# AMELIORATION OF WATER-LOGGED TERRAIN IN QUEBEC

## II - Fertilization of planted and residual trees on peatland



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W. Stanek

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INFORMATION REPORT Q-X-20

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ABSTRACT

An open, nutrient poor peatland near Quebec City was drained in 1969. Part of the area was used for an experiment with N, P, K fertilizers. A split-split plot design was used. Black spruce, jack pine and lodgepole pine seedlings were spot fertilized. Several plots randomly selected in a black spruce residual stand were fertilized with N, P, K and Cu. In this report the area, statistical design and methods are described.

## INTRODUCTION

In peatland forestry, conversion of water-logged peatlands into producing forests generally consists of three phases: (1) lowering the high water table by drainage, (2) reforesting with a suitable species, and (3) fertilizing newly established and residual trees.

The purpose of this study is to determine the effects of fertilization on growth of artificially regenerated and residual trees on drained peatland. Berg (1952), Zehetmayer (1954), Malmström et al.(1956), Thurmann-Moe (1962), Huikari (1962), Heikurainen (1964) and Meshechok (1968) reviewed and conducted experiments notably in Scotland and the Scandinavian countries, and indicated considerable improvement of forest tree productivity on fertilized peatlands. This experiment was designed as a pilot project for similar studies in this country, because vast areas of peat-wastelands, which exist across Canada, could turn under sound management into a formidable forest resource of the future.

## LOCATION AND DESCRIPTION OF THE AREA

A 250-acre peatland in the Donnacona Block of the Valcartier Camp military reserve situated 15 miles northwest of Quebec City was selected for amelioration work (Fig. 1). The peatland rests on a terrace of the Jacques Cartier River. The underlying soil consists of stratified stands and gravels over gleyed clay. This sequence is characteristic of the Champlain Sea deposits (Dresser and Denis, 1944).

An annual temperature of 38.7°F, precipitation of 49.0 inches and

P.E.T. of 20.4 inches (51.8 cm) (Fréchette, 1965) were recorded at the nearby Valcartier Forest Experimental Station.

The study area is in Region L4a, Laurentian Section (Rowe, 1959). The forests on well-drained uplands are composed of northern deciduous species, in the valleys of mixed or pure coniferous stands, and on peatlands mainly of black spruce.

The vegetation of the experimental area indicates oligotrophic (nutrient poor) conditions (Huikari, 1952; Heikurainen, 1964). The associations belong to two types mainly, the Sphagno chamaedaphnetum calyculatae (Grandtner, 1960; Gauthier, 1967) and the Sphagno piceetum marianae (Grandtner, 1960; Gauthier, 1967).

The organic soil consists almost entirely of barely decomposed and semidecomposed plant residue of mosses, sedges, and dwarf shrubs. The content of wood erratics is small. Carex-sphagnum and forest-sphagnum peat occur frequently (Lukkala, 1929). The peat was 3 to 7 ft deep, although in some places it was 14 ft deep.

The peat has developed on top of a podzol with a strongly iron-cemented illuvial horizon which is nearly impermeable to water (Ray, 1958). Both the cemented layer and the clay stratum aided paludification by impeding drainage. This was remedied by draining (Stanek, 1970) in February 1969. After drainage the water table fluctuated 8 to 20 in and occasionally it fell below 20 in. The highest levels were measured in the spring and after rainfalls, the lowest during the late summer and periods of drought. The chemical analyses of the soil's top 24 in are shown in Table I. When they are compared with those of Malmström (1956) the P content of the soil is low, N and K are mediocre and the pH of 3.0 is relatively low. However, the nutrient contents of the foliage shown in Table II are higher than those given by Tamm (1956) as deficiency levels, and are within Ingestad's (1962) ranges for moderate deficiency.

## OBJECTIVES OF THE STUDY

This study contains three parts, each with a special objective. The short-term experiment A (0 to 5 years) is aimed at determining the effects of rock phosphate, superphosphate, urea and potash upon survival, height growth, and chemical content of foliage and seedlings of black spruce (bS) (Picea mariana (Mill.) B.S.P.), jack pine (jP) (Pinus banksiana Lamb.), and lodgepole pine (lP) (Pinus contorta Dougl.).

The long-term experiment B (5 to 15 years) aims at testing the same response variables as in A. Five years after the first fertilization, one-half of the short-term Study A will again receive dosages of the same fertilizers.

Study C is concerned with the effects of rock phosphate at two levels and of superphosphate, urea, potash, and copper sulphate upon the height growth, diameter growth at breast height (dbh), and chemical content of foliage of young, naturally established black spruce.

The following could be inferred: (1) interactions of rock phosphate with urea and potassium sulphate; (2) effects of P in the forms of rock phosphate and superphosphate on growth of artificially regenerated trees; (3) value of N, P, K and Cu fertilizers in peatland amelioration;

(4) correlation of the chemical contents of foliage,growth responses, and fertilizer application; (5) recommendations for application of N, P, K, and Cu fertilizers in peatlands of similar ecological makeup; (6) growth of container-grown seedlings in comparison to that of nursery-grown stock; and (7) response to second fertilizer application 5 years after beginning of experiment.

## METHODS

### Chemical Analyses

The total nutrient content of foliage was determined on the current year's needles collected from the upper third of the crowns during dormancy. The total nutrient content of peat was determined from sample columns 24 in deep and 2 in square.

