands. The dieback scenario is related to extreme droughts in two years and extreme competition for soil moisture in dense stands having no thinnings over 10 years of growth.

Two additional days were spent reviewing CONARE bare-root nursery techniques in two nurseries with 10 million seedlings each and visiting pine and eucalyptus plantings within a 3-hour driving radius of Chaguaramas. Graphic ant defoliation damage was seen on both species and reduction in foxtailing after changing from Guatemalan to Honduran seed sources.

Training/Consultation

In late 1983 North Carolina State University accepted Ricardo Bellandi as a special student for January 10-June 30, 1984. Approximately \$5000.00 of CONARE'S training allotment will be used to cover round trip airfare, tuition and fees, books, per diem, and overnight travel expenses to industry plantings or professional meetings in the Southeastern United States. Financial and logistical work are being handled by USDA-OICD in Washington, D.C.

One other training option identified is sending three men to the Forest Sciences School in Chile for one month each on training in harvesting of pine plantations. Another alternative is to have Mr. Bellandi stop in Puerto Rico on the way back to Venezuela to review pine provenance trials and spacing studies and local harvesting of pine sawtimber with a portable mill.

Coop Agreement

The formal agreement was signed by CONARE in September 1983 and by the Southern Forest Experiment Station in October 1983.

BRAZIL

Travel Dates - February 5-11

Consultation and Technology Transfer

From February 6 through 10 I attended the Symposium on Plantation Forest in the Neotropics - Its role as Source of Energy at the Univ. of Viscosa in Minas Gerais; the first symposium sponsored by IUFRO in the series was held at ITF in Puerto Rico in September 1980. Attending the meeting was substituted for a planning trip to Surinam. Attending the symposium allowed me to tell a wide audience about the new ongoing Caribbean Pine Project, formally and informally; allowed contact with university and private industry professionals actively working with Caribbean and Oocarpa pines; and allowed me to present two technical papers, supplemented by slides, on a) Pinus caribaea var. hondurensis Spacing Study in Puerto Rico and b) Susceptibility of Pinus Caribaea and Pinus Oocarpa Provenances to Rain-Wind Damage From Cyclonic Storms in Puerto Rico.

Attending the symposium also alerted me to several local publications having many papers on pine provenance trials in Brazil. Information in these will be used to compare growth rates of Caribbean pine in Brazil with rates observed in cooperator countries. Contacts made with private industry and university personnel can be used to quickly disseminate findings from the project, as they are developed:

JAMAICA

The two cooperator agencies in Jamaica are the Department of Forest and Soil Conservation (The Department) and Forest Industries Development Corporation (FIDCO).

Travel Dates - March 23-29 and October 26-November 23

The first trip was a 1-week planning meeting to decide on acceptable clauses for a coop agreement, determine local accomplishments with pine since 1979, and determine overall training needs. The second trip constituted 4 weeks of intensive field and office research.

Office Work

A draft coop agreement was made in March with the help of Roy Jones, Department Head; J. Goodwin, Training Officer; Donald Thompson, Senior UK Research Officer on loan to the Department; and Mr. Thompson's local counterpart in research, Miss Marilyn Headley. Both Thompson and Headley are technical counterparts for the grant. Mr. Roy Jones signed the agreement for the Department in November 1983 as did the Southern Forest Experiment Station.

A number of technical contacts were made initially in March and renewed

in Oct.-Nov. These included:

- William McClusky, Agricultural Rural Development Officer at the US Embassy in Kingston; he graciously reviewed ongoing AID rural assistance programs and attempts to include forestry components in the overall portfolio.

- Dr. R. DeKruyff, Director of Rural Physical Planning and Development; for over 2 years he and his staff have prepared an island-wide inventory of Jamaica's land, agricultural crop, and forest resources, all of which are being related to existing and more detailed soil surveys. Dr. DeKruyff will make available someone from his staff to sample and taxonomically describe soils at selected Caribbean pine field sites.

- Mr. Owen Evelyn, Head of the FIDCO Inventory Division, made available forest compartment and soils maps plus growth data from FIDCO permanent sample plots, in stands ten years or older. These and other maps on geology were used to select actual field research plots in Oct.-Nov.

- John Kellie, Adviser/Manager for FIDCO gave freely of his time to explain many internal activities of his company, including a good historical perspective of certain managerial problems that must be dealt with if thorough utilization of pine wood resources is to be achieved in Jamaica.

- Tom Allan, FAO Liason Officer in Jamaica summarized the many activities of FAO locally and suggested several alternatives for training local Forest Department Staff.

- Donald Thompson spent countless hours helping out with solving logistical matters and provided good summaries about ongoing accomplishments with tree improvement, provenance research, insect and disease work, and hurricane damage assessments in pine and natural forests after Hurricane Allan hit the island in 1980.

Field Work

In the March trip I spent 1/2 day at the Mt. Airy nursery. Annual pine seedling production there has reached 1 million, all produced in plastic bags. Slides and photos I took on container production contrast nicely with even larger bare-root pine operations in Venezuela and can be used in future technology transfer articles.

In the October-November trip, I helped establish 15 growth and yield plots on 12 different sites; composite soil samples from 0-20 and 21-100 cm were also collected at each plot. The entire FIDCO inventory staff was made available for this work as well as a Peace Corps volunteer and two staff members from the Forest Department.

Mr. Andy Roby, working with FIDCO for 1 year as part of a 2-year M.S. program at CFT in Oxford, England, also assisted and helped lead field crews when work was divided between two teams. Mr. Roby also established an additional 13 growth plots after my departure, November 23.

The existing 28 plots are those which I consider the "minimum" number

needed to adequately sample existing local variability in soils, geology, and age classes of Caribbean pine. Of many plots still available for sampling (Table 3) and to refine site and growth variability even more, Mr. Roby will assess these as time permits over the next 8 months and utilize collected data for his M.S. Degree. Personnel in both FIDCO and the Forest Department agreed to this approach since eventual pooling of all data will provide more interpretations than those possible from analysis of only 28 plots.

Mr. Roby will also work with a soil scientist from Dr. DeKruyff's Rural Physical Planning Office to taxonomically describe soils at as many field sites as possible. Combined soils data and growth and yield information will enable both FIDCO and Dr. DeKruyff's Department to place quantitative measures on land productivity potential for forest crops as has already been done for most agricultural crops. Overall, the enthusiastic cooperation of FIDCO, Mr. Roby, Dr. DeKruyff, and Forest Department staff concerned with the grant will yield more quantitative information than was originally expected.

Training/Consultation and Equipment

In March I gave two different slide shows for Forest Department and FIDCO staff. For the former, I talked about agro-forestry and nursery activities in Haiti and overall growth and yield of Caribbean pine in Puerto Rico. For FIDCO, I talked from a managerial standpoint on a) Good/Poor Bare-root Pine Nursery Techniques, b) Hurricane Damage to Pines in Puerto Rico, and c) Density Effects on Growth of Caribbean Pine in Puerto Rican Spacing Trials.

As a result of my March visit, ITF included one Jamaican in the second short course for West Indies islands, May-August 1983. As was the case in Trinidad and Venezuela, the overall consensus was to support short-term scholarships for several Forest Department individuals. No training costs have yet been charged against the grant. However, in November 83 I coordinated the visit of 4 Jamaicans to Puerto Rico, under FAO auspices, to study forestry and soil conservation practices on mountainous uplands.

In December 83, Mr. Guy Symes, Managing Director for FIDCO, visited 1 day at ITF, as part of a 3-day promotional tour sponsored by the Puerto Rico Industrial Development Corporation. The trip explored whether FIDCO could supply certain wood products for furniture or cabinet making in Puerto Rico.

In the October-November trip to Jamaica, I hand-carried relaskopes, tapes, and other items given to Forest Department technicians for conducting field phases of the grant. At the same time, I took an additional \$400.00 of miscellaneous field equipment ordered by the Forest Department.

Problems

There were local circumstances in Jamaica that prohibit or restrict buying of petrol for official vehicles and/or paying an adequate overnight allowance for extended field trips. The coop agreement recognized this fact and I was able to continue field work by paying for petrol and other expenses with out-of-pocket travel advance funds. In the future, such expenses in other countries and those for any kind of contract labor will be best handled

TABLE 3

Matrix table for sampling Caribbean Pine growth and yield in Jamaica according to age, elevation, soils, and geological variability.

Soil Series	Geology	Elevation	Age (yrs.)			
			8-12	13-16	17-20	> 20
Hall's Delight	Calcareous shales of Richmond Beds	H*	---	R	X	---
		L**	X(2)	R	R	R
Valda	Newcastle porphyry or Volcanic extrusives	H	X	---	X	---
		L	X(2)	X(2)	---	R
Cuffy Gully	Wagwater Conglomerates	H	R	R	R	R
		L	---	---	---	---
Island Head Artnully	Metamorphics and undifferentiated shales	H	R	X	X X	X
		L	---	---	---	---
Flint River	Granites	H	---	---	---	---
Bonny Gate	Yellow limestone	H & L	R	---	---	R
St. Ann	Red limestone	H & L	---	X	X	---

* H = High elevation (> 3000 ft)
 ** L = Low elevation (< 3000 ft)

X = Plots done by Liegel, Nov. 83
 X(2) = Two plots at one site
 R = Plots done by Andy Roby between Nov.-Dec., 1983
 ... = Plots to be done "as time permits" by Roby for FIDCO and CFI study

by including them as designated expenses under the AD-202 Travel Authorization.

OTHER ACTIVITIES

The pine tree improvement coop at NCSU in Raleigh will do analyses of breast height cores for wood density "at cost". This information was given to all cooperators so that local decisions could be made to undertake sampling or not.

Soil analysis, at least for Jamaica, can be done at NCSU at no cost. Depending on future budget restraints, soils analyses for other countries may have to be done on a cost basis.

In early 1983 I exchanged work plans with Dr. F. Johnson, University of Idaho; he has an AID grant for studying native pines in Honduras. When possible, we will try to help each other and keep one another informed of each other's activities.

PART II:

1984 PROJECTED ACTIVITIES

JAMAICA

The major work for 1984 is to analyze and interpret growth and yield data and soil samples collected between October and December 1983. Completion of this work will a) indicate possible changes in field or office work for remaining countries and b) develop mechanisms for timely analysis and interpretation of data from remaining countries.

Planned training activities include sending Forest Department Junior Staff to (1) a short course on entomology and pathology at Purdue University and 1-2 weeks of practical training with the Forest Service in Florida and (2) a 1-week seminar on biomass-bioenergy at Univ. of Georgia, Athens. Both training options have been discussed with Mr. Thompson, who in turn is now getting final approval from Mr. Jones.

VENEZUELA

Scheduled field work for March-April 84 will be delayed until July 84 because of Mr. R. Bellandi's extended training at NCSU in Raleigh, N.C. He has a major role in conducting field work in Venezuela. Other short-term training in Chile is being investigated, as well as equipment or technical book needs. Books or equipment could be carried back by Mr. Bellandi when he returns to Venezuela or by myself when I undertake field work in July.

TRINIDAD

The most pressing matter is to obtain Cabinet approval of the joint research undertaking so that field work scheduled for November 84 can be completed on time. Follow-ups on training activities listed in Part I will be made to institutions offering this training. Letters are being written to local Cabinet and Ministry personnel according to instructions just received from Dr. Ramdial. The letters will explain advantages of the Caribbean pine project for local Forest Division, Ministry of Agriculture, and forest industry concerns. There is plenty of time to obtain needed approvals by November 1984, to keep the overall field research schedule on track.

SURINAM/COSTA RICA

Contacts in Surinam will be kept informed of the project's progress through progress reports and other correspondence. Contacts in Costa Rica have been approached for substituting field work in Surinam. If suitable growth plots can be established on Costa Rican volcanic ash soils, the entire range of potential planting sites for Caribbean pine in Central America and the Caribbean will be covered thoroughly.

TECHNOLOGY TRANSFER

To disseminate information on Caribbean pine work in Puerto Rico and cooperator countries, several avenues are being followed:

1- Ten 2-page articles have been sent to and accepted by CFI in England for inclusion in the April 1984 Zimbabwe IUFRO meeting on tree improvement and genetics;

2- The Journal of Forestry editor was contacted to see whether a series of articles can be used in the Journal. A 2-page, 500 word Note is being peer reviewed now; it outlines general objectives of the project. The next step is a 3000 word feature article, covering activities in all countries.

3- General announcements about the grant's objectives have been submitted for news items in the Commonwealth Forestry Review, Forestry Abstracts, and the 2nd Caribbean Foresters' Workshop.

OTHER ACTIVITIES/PLANS

If officials in Costa Rica do not want to be included in the grant and Surinam is excluded for reasons mentioned in Part I, several options are available for using the country allotment funds for other uses:

A- to cover travel/per diem and field expenses in assessing growth and

yield in native stands or plantations of known age in Honduras, and possibly Guatemala. Overlap with ongoing work by the University of Idaho in Honduras would be beneficial. Guatemala has been the most widely used regional seed source in the last 10 years, but there is a large percentage of foxtails in most plantings.

B- to cover 1/2 time (20 hours/week) Secretarial/Clerical help in preparing technology transfer articles on grant progress for local and U.S. journals and for helping out with correspondence relating to training and cooperative agreement problems. The latter activities are particularly time consuming. One person working on 1/2 time basis would cover them adequately.

CONCLUSIONS

Field and planning activities in three countries have proceeded smoothly, with full cooperation of local counterparts and agency heads. By including other local agency participation as much as possible, actual accomplishments will be greater than those originally anticipated. The prime example is Jamaica where accumulated project data on growth and yield can be easily integrated with an ongoing country wide assessment of agricultural and other land resources. Wherever possible, similar approaches will be used in other countries.

Considering the 6-month delay in project start-up, overall scheduling is proceeding as planned. Sufficient time remains for completing coop research agreements with the Trinidad Ministry of Agriculture, Lands, and Food Production by late 1984. Communication channels are also being explored for finding a replacement country or activities for Surinam which must be excluded for reasons beyond project control.

Several technology transfer activities are under way as are stateside training activities for personnel of cooperator institutions. All trainees will be encouraged and helped to summarize their experiences and the potential impact on their country's forestry problems. The key to success of this project's activities is sufficient documentation and timely technology transfer of results, whether of field, training, or data analyses phases, to as wide an audience as possible, both within and external to the Caribbean Basin. Such a plan will allow all cooperator agencies to use accumulated data as baseline material for bilateral and international donor agency sponsored forestry development projects.

ANNEX 1

Proposed and actual/planned schedules for field and other work associated with AID cooperative study for assessing Caribbean pine growth and performance in various countries.

Proposed Schedule	Activity	Actual/Planned Schedule	Activity
July 82	Funding approved	December 82	Funding approved
Aug. 82-Feb. 83	Lit. review for all countries	December 82 to present	Lit. review of topic pertaining to grant
Feb.-April 83	Planning trips to cooperator countries	Jan.-March 83	Planning trips to 3 of 4 countries
June 83	3-weeks of field work in Venezuela	Oct.-Nov. 83	4-weeks of field work in Jamaica
July-Dec. 83	Interpret and write up Venezuela field work	Dec.-June 84	Interpret and write up Jamaica field work
Jan. 84	4-week field trip to Surinam	July 84	3-weeks of field work in Venezuela
Feb.-May 84	Interpret and write up Surinam data	Aug.-Nov. 84	Interpret and write up Venezuela field data
June 84	4-week field trip to Trinidad	Nov. 84	4 weeks of field work in Trinidad
July 84	Interpret Trinidad field data	Dec.84-March 85	Interpret and write up Trinidad field data
Aug. 84	4-week field trip to Jamaica	March-April 85	Field trip to Surinam replacement
Sept.-Dec. 84	Interpret and write up Jamaica field data	May-July 85	Interpret and write up last country field data
Jan.-June 85	Final overall synthesis of results and final AID report	Aug.-Dec. 85	Final overall synthesis of results and prepare final AID report

COOPERATIVE AGREEMENT
between
JAMAICA MINISTRY OF AGRICULTURE
DEPARTMENT OF FORESTRY AND SOIL CONSERVATION
and
U. S. DEPARTMENT OF AGRICULTURE, FOREST SERVICE
SOUTHERN FOREST EXPERIMENT STATION

THIS AGREEMENT, made and entered into by and between the Jamaica Ministry of Agriculture, Department of Forestry and Soil Conservation, hereinafter referred to as the Department, and the U. S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, hereinafter referred to as the Experiment Station, under the provisions of the Act of June 30, 1978 (16 USC 1641-1646), witnesseth:

WHEREAS, the Department is interested in increasing its data base, understanding and knowledge of tropical forestry and environmental quality and the Experiment Station is in the position to assist in this objective,

NOW, THEREFORE, in consideration of the above premises, the parties hereto agree as follows:

A. The Department will

1. Identify a project coordinator whose role will be to: act as liaison between the visiting scientist from the Experiment Station and other participating organizations (viz. CONARE, Venezuela; Trinidad Forestry Division; and the Surinam Forest Service); identify training needs and alternatives that can be met through local cooperative research undertakings or out-of-country activities; determine the availability of Department technical staff to help with the research work plan, including the determination of suitable schedules for field work; and assists in developing progress and final reports, both of local and regional nature, describing results and interpreting data from the cooperative research undertakings.
2. Provide access to field plantings for growth and yield and soils research.
3. Make available research and other file data that are helpful in obtaining work plan objectives.
4. Provide temporary housing, when necessary, for visiting field research plots at remote field sites and vehicles to transport equipment and personnel to field sites where cooperative research is undertaken.
5. Help in identifying and contacting other local agencies to obtain supplemental data or necessary permissions, when needed for specific field activities.

6. Provide other administrative and logistical support, within the normal controls of the Department, which facilitate all cooperative research activities at the local level.
- B. The Experiment Station will
1. Provide scientific leadership and coordination of the project.
 2. Provide essential field equipment for conducting growth and yield and soils research.
 3. Help in coordinating out-of-country training for Department personnel, through seminar, short courses, technical visits, or other means that fall within the country's individual allotment for training/equipment needs.
 4. Help coordinate analysis, interpretation, and syntheses of old and new field research data and/or samples for the Caribbean pine project.
 5. Assemble and distribute local bibliographic materials relating to growth and yield and soils data collected for the project.
 6. Pay for all transportation and per diem expenses incurred by the Experiment Station scientist between Puerto Rico and Jamaica.
 7. Be responsible for preparing progress and final reports on project accomplishments in coordination with the Department project coordinator.
 8. Provide financial assistance to augment local transportation for field visits and as needed.
- C. It is Mutually Understood and Agreed that
1. Nothing herein shall be construed as obligating the Experiment Station to expend or as involving the United States in any contract or other obligation for the future payment of money in excess of appropriations authorized by law and administratively allocated for this work.
 2. The United States shall not be liable to the Department for any damages incident to the performance of work under this agreement.
 3. The Department is not under any obligation to make payment of monies in excess of Government of Jamaica allocations for this work.
 4. This agreement will be effective upon execution by both parties and will remain in effect until August 31, 1984, unless sooner terminated by either party giving 60 days notice to the other in writing, and may be amended or extended by mutual consent.

IN WITNESS WHEREOF, the parties hereto have executed this agreement as of the last date written below.

November 21, 1983
Date

JAMAICA MINISTRY OF AGRICULTURE
DEPARTMENT OF FORESTRY AND SOIL CONSERVATION

By Roy L. Jones
Title Minister of Forestry & Soil Conservation

October 20, 1983
Date

USDA, FOREST SERVICE
SOUTHERN FOREST EXPERIMENT STATION

By H. Wayne Hunt
Title H. WAYNE HUNT, Assistant Director for Research Support Services

J Hester - US-AID
Review + Info.
CSP

2, E. 06

US-AID Supports Study of
Honduras Pine in the Caribbean

For Submission to:
Journal of Forestry Note Series

Leon H. Liegel

Draft
13 April 84

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US-AID Supports Study of
Honduras Pine in the Caribbean¹

by

Leon H. Liegel, Roy Jones, Guy Symes, Bal Ramdial, and Gonzalo Arellano²

Large reforestation efforts are being undertaken with exotic trees in the Caribbean region. . Often, specific site requirements for best growth are not known for the individual species planted. Excessive foxtailing, crooked stems, poor form, and dieback are general indicators of "off-site" plantings. Such observations are now quite extensive for Pinus caribaea var. hondurensis, a widely planted species known locally as Honduras or Caribbean pine. However, for over 30 years there has been little technical information exchange between Caribbean countries where this pine has been planted.

In December 1982, a major step towards resolving this problem was the awarding of a 3-year, \$150,000 grant from the United States Agency for International Development (US-AID). This grant is currently funding a major project to assess growth and yield and site relationships of Honduras pine in Jamaica, Surinam, Trinidad, and Venezuela. A secondary objective is to

1

Information and data cited in this paper were sponsored in part by US-AID Project AID/SCI/E2/06, "Growth and Site Relations of Caribbean Pine . . ."

2

Authors are respectively Research Soil Scientist, Institute of Tropical Forestry, Rio Piedras, Puerto Rico; Head, Department of Forestry and Soil Conservation and Managing Director, Forest Industries Development Corporation (FIDCO), Kingston, Jamaica; Chief Conservator, Ministry of Agriculture, Lands and Food Production, Port-of-Spain, Trinidad; and General Manager, Corporacion Nacional de Reforestacion (CONARE), Caracas, Venezuela.

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improve existing communication linkages, allowing cooperator institutions to mutually benefit from each other's forestry research experiences. The project is being accomplished in the following stages: 1) collect, analyze, and synthesize existing but nonpublished Honduras pine research data from all countries; 2) support forestry training activities for local technical and scientific staff of cooperator institutions; 3) conduct new field research to refine soil/site interpretations for Honduras pine; and 4) publish and disseminate results from stages 1 and 3.

One stage 1 activity in 1983 was collection of unpublished pine volume and form data from over 400 sample plots established in Jamaica in 1979. Data showed that mean annual underbark increments for 20-year-old stands averaged 16 m³/yr, with mean annual height increments of 1.4 m/yr.

As a stage 2 activity, the grant now sponsors a forester from Venezuela's Corporacion Nacional de Reforestacion (CONARE) in a special 6-month graduate program in tree improvement and genetics at North Carolina State University (NCSU) in Raleigh. Other trainings in integrated pest management, nursery management, and fuelwood alternatives are being planned through short courses or traveling scholarships away from cooperator countries.

In stage 3, the major objective of the research portion of the project is determining which soil physical and/or chemical properties significantly influence volume and growth performance of Honduras pine, and whether these properties are in the surface or subsurface horizons. New growth and yield

data are being taken on 30 or more plots established in Honduras pine plantations in each country. Plots are distributed across major soil/geological associations where existing growth data are scarce or absent (see sidebox). Similar stand conditions exist in all countries in that pine plantations are mostly unthinned and usually unmanaged except for basic weed and fire control. Height accumulation techniques developed for southern pines in the United States are used to determine plot volumes and diameter and height distribution data. Soil analyses follow the fertility capability classification (FCC) criteria developed at the Tropical Soils Program at NCSU's Soil Science Department.

In light of increasing demands for wood products in both Caribbean and world markets, the project is very relevant to integrated forest development in all cooperator countries. Development of more comprehensive site interpretations for Honduras pine will have regional and perhaps world-wide significance because the species is planted throughout the American, Asian, and African tropics. Data synthesis, training, and cooperative research efforts will provide quantitative data that can be used by managers, foresters, ecologists, and economists for rational decision making about best use of land resources often having many alternative uses. Project implementation will serve to strengthen cooperative ties between forestry institutions in all cooperator countries and allow institution building through funding of various technical training activities.

To make interpretations and analyses as complete as possible, the principal

investigator in the study is soliciting information from anyone working with Honduras pine in the Caribbean region or elsewhere. Of particular interest are unpublished data on Honduras pine growth and yield as related to local soils and other environmental data and seed production, fox tailing, and wind damage in plantations of known age and seed source. Write or call:

L.H. Liegel
Institute of Tropical Forestry
Southern Forest Experiment Station
P.O. Box AQ
Rio Piedras, Puerto Rico 00928

Sidebox

Site Diversity of Honduras Pine Study Sites

<u>Country</u>	<u>Elevation</u> (m)	<u>Rainfall</u> (mm)	<u>Dominant Soils & Geology</u>	<u>Total Plantings</u> (ha)
Puerto Rico ¹	20-800	1500-2800	sands over granite, shallow and deep clays over volcanic rocks and conglomerates	1000
Jamaica	260-1300	1800-3500	shallow and deep clays from calcareous/noncalcareous shales, volcanic rocks and conglomerates, and red/yellow limestones	9000
Surinam	100	2500-3000	marine or fluvial sands	5500
Trinidad	20-300	1000-2800	sands and clays from igneous and calcareous rocks and sedimentary deposits	8000
Venezuela	50	900-1100	sedimentary and aeolian sands	150,000

¹Although it is not a direct recipient of grant funds, Puerto Rico serves as a comparison against which to measure Honduras pine growth and yield data obtained from other countries. Field assessment techniques used in the study were tested successfully to inventory Puerto Rico's pine plantings in 1975-76.

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United States
Department of
Agriculture

Forest
Service

Southern Forest Experiment Station
Institute of Tropical Forestry
P.O. Box AQ
San Juan, Puerto Rico 00928 Tel. 809-763-3939

Reply to: 4040

Date: 28 June 82

2. E. 06

Dr. Irvin Asher
Office of Science Advisor
Agency for International Development
Room 3909, New State
Washington, D.C. 20523

Dear Dr. Asher:

Thank you for your informative telephone call of 25 June 82 regarding my AID/SCI proposal (E2/06) to study Caribbean pine growth and site relationships. I have carefully considered the four questions or issues raised by the AID Research Advisory Panel in its review of my proposal. The following additional information is presented to address those specific points in greater detail.

"Objectives That Are Too Broad, and Therefore Unattainable"

I strongly disagree that my proposal objectives are too broad and unattainable within the time and money allocated. First, I have limited my experimental "universe" to only five countries, including Puerto Rico, where Caribbean pine has been or is now being planted extensively as an exotic. I purposely excluded all other countries, over fifty in number in the New and Old World tropics, where Caribbean pine is also planted or managed within native pine forests. Such restriction seems logical when considering AID/SCI grant funds potentially available in any one proposal, the real and pressing managerial problems now facing the five countries chosen, and the closeness of all countries which facilitates travel between them all.

Second, in each cooperator country, I propose restricting experimental sites to plantations located only on those major soil associations deemed of potential commercial value for Caribbean pine. Thus, not all soil series or families are sampled, just the major groups or associations, probably three to five in each country. Within these soil associations, I further restrict sample plots to one or two per 5-year age class. And, within each sample plot, I will determine up to 24 specific soil physical or chemical properties through laboratory analyses. These properties have already been identified as either affecting growth, yield, and management of agricultural crops in several countries, or have been specifically correlated with growth of Caribbean pine in Puerto Rico and in other countries, as was shown in the literature review of my proposal.

Rec'd in SCI: JUN 24 1988



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My proposal is therefore a unified work plan for forestry agencies in five countries to determine which soil properties and/or climatic and topographic variables are most important in influencing growth and performance of planted Caribbean pine on diverse sites in the Caribbean. Admittedly, the proposed project is an energetic one, involving well-orchestrated office, field, laboratory, and analytical work. Yet, proposal objectives by themselves are explicit and straightforward when viewed in context of the entire proposal. If the objectives of my proposal were of doubtful value or unattainable, I doubt whether all cooperator institutions would have given such strong endorsements to the project (see letters attached, some of which were sent to your office after the 1 February 82 full proposal submission deadline).

"Methodology Should Be More Specific"

As outlined, the major steps in my proposal methodology, I feel, are also explicit and straightforward, as well as cited to prior work by myself or other scientists when appropriate. Stages 1 and 2 involve collection and synthesis of published and non-published growth data on Caribbean pine and soils information for each cooperator country. Non-published data must be obtained by an on-site visit to each country. The on-site trip will also allow review of field plot location, developing work schedules and responsibilities, and assessment of training needs and possibilities for local scientific or technical staff. More specific details on the initial planning stages cannot be given until funding is actually approved and meetings are held with co-investigators and their institution heads or representatives.

Field work in the third stage centers around a) obtaining plantation growth plot measurement data by procedures documented by Lohrey and Dell (1969) and in b) obtaining soils data that can be placed into Fertility Capability Class (FCC) units described by Buol et al. (1975). In my proposal, Figures 4, 5, 6, and 7 show the kinds of growth or climatic data to be collected and assessed for each field plot; Figures 2 and 3 show the soil physical or chemical parameters that will be determined by routine laboratory methods used by Buol et al.

My proposal contains a synopsis of methodology for collecting growth measurements and for assessing and collecting soil samples; detailed methodologies have been published by Lohrey and Dell and by Buol et al. Not stated in the proposal is that proposed chemical modifiers to be added to the FCC system (B, N, Na, P, Mn, Cu, Zn, and organic matter) will be determined by laboratory procedures used by myself and documented in my doctoral dissertation in 1981. The laboratory procedures involved are well known to agronomists, foresters, and soil scientists who routinely study soil/plant relationships:

N	a semi-micro Kjeldahl digestion procedure
Na, P, Mn, Cu, Zn	determined in double-acid (Mehlich I) soil extracts and analyzed by atomic absorption
B	a modified Gupta (1967) procedure, with azomethine-H to develop color on solutions run through an automatic analyzer
organic matter	by the Walkley-Black wet oxidation method
effective rooting depth	by visual observations of soil pits or soil bucket auger borings

✓ 3'

I felt that detailed descriptions of data analyses options were not needed because I cited prior work dealing with correlation of tree growth to soil, climatic, or other variables by simple or multiple regression techniques (Page 1976, Liegel 1981) or by discriminant analysis (Vincent 1978). I imply, though do not specifically state, that correlations of Caribbean pine growth and yield data with FCC units will be done in tabular or graphic formats similar to those presented by Buol et al. (1975) for agricultural crops. In the entire data analysis phase, I also assume that standard precautions in statistical work will be followed: looking for intercorrelation or multicollinearity among the independent variables selected before formulating predictive regression equations and looking at homogeneity of variances for growth data from sample plots on individual soil associations before deciding whether data can be pooled to determine country- or region-wide summaries for the growth data collected.

Overall, I think that the methodologies I outlined follow the cardinal rule of any experiment: restrict objectives, replicate in place or time, and randomize treatments or locations of experimental plots.

"Provide Methodology for Mapping Soil Types
of Pinus caribaea Ecosystems of
Various Countries"

This remark involves concepts and field work far-removed from my proposal's stated objectives. Mapping soil types for Caribbean pine might be appropriate for countries like Honduras or Guatemala where extensive natural pine forests exist but where there are neither good soils nor vegetative base maps. However, the focus of my proposal is defining growth and performance of planted Caribbean pine stands, using already-available large to medium scale soil maps and supplementary field sampling to verify map accuracy. Methodology in my proposal does include a qualitative description of understory in sample plots by characterizing it in broad classes like brush, grass, or pine needles only. Identifying these broad understory classes will indicate relative speed and state of natural succession by native volunteer plant species within Caribbean pine plantations and will indicate the kinds of more specific classes that can be used in more detailed soil series or vegetative mapping that are more in line with general ecological and survey studies, not silvicultural growth and yield work as my proposal is.

"Combine With Work Proposed for
Honduras by Local Applied Forestry
Research Center"

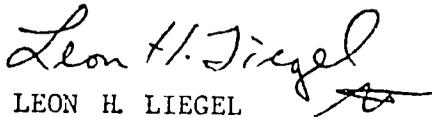
The Institute of Tropical Forestry (ITF) has an existing cooperative agreement with the Corporacion Hondureña de Desarrollo Forestal (CODEFOR), with headquarters in Tegucigalpa, to train one of its employees through September 1982. At present, ITF has no formal cooperative agreement with the National School of Forest Science in Siquatepeque. However, two of the School's professionals visited ITF in 1978 and I visited the School in 1971.

I have not reviewed or seen the AID/SCS proposal submitted by the School and the University of Idaho. Its title, at least, indicates that their proposal is a much more localized study and probably includes both Pinus caribaea and P. oocarpa since they both occur in the Honduras uplands. There is virtually little

published information on site quality and productivity for these upland areas; thus any work in this subject area would be very meritorious. If either or both of the AID/SCI proposals dealing with Caribbean or Honduras pine are funded, it would be an easy matter to exchange information on techniques and methodologies so that undue duplication of efforts could be avoided. In this way additional plot data can also be obtained, at least for my study, that would expand the inferences that could be made about growth and yield of Caribbean pine on diverse sites in the Caribbean as well as in the native range in Central America.

If your office still needs other supporting statements or any other information regarding my proposal, please call immediately, to the number appearing on page 1 of my letter.

Sincerely yours,



LEON H. LIEGEL
Research Soil Scientist

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COOPERATOR COUNTRY ENDORSEMENTS

No. F.S.1/2/26.W.D.L...I'

In replying the above number and date of this letter should be quoted.



The Forest Division

Port-of-Spain

Trinidad and Tobago

1st March, 1982.

Dr. L.H. Liegel,
Institute of Tropical Forestry,
P.O. Box AQ,
Rio Piedras,
Puerto Rico 00928.

Dear Dr. Liegel,

Further to my letter of 11th January 1982, I wish to advise that the Government of the Republic of Trinidad and Tobago has agreed to participate in the project entitled "Cooperative Research with Soil/Site and Productivity Data of *Pinus caribaea*."

Please advise me of further developments.

Yours sincerely

H. Lachon

/s/ Ag. Conservator of Forests

M:bh

TELEGRAPHIC ADDRESS
"FORESTS"

FORESTS DEPARTMENT

KINGSTON.

JAMAICA

14th January, 1982

ANY REPLY OR SUBSEQUENT REFERENCE
TO THIS COMMUNICATION SHOULD BE
ADDRESSED TO THE COMMISSIONER OF
FORESTS AND NOT TO ANY OFFICER
BY NAME AND THE FOLLOWING
REFERENCE QUOTED.

No. B35/2

L.H. Liegel
Southern Forest Experiment Station
P.O. Box AQ
Rio Pedras
Puerto Rico

Dear Mr. Liegel,

I am in receipt of your letter of 31st December, 1981. It appears that you have not received my letter of 22nd December giving general support in reply to yours of 16th November, 1981.

Let me further confirm that it is my intention to participate and co-operate with the Institute of Tropical Forestry in soil/site work with P. caribaea (Carib pine) in Jamaica. The proposal will relate to our site classification project 1A with particular reference to Carib pine. Mr. D. Thompson is nominated as the project officer and a short brief of his curriculum vitae is enclosed. The Forest Department will provide general support for the field activities including transportation, field camps and office facilities. The forestry sector in Jamaica has a particular interest in data relating to Carib pine growth and fully supports your applications for AID funding to further develop research in this field. We particularly require assistance in data analyses.

I would also wish my staff to participate in the exchange of information and technology, and the training programmes indicated in the proposal.

I suggest that when you have obtained AID support for the project, that you pay an early visit to Jamaica to allow us to determine in greater details a programme of participation and the project inputs and outputs relevant to Jamaica.

Yours sincerely,

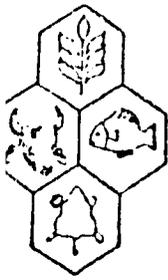


Roy S. Jones
Acting Director of Forestry

RSJ/am

cc. T. Allan
D. Thompson
A.E. Lugo Director I.T.F.

note: John Latta
received
STAN ea
in
pu. to p. co
immediately
before
sending in
AID
proposal
1. H. Lugo
18 Jan



MINISTERIE VAN LANDBOUW, VEETEELT, VISSERIJ & BOSBOUW

Postbus

Telefoon

Telegram Adres MINAGR.

Paramaribo - Suriname

Hoofd Afdeling

Overwerp:

Ons kenmerk:

Bijlage(n):

Paramaribo, January 15th, 1982.

cc: Dr. Leon H. Liegel
Southern Forest Experiment
Station
Institute of Tropical
Forestry
P.O. Box AQ
Rio Piedras,
Puerto Rico 00928

Dear Dr. Liegel,

Thank you for your letter of 30 December 1981. We shall be very happy to cooperate in the proposed AID-funded research and suggest that Mrs. Balkema represents Surinam in this study and coordinates the work here. We include a brief curriculum vitae as requested.

We should however like to have some more information about the projected research and to know what financial and other inputs are expected from us, as Pinus is no longer the most important object in our forestry research. Use of department vehicles and field camps, when and where available, should provide no problems.

Yours sincerely,

Ir. J. de Vletter
Head Research Dpt
Surinam Forest Service
POB 436
Paramaribo
Suriname

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