PD-AAX-214 3.F.18

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February 20, 1987

Dear Jim:

Attached is the final report summarizing activities connected with seed collections of Pinus maximinoi, P. chiapensis and P. ayacahuite(Project 3F-18). We really have killed ourselves in the field to make this project successful and I think our results show this. Your office will receive copies of all technical bulletins generated from our collection work as well as summary reports of species performance in Brazil, Colombia, Guatemala, Honduras, Mexico, South Africa and Venezuela as they become available. Your support of this project has been greatly appreciated and I hope we can work together again in the near future.

Sincerely,

Bill

William S. Dvorak
Director: CAMCORE

cc: C. Gallegos

Rec'd in

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FINAL REPORT

TESTING OF THREE PINE SPECIES FROM MEXICO, GUATEMALA AND HONDURAS: PINUS MAXIMINOI, PINUS CHIAPENSIS AND PINUS AYACAHUITE

Principal Investigator: William S. Dvorak

Summary

Pinus maximinoi

1. Seeds from 23 provenances and 714 mother trees of *Pinus maximinoi* were collected in Guatemala, Honduras and Mexico during the duration of the project. These collections represent the largest sampling of the species ever conducted in terms of geographic range explored and number of trees selected. The location of the collection sites are listed in Table 1.

2. One of the major outcomes of the seed collection work was the finding that *P. maximinoi* occurs on *both* fertile and degraded sites. Prior to the CAMCORE activities, it was concluded by others that *P. maximinoi* only inhabits the richest mountain soils in the highlands of Central America and Mexico. The practical implications of this new finding is that select *P. maximinoi* populations may be well suited for eroded mountain slopes in other areas of the Tropics. A recent report by Ladrach(1984) about *P. maximinoi* adaptability in the Colombian highlands appear to confirm this.

3. Soil samples were taken at 16 *P. maximinoi* collections sites. Physical soil analysis were made on horizon depth, soil texture and pH and results are being compiled at the present time. In addition, ESNACIFOR, is conducting chemical soil analysis on samples from nine *P. maximinoi* sites in Honduras. This will provide the most detailed soil information ever collected for the species and will help foresters better match site characteristics to species requirements.

4. Wood density values for *P. maximinoi* were found to average around .47 in stands in southern Mexico and Honduras. This information contradicts previous reports that the wood of *P. maximinoi* is "too soft" for use as a pulp species. Results from plantations of *P. maximinoi* in Colombia at eight years indicates they produce wood with a specific gravity of .40(Ladrach, 1986.)

5. Forty-nine genetic tests have been distributed to CAMCORE members in Brazil, Colombia, Honduras, Mexico, South Africa

and Venezuela(Table 2). The tests are designed so that provenance x site and family x site information will be easily obtained. The establishment of the tests have been staggered over a three year period. Approximately 90% of the tests have been field established; the oldest tests are one year of age. Within each test are local commercial check lots such of P. patula or P. oocarpa so that performance of P. maximinoi can be directly compared.

6. A CAMCORE technical bulletin entitled P. maximinoi by Dvorak, W. S., J. K. Donahue and E. Ponce is in preparation and will be published by June 1987. It will be available in both English and Spanish.

Pinus chiapensis

7. With funds from the project, a range-wide seed collection of P. chiapensis was made that extended from Veracruz, Mexico to El Quiche, Guatemala. It is the first time such an intensive collection of the species has been attempted. A total of 16 provenances and 379 mother trees were sampled during the collection(Table 3).

8. Prior to the CAMCORE/AID initiative, it was thought P. chiapensis occurred at elevations from 550m to 2000 m. However, our exploration has led to the discovery of stands as low as 200 m elevation and as high as 2200 m. Seed collection activities have also confirmed that P. chiapensis should be given an "endangered species" status. Most stands in the Mexican state of Chiapas are between two to four hectares in size.

9. Foresters usually describe P. chiapensis as growing on "fertile" sites in Mexico and Guatemala. CAMCORE conducted physical and chemical analyzes of soil samples from select P. chiapensis sites to quantify the fertility status of the soil. Results indicate the following: A typical P. chiapensis site is one with an O, Al, E and B horizons of 6,10, 17 and 60+cm depth, respectively. The species grows on acid to moderately acid soils(pH 4.5 to 6) that are characterized by low P contents(1 to 2 ppm) and high base status(60 to 100%). Soil texture ranges from sandy loams(A horizon) to clays(B horizon). All soils studies are well drained.

10. Wood samples were taken in a P. chiapensis stand in Barillas, Guatemala and specific gravity was found to be .35. This species appears to have the same kind of wood as Pinus strobus, one of the most commercially important timber species in the United States from 1870-1890. In our wood studies, little difference in specific gravity was found between juvenile and mature wood indicating P. chiapensis will kiln dry well without shrinking or warping. Like other white pines, it will hold nails well and can be used for a number of products like shingles, interior moulding, light

construction etc.

11. Twenty-five provenance/progeny tests and conservation banks have been distributed to CAMCORE members in Brazil, Colombia, Guatemala, Mexico, South Africa and Venezuela(Table 4). This number does not include the tests to be sent to members in mid 1987 with seed from collections made in 1986. Old bulk plantings of P. chiapensis indicate it will grow at a rate better than 23 cu m/ha/yr on appropriate sites. With the wide range of provenances included in the CAMCORE collections and better soils information, it is anticipated that some sources will grow 35 cu m/ha/yr. However, some cooperative members have had difficulty raising P. chiapensis and P. ayacahuite seedlings in the nursery. Both species grow very slowly compared to the hard pines, sometimes taking as long as one year to reach field planting size of 20 cm. Examination of the root systems of the P. chiapensis seedling shows that only the main tap roots have formed, no fibrous secondary root systems are present. Furthermore, even though all CAMCORE members have good knowledge of correct mycorrhizae inoculation procedures, roots of many P. chiapensis show no evidence of ectomycorrhizae. If seedlings are field planted during a period of unexpected drought, mortality is high. If planted under optimum conditions, seedlings may remain yellow as long as two years in the field. However, during the third year, once seedlings have "adapted to the site" growth may be as much as three to four meters. If P. chiapensis is to be a commercial plantation species, studies will have to be conducted to determine why the species is such a slow starter. It may require a different mycorrhizae association than do the hard pines. Such studies are being considered at North Carolina State University.

12. Several articles have been generated on P. chiapensis as a result of the CAMCORE/AID collaborative effort. "An evaluation of Pinus chiapensis as a commercial plantation species for the tropics" written by W.S. Dvorak and J. Brourard is to be published in the next issue of the Commonwealth Forestry Review. Mr. J. K. Donahue of the CAMCORE program submitted a paper at the IX World Forestry Conference in Mexico City(July, 1985) on "Conservation efforts for endangered white pines in southern Mexico:Pinus chiapensis and P. ayacahuite". A CAMCORE technical note entitled "Natural Range of Pinus chiapensis and Pinus ayacahuite found to overlap in Ixtlan, Oaxaca, Mexico by J.K. Donahue and M. Arizmendi was released August, 1986. A CAMCORE technical bulletin entitled "Pinus chiapensis" is in preparation and will be published by the end of the year.

Pinus ayacahuite

13. Fifteen provenances and 384 mother trees were sampled in the CAMCORE/AID seed collections from 1984-1986(Table 5).

These collections marked the first time any sampling has been done in the southern range of the species(eastern Guatemala and Honduras). Stands of P. ayacahuite in Honduras can only be found on the most remote mountain peaks. Because of the isolated nature of these populations, they are not endangered. The same is not true for populations in Guatemala and southern Mexico. Most stands range in size from 5 hectares to a few hundred trees.

2. Soils samples taken at P. ayacahuite collection sites are being analyzed at the present time. Study of wood samples indicate the specific gravity of P. ayacahuite is similar to P. chiapensis, about .35.

3. Thirteen provenance/progeny tests have been distributed to members in Colombia, Brazil, South Africa and Venezuela(Table 5). This number does not include those tests that will be distributed in 1987. Pinus ayacahuite suffers from the same slow start as described for P. chiapensis. In addition to studies of mycorrhizae association, growth/temperature relationships for the species need examined. In a CAMCORE study of P. ayacahuite in South Africa, the species "broke out" of its dormant stage in the nursery only after several nights of heavy frosts.

4. A CAMCORE technical note on P. ayacahuite is in preparation and will include information on collections sites, soils, wood quality as well as recommendations for conservation and testing.

Literature Cited

Ladrach, W. E. 1984. Growth of Pinus pseudostrobus Lind. and Pinus maximinoi H. E. Moore after five years. Carton de colombia Research Report No. 94. pp. 4.

_____ 1986. Control of wood properties in plantations with exotic species. Carton de Colombia Research Report No. 106. pp. 12.

Summary of Expenses

The following table summarizes expenses incurred from June, through December, 1986 as well as the cumulative total for the entire three year project. A balance of three dollars and ninety-eight cents remained at project completion.

	June - December, 1986	Cumulative
Salaries and Wages	$16,325.38	$39,262.27
Supplies	2,383.54	6,379.69
Equipment	-0-	4,437.75
Other Direct Cost	2,605.41	19,358.48
Other Current Services	8,507.84	41,299.83
SUBTOTAL	$29,822.17	$110,738.02
Overhead @ 24%	3,473.25	21,828.00
	$33,295.42	132,566.02

Table 1. Summary of *Pinus maximinoi* collections made in Guatemala, Honduras, and Mexico.

COUNTRY	STATE OR DEPARTMENT	PROVENANCE	LATITUDE/ LONGITUDE	ALTITUDE (m)	MEAN ANNUAL RAINFALL (mm)	NUMBER OR TREES SAMPLED
GUATEMALA	ALTA VERAPAZ	COBAN	15°28N 90°24W	1420	2109	31
GUATEMALA	BAJA VERAPAZ	SAN JERONIMO	15°04N 90°14W	1280	970*	30
GUATEMALA	GUATEMALA	SAN JUAN SACATEPEQUEZ	14°41N 90°38W	1580	1138	30
GUATEMALA	JALAPA	LA LAGUNILLA	14°42N 89°57W	1540-1860	1017	20
GUATEMALA	ZACAPA	SAN LORENZO	15°05N 89°40W	1770-1800	1500*	10
HONDURAS	COPAN	DULCE NOMBRE DE COPAN	14°50N 88°50W	1000	1446	50
HONDURAS	LA PAZ	MARCALA	14°19N 88°00W	1400	1671	40
HONDURAS	YORO	TAPIQUIL	15°12N 86°51W	1680	1069	50
HONDURAS	FRANCISCO MORAZAN	TATUMBLA	14°01N 87°07W	1300	937*	41
HONDURAS	FRANCISCO MORAZAN	VALLE DE ANGELES	14°10N 87°02W	1400	923*	50
HONDURAS	OCOTEPE-QUE	EL PORTILLO	14°30N 89°05W	1200	1269	30
HONDURAS	EL PARAISO	YUSCARAN	13°50N 86°50W	1800	1342	30
HONDURAS	COMAYAGUA	MINAS DE ORO	14°45N 87°25W	1300	1600	30
MEXICO	CHIAPAS	ALTAMIRANO	16°43N 92°03W	1280	1750*	39
MEXICO	CHIAPAS	SAN JERONIMO	17°09N 92°08W	940-1020	1750*	24
MEXICO	CHIAPAS	CIENAGA DE LEON	16°41N 93°52W	1050	1750*	18
MEXICO	CHIAPAS	COAPILLA	17°17N 93°09W	1300	1250*	36
MEXICO	CHIAPAS	LA CANADA	16°49N 92°17W	1270-1360	1750*	20
MEXICO	CHIAPAS	MONTE CRISTO	15°44N 92°33W	800	2644*	29
MEXICO	OAXACA	SAN JUAN COPALA	17°10N 97°58W	1370-1560	1350*	22
MEXICO	OAXACA	SAN JERONIMO	16°10N 97°00W	1220-1480	1950*	32
MEXICO	OAXACA	CANDELARIA	16°00N 96°31W	1370-1480	1350*	23
MEXICO	GUERRERO	LAS COMPUERTAS	17°10N 99°59W	1050-1200	1400	29