Chemical analyses of the soil and foliage samples, which had been oven dried at 108°C for 24 hr, were made in the Soils Laboratory of MacDonald College of McGill University: pH was determined in 0.1 N/CaCl; total N, P, K, Ca, Mg, Cu, Fe, Mn, and K were determined after sulphuric peroxide digestion; C was determined by using the Walkley-Black procedure; and percent ash was determined on loss by ignition at 400°C for 8 hr.

### Planting Stock and Planting

The seed used in container-planting originated from:

(1) jP, collected 1966 in Labrieville, Saguenay County, Quebec, latitude 49° 18 min, longitude 69° 35 min, altitude 500 ft, germination capacity determined June 1968 was 91%.

(2) lP collected 1964, Aleza Lake, Prince George, B.C., latitude 54°, altitude 2,000 ft. Most of the seeds germinated, however, very slowly in comparison to jP.

(3) bS, collected 1967 at Nicauba, Quebec, latitude 49° 15 min, longitude 73° 50 min. Germination capacity in 1969 was very high.

The 2-2 jP nursery stock of local provenience was obtained from the Valcartier Station nursery. The bS 2-2 nursery stock was supplied from the Ontario Department of Lands and Forests' nursery at Thunder Bay. Presumably the seed originated in Site Region No. 5 (Hills, 1952).

All seeds were prepared for germination in Petri dishes on January 16, 1969. Immediately after germination, the seeds were placed into styrene bullets (Walters, 1968) filled with a rooting medium of Vermiculite and peat moss. The plants were kept in a hydroponic culture with mineral nutrients in low concentration (Ingestad, 1967). Planting commenced at the end of May and was finished on June 11. All bullets were planted with the planting gun described by Walters (1961).

Nursery stock of 2-2 bS and jP was planted in simple slits made by spades and the soil around the trees was pressed firmly into place. The numbers of trees in the experimental design are shown in Table III. In total 2,662 trees in plastic bullets and 9,695 trees grown in the nursery were planted.

Fertilizer Treatments

The approximate composition and price of the fertilizers are shown in Table IV. The cost of fertilizers and the dosages applied per tree and per acre in Studies A and B are shown in Table V and the treatments numbers in Table VI. The dosages and costs of Study C are shown in Table VII. Fertilizers were applied by hand with measuring cups and spoons. In Studies A and B all fertilizers were placed around the seedlings 3 in from the stem.

In Study C the granular fertilizers were placed 1 ft from the stem. The copper sulphate was sprayed as a watery solution. In Study A the application of fertilizers started on June 12, and was completed on June 19. In Study C fertilization was carried out between July 9 and 11, 1969.

Experimental Design

In Studies A and B the experimental unit is made up of 25 observational units, each consisting of one tree. Within each experimental unit 5 to 10 trees were planted for future chemical analyses, and around each experimental unit there was a buffer zone two trees deep (Fig. 2), made up of 2-2 jP and bS. Seven treatments in four replications were given to five kinds of trees used in the experimental units (Table VI). This required 140 experimental units arranged in a split-split-plot design (Fig. 3). In Study B, the same fertilizers as in Study A will be applied 5 years hence (in 1974) to one-half of A, whilst the other half will serve as control. The experiment will follow the design of a split split-split plot.

In Study C an observational and an experimental unit consist of one tree. Seven plots 100 by 100 ft were chosen in a natural, young but uneven-aged black spruce stand with uniform ecological conditions. Suppressed, malformed, and diseased trees were removed, the remaining trees were pruned to a height of 5 ft. All trees were numbered and their height and dbh measured. The ages of several trees were counted at ground level. The data are shown in the Appendix. There are seven plots in Study C with each plot receiving one treatment (Table VII).

Response Variables to be Measured

The adequate number of trees to be measured per experimental unit is a question pertinent to all three studies. A sample of 10 observational units per experimental unit is considered satisfactory because it is assumed that the coefficient of variation will be small. The height of trees will be measured each year at the end of the growing season, when the survival will be determined. The data should be recorded on 40 by 80 sheets obtainable from the Biometrics Section in Ottawa where the data will also be analysed.

## DISCUSSION OF POST-PLANTING OBSERVATIONS

Jack pine seedlings in bullets were planted as early as May 26. However, in that part of the peatland, late frost occurred on May 29,and almost all of the planted seedlings suffered severe damage to shoots or had been killed. The remainder of the jack pine material in bullets, planted after June 7, was preserved from frost damage. The jack pine 2-2 nursery stock which was planted on May 27 and 28, was exposed to the same frost conditions, but suffered no frost damage because it was still dormant. In evaluating the results this fact should be given consideration. The damaged seedlings are located in Block I, jack pine, treatment 8, 9, 10, 12, 13, and 14 (planted May 26).

The severe damage caused by frost indicates the necessity of either hardening-off the planting stock or delaying planting until the danger of late frost is negligible.

Using a Bombardier Muskeg Carrier and a tandem rear-deck, four-wheel trailer facilitated site clearing and transportation of men and materials. The rental rate was $7 per hour, without operator, and 20 hours were required. The rental cost was more than made up by savings resulting from faster transportation of the labourers and flexibility of the operations.

The responses of the seedlings to fertilization were evident during the inspection of the experimental area in late fall of 1969. The healthy appearance of many seedlings fertilized with P and N in contrast to that of plants in control plots was rather striking.

Changes in vegetation were observed in places where fertilizers were applied. Sphagnum suffered undetermined damage from application of ground mineral phosphate. Rather strikingly evident were burns on vegetation caused by superphosphate and "triple" superