

[REDACTED]

//Provenance Trial of Pinus caribaea

Re-measurement 1978 Age 5 years

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March, 1978

1. History

A set of 8 provenance batches of seed of Pinus caribaea were obtained from Commonwealth Forestry Institute Oxford in June 1972 and planted in the nursery in August. The resulting plants were planted in random blocks of 49-tree plots in February 1973. Five blocks were established, on the CATIE estate at Turrialba.

Blocks 1 & 2 At Puente Cajón on an ill-drained, flat site on poor clayey soil.

3 Florencia Norte, on a sloping well drained site cleared from secondary forest.

4 San Juan Sur on a well-drained sloping site cleared from rough pasture.

5 Nochebuena "arriba". Similar conditions to 4, but slightly lower and less well-drained.

One of the eight Oxford batches, K29 produced insufficient seedlings for a full set of plots and was substituted by seedlings raised from seed collected locally on the CATIE estate. The original provenance of the CATIE parents is not certainly known, but the seed was obtained from Guatemala.

The K29 trees, from a special collection in Belize, and surpluses from five of the other batches were planted in separate plantations adjacent to Blocks 1 & 2 at Puente Cajón.

In November 1974, when the trees were 21 months old from planting, assessments of height and survivals were made. These data were analysed by D. Zeaser in 1976 who prepared a summary report (copy in this file), which gives additional detail about the trial sites. Zeaser was unable to detect significant differences in heights or survival over the whole trial. Overall means were 1.47 m. Ht and 77.4% survival. He did note, however, that survivals were low and irregular in blocks 3 & 5.

2. Provenances Tested

Provenances	Origin	Lat. N.	Long. W.	Altitude	Mean Annual Rainfall (mm)
T1	Turrialba (plantation)	9°53'	83°38'	602	2674
K20	Alimacamba, Nicaragua	13°34'	84°17'	25	2900
K24	Guanaja, Honduras	16°27'	85°54'	75	2300
K57	Culmi, Honduras	15°06'	85°37'	550	1500
K58	Brus, Honduras	15°45'	84°40'	10	2800
K60	Potosi, Honduras	15°20'	88°25'	650	1200
K61	Santa Clara, Nicaragua	13°48'	86°12'	700	1500
K64	Santos, Belize	17°30'	88°30'	80	2000
"Belize"	Mount Pine Ridge, Belize	17°00'	88°55'	400	1780
K29	Poptún, Guatemala	16°21'	89°25'	500	1690

3. 1978 Remeasurement

The plots had been neglected for some years and, except in Puente Cajón were overgrown with weeds. Original demarcation was mostly lost. During early February all plots were cleared and inspected. Block 3 at Florencia Norte had only 45 trees surviving and no demarcation. The 45 trees were allocated to provenances on the basis of an inadequate plot diagram and their heights and diameters measured.

In all other blocks demarcation was restored, survival was counted on each 49-tree plot and on the inner 25-tree measurement square. Heights and diameters of all trees in the inner squares were measured and, in plots where survival was less than 24/49, all survivors were measured. Recently felled trees (mainly in block 4, in the course of road widening) were regarded as surviving upto the time of measurement and measured whenever possible.*

Since it was clear that the Puente Cajón site had quite different survival and growth rates from the other three sites, an additional plot of 49 trees was located at random in each of the plantations established nearby with surplus stock. Results from these additional plot are designated "Block 3(A)" in the following tables.

* Since these measurements were made, more trees have been felled in Block 4 to make space for an electric power line.

Numbers of "foxtail" trees were noted in Blocks 4 & 5 but provided little information. They do not occur on the Puente Cajón site. Cones were also looked for but none were seen on these young trees.

4. Results

Survivals ex 49, Survivals ex 25 inner trees, plot mean heights (m) and plot mean diameters (cms) are shown in the tables attached as appendices 1-4. Inspection of these tables quickly confirms the impression obtained in the field that survival was better and growth much slower on the ill-drained Puente Cajón site (Blocks 1, 2 & 3(A)) than on the other three sites (Blocks 3, 4 & 5).

5. Analysis of Data

Since growth at Puente Cajón appeared quite different from that of the other three sites, preliminary statistical analyses of the data from Puente Cajón (Blocks 1, 2 & 3(A)) and from Blocks 3, 4 & 5 were made separately on a desk calculator, using estimated values for missing plots. These analyses showed no significant differences in growth amongst the eight provenances on either site type, although there were significant differences in survivals on the drier sites.

The data were then sent to Commonwealth Forestry Institute Oxford for more detailed analysis by computer.

At Oxford the fragmentary data from Block 3 were rejected and orthogonal analyses carried out on several combinations of provenances adequately represented in the remaining five replicates.

All these analyses tended in the same direction. Survival was very variable and differed significantly amongst replicates but not among provenances. Height and diameter growth followed a similar significance pattern but with rather more distinction amongst provenances. An analysis which compared the growth of all eight provenances in four replicates; grouped in pairs to represent Puente Cajón (Blocks 1 & 2) and "better drained sites" (Blocks 4 & 5) is perhaps the most informative and is summarised in Table 1.

Discussion

The site means shown in this table emphasise the poorer growth but better survival found on the ill-drained Puente Cajón site. Only extreme differences in growth reach statistical significance within sites. As would be expected, the rankings for height and diameter growth are very similar; that is, the taller trees are also the fatter.

Table 1.- Provenances of Pinus caribaea on two site types at Turrialba
Provenance means, age 5 years

Sites	Heights (m)	Breast Height Diameters (cm)	Survivals (%)
<p>1</p> <p>Well-drained Sites Blocks 4 & 5 Site means: Ht. 7.6 m. Diam. 12.6 cm. Surv. 54%</p>	<p>K60 9.3</p> <p>T1 9.1</p> <p>K57 8.3</p> <p>K20 7.8</p> <p>K61 6.7</p> <p>K64 6.6</p> <p>K58 6.5</p> <p>K24 6.3</p>	<p>T1 15.9</p> <p>K60 15.2</p> <p>K57 14.5</p> <p>K20 12.8</p> <p>K64 11.4</p> <p>K58 10.6</p> <p>K61 10.5</p> <p>K24 9.7</p>	<p>K64 81</p> <p>T1 67</p> <p>K20 61</p> <p>K60 59</p> <p>K58 56</p> <p>K57 38</p> <p>K61 38</p> <p>K24 28</p>
<p>2</p> <p>Puente Cajón Blocks 1 & 2 Site means: Height 3.8 m. Diam. 6.7 cm. Survival 80%</p>	<p>K61 4.4</p> <p>K57 4.2</p> <p>K58 4.2</p> <p>K60 4.1</p> <p>K20 4.0</p> <p>T1 3.7</p> <p>K24 3.1</p> <p>K64 2.9</p>	<p>K57 7.6</p> <p>K61 7.5</p> <p>K58 7.3</p> <p>K60 7.1</p> <p>K20 6.6</p> <p>T1 6.3</p> <p>K24 6.2</p> <p>K64 5.0</p>	<p>K58 89</p> <p>T1 86</p> <p>K60 85</p> <p>K24 84</p> <p>K57 83</p> <p>K64 82</p> <p>K20 79</p> <p>K61 45</p>
Overall Means	5.7 m.	9.6 cm.	67%

Vertical bars connect provenance means which do not differ significantly at the P 0.05 level of probability.

Site means differ at the P 0.001 level of probability for height and diameter and at P 0.05 level for survival.

A point of some interest is the marked interaction of provenances, with site, as had been suspected by Zeaser in his earlier assessment. Thus, the local selection, T1, and K60 from Honduras, which rank first and second for growth on the well-drained sites, achieve only fourth and sixth ranks at Puente Cajón. In contrast, K61 grows well at Puente Cajón but is among the smaller provenances on the well-drained sites and K57 from Honduras is among the larger provenances on both sites.

Poor survival in Blocks 3 and 5 of this experiment are reflected not only in the survival figures (Appendix 1) but also in the growth data (Appendices 3 & 4). Poorly stocked plots not only suffer greater weed competition, but also poorer maintenance because small weed-covered trees are easily overlooked and may be damaged during weeding.

Because there is no within-site replication (except at Puente Cajón) and the number of plots yielding reliable data has been reduced by losses, statistical analysis of the experiment has been made more difficult and the experiment is unlikely to produce conclusive results.

Conclusions

On present evidence we may tentatively say:

- a) On well-drained sites seed collected locally from well-grown parent trees will probably produce as good or better crops than any of the other sources tested. Next best would be Honduran seed from Potosi or Culmi.
- b) Growth of all provenances is poor at Puente Cajón but the Santa Clara, Nicaragua seed grew faster than the other sources tested.
- c) There was a need to repeat this experiment with improved within-site replication and this has already been done by Zeaser in Experiment 77-1 (113) planted in 1977.

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Pinus caribaea Provenance Trial

Expt. 73-1 (8)

Planted February, 1973Re-measurement February, 1978 - Age 5 yearsSurvivals ex 49 trees/plot

W.G.D. 6/3/78

(Trees recently cut, or uprooted by bulldozer, deemed to be survivors)

PROVENANCES	BLOCKS						TOTALS	MEANS
	1	2	3a	3	4	5		
K20	45	31	30	9	40	19	174	29.0
K24	45	37	40	6	27	4	159	26.5
K60	39	44	36	4	32	26	181	30.2
K61	47	38	47	2	31	8	173	28.8
K64	44	36	42	8	44	35	209	34.8
T1	43	41	--	11	33	33	161	32.2
K57	45	35	--	3	24	14	121	24.2
K58	46	41	--	2	31	24	144	28.8
K29	--	--	39	--	--	--	39	39.0
Belize	--	--	31*	--	--	--	31	31.0
(K29)	--	--	36	--	--	--	36	36.0
TOTALS	354	303	301	45	262	163	1428	--
MEANS	44.2	37.9	37.6	5.6	32.8	20.4		29.8

* = Value corrected for missing corner of plot

- = Plot not planted

Pinus caribaea Provenance Trial

Expt. 73-1 (8)

Planted February, 1973

Re-measurement February, 1978 - Age 5 years

Survivals ex 25-tree inner measurement squares

W.G.D. 6/3/78

(Trees recently cut or uprooted by bulldozer taken as surviving)

PROVENANCE	BLOCKS						TOTALS	MEANS
	1	2	3(a)	3	4	5		
K20	23	14	13	**	23	9*	82	16.4
K24	23	19	20	**	13*	1*	76	15.2
K60	16	22	18	**	19	12	87	17.4
K61	25	19	24	**	20	2*	90	18.0
K64	22	19	21	**	22	20	104	20.8
T1	23	22	--	**	16	17	78	19.5
K57	24	17	--	**	10*	8*	59	14.8
K58	23	22	--	**	16	16	77	19.3
K29	--	--	19	--	--	--	19	19.0
Belize	--	--	14	--	--	--	14	14.0
(K29)	--	--	22	--	--	--	22	22.0
TOTALS	179	154	151	**	139	85	708	--
MEANS	22.4	19.2	18.9	**	17.4	10.6	--	17.7

- = Plot not planted

* = Height and diameter means calculated from all trees surviving on the full 49-tree plot

** = The inner 25-tree squares could not be identified in Block 3

Pinus caribaea Provenance Trial

Expt. 73-1 (8)

Planted February, 1973

Re-measurement February, 1978 - Age 5 years

Mean Heights (metres)

W.G.O. 6/3/78

PROVENANCES	BLOCKS						TOTALS	MEANS
	1	2	3(a)	3	4	5		
K20	4.9	3.2	6.5	4.1	9.1	6.6	37.4	6.2
K24	3.5	2.8	2.3	8.8	7.8	4.8	30.0	5.0
K60	3.7	4.5	5.8	8.3	9.2	9.5	41.0	6.8
K61	5.0	3.8	5.9	3.5	8.0	5.4	31.6	5.3
K64	3.4	2.5	3.6	6.3	7.3	5.9	29.0	4.8
T1	3.3	4.1	-	6.2	8.5	9.8	31.9	6.4
K57	4.6	3.8	-	5.8	8.6	8.0	30.8	6.2
K58	4.1	4.3	-	5.0	6.8	6.2	26.4	5.3
K29	-	-	4.7	-	-	-	4.7	4.7
Belize	-	-	4.4	-	-	-	4.4	4.4
(K29)	-	-	3.9	-	-	-	3.9	3.9
TOTALS	32.5	29.0	37.1	51.0	65.3	56.2	271.1	-
MEANS	4.1	3.6	4.6	6.4	8.2	7.03	-	5.6

- = plot not planted

Pinus caribaea Provenance Trial

Expt. 73-1 (8)

Planted February, 1973Re-measurement February, 1978 - Age 5 yearsMean Diameters BHOB (cms)

W.G.D. 6/3/78

PROVENANCES	BLOCKS						TOTALS	MEANS
	1	2	3(a)	3	4	5		
K20	8.67	4.58	9.10	10.44	14.95	10.67	58.41	9.74
K24	7.51	4.83	3.50	13.27	13.50	5.92	48.53	8.09
K60	6.06	8.12	9.22	10.37	15.51	14.84	64.12	10.69
K61	8.60	6.49	8.81	3.70	12.58	8.46	48.64	8.11
K64	6.05	3.94	6.74	7.31	12.94	9.85	46.83	7.81
T1	5.98	6.67	-	9.24	15.26	16.46	53.61	10.72
K57	8.98	6.21	-	7.23	15.48	13.69	51.59	10.32
K58	7.19	7.32	-	6.40	11.19	10.06	42.16	8.43
K29	-	-	7.80	-	-	-	7.80	7.80
Belize	-	-	7.34	-	-	-	7.34	7.34
(K29)	-	-	5.83	-	-	-	5.83	5.83
TOTALS	59.04	48.16	58.34	67.96	111.41	89.95	434.86	-
MEANS	7.38	6.02	7.29	8.50	13.93	11.24	-	9.06

- = plot not planted