*Estimated

Table 2. Tests of provenance/progeny of *Pinus maximinoi* provided to CAMCORE Cooperators.

Cooperator	Test Identification		
Aracruz Florestas	15-01-01G		
Carton de Colombia	15-02-01C,	15-02-01Y,	15-02-01Z
	15-02-02C,	15-02-03A,	15-02-07B
	15-02-08C,	15-02-15D,	15-02-15E
	15-02-16A,	15-02-22A	
Carton de Venezuela	15-03-01E,	15-03-07C,	15-03-09B
CONARE	15-04-02B,	15-04-03E	
EMBRAPA	15-06-01D,	15-06-02E,	15-06-03C
	15-06-07E,	15-06-09A,	15-06-15B
	15-06-21A		
Pizano/Monterrey	15-09-02F,	15-09-03D	
SAFRI	15-10-01A,	15-10-01B,	15-10-02A
	15-10-03B,	15-10-07A,	15-10-08B
	15-10-15A,	15-10-17A,	15-10-21B
ESNACIFOR/COHDEFOR	15-13-01H,	15-13-14A	
INIF/CGF	15-14-02G,	15-14-05A,	15-14-10A
	15-14-20A		
CENIBRA	15-15-01F,	15-15-02D,	15-15-08A
	15-15-19A		
Florestas Rio Doce	15-16-07D,	15-16-13A,	15-16-15C
	15-16-18A		

Table 3. Summary of *Pinus chiapensis* collections made in Guatemala, Honduras, and Mexico.

COUNTRY	STATE OR DEPARTMENT	PROVENANCE	LATITUDE/ LONGITUDE	ALTITUDE (m)	MEAN ANNUAL RAINFALL (mm)	NUMBER OF TREES SAMPLED
GUATEMALA	HUEHUE-TENANGO	BARILLAS	15°48N 91°19W	1400-1700	2359	35
GUATEMALA	QUICHE	COTZAL	15°27N 90°54W	980-1430	2225	13
MEXICO	OAXACA	GUEVA DE HUMBOLDT	16°48N 95°22W	850-1015	1369	18
MEXICO	CHIAPAS	LA LIBERTAD	16°53N 92°53W	1800-2025	1717	31
MEXICO	CHIAPAS	LA TRINIDAD	17°02N 92°45W	1160-1530	2337	20
MEXICO	CHIAPAS	LARRAINZAR	16°52N 92°41W	1725-1860	2088	29
MEXICO	CHIAPAS	POHLO	16°56N 92°32W	1340-1380	2088	29
MEXICO	CHIAPAS	PUEBLO NUEVO	17°06N 92°52W	1740-1780	2050	30
MEXICO	CHIAPAS	SANTA CRUZ	16°49N 93°27W	850-1015	1326	24
MEXICO	OAXACA	SAN GABRIEL	16°11N 92°17W	1250-1800	2250*	26
MEXICO	OAXACA	YERUABUENA	17°58N 96°45W	1070-1560	1750*	39
MEXICO	OAXACA	TUTLA	17°25N 95°25W	470-690	2400*	29
MEXICO	OAXACA	HIGHWAY 175	17°36N 96°23W	2000-2030	1893	7
MEXICO	OAXACA	NOPOALA	19°54N 97°13W	710-960	2287	22
MEXICO	GUERRERO	HIERBA SANTA	17°31N 99°58W	1850-1940	2052*	5
MEXICO	OAXACA	TEOTLAXCO	17°28N 96°20W	1150-1400	1856	22

*Estimated

Table 4. Tests of provenance/progeny of *Pinus chiapensis* provided to CAMCORE Cooperators.

Cooperator	Test Identification		
Aracruz Florestal	12-01-01C,	12-01-10A	
Carton de Colombia	12-02-01D,	12-02-07C,	12-02-14B
Carton de Venezuela	12-03-01H,	12-03-07D,	
CONARE	12-04-01G		
EMBRAPA	12-06-01F,	12-06-11A	
Jari	12-08-01I		
SAFRI	12-10-01A, 12-10-09A,	12-10-01B, 12-10-14A	12-10-07B
BANSEFOR/INAFOR	12-12-05A		
INIF/CGF	12-14-01E, 12-14-15A	12-14-08A,	12-14-12A
CENIBRA	12-15-02A,	12-15-06A	
Florestas Rio Doce	12-16-07A,	12-16-14C	

Table 5. Summary of *Pinus ayacahuite* collections made in Guatemala, Honduras, and Mexico.

COUNTRY	STATE OF DEPARTMENT	PROVENANCE	LATITUDE/ LONGIDTUDE	ALTITUDE (m)	MEAN ANNUAL RAINFALL (mm)	NUMBER OF TREES SAMPLED
GUATEMALA	TOTONI-CAPAN	CHUIPACHEC	14°56N 91°22W	2500-2730	926*	45
GUATEMALA	HUEHUE-TENANGO	SANTA EULALIA	15°44N 91°27W	2700-2730	2367	7
GUATEMALA	QUEZAL-TENANGO	PALESTINA	14°56N 92°18W	2580-2720	868*	20
HONDURAS	LA PAZ	LAS TRANCAS	14°07N 87°49W	2120-2400	1579	47
HONDURAS	OCOTEPE-QUE	PLAN DE RANCH	14°25N 89°08W	2730	1269	58
HONDURAS	LEMPIRA	CELAQUE	14°33N 88°40W	2000-2500	1850**	12
MEXICO	CHIAPAS	EL PORVENIR	15°25N 92°20W	2645-2760	2038	30
MEXICO	CHIAPAS	ARCOTETE	16°44N 92°36W	2250-2320	1238	17
MEXICO	CHIAPAS	BUENAVISTA VILLAFLORES	16°31N 92°14W	2290-2375	1238	20
MEXICO	CHIAPAS	CANDELARIA	16°44N 92°33W	2290-2350	1238	4
MEXICO	OAXACA	IXTLAN	17°24N 96°29W	2330-2920	1650**	32
MEXICO	OAXACA	NUNDACO	17°09N 97°38W	2840-2940	1750**	22
MEXICO	HIDALGO	LOS CUBES	20°23N 98°24W	2180-2300	1200**	29
MEXICO	OAXACA	LLANO GRANDE	17°10N 96°21W	2560-2860	1100**	20
MEXICO	OAXACA	CONCEPCION PAPALO	17°50N 96°47W	2510-2620	1250**	21

* Rainfall recorded at nearest meteorological station which is probably lower than actual rainfall at collection site.
** Estimated rainfall.

Table 6. Tests of provenance/progeny of *Pinus ayacahuite* provided to CAMCORE Cooperators.

Cooperator	Test Identification
Carton de Colombia	09-02-01C, 09-02-03A, 09-02-09A 09-02-11A
EMBRAPA	09-06-05A
SAFRI	09-10-01A, 09-10-01B, 09-10-02A 09-10-04A, 09-10-11B
INIF/CGF	09-14-01D, 09-14-07A
CENIBRA	09-15-06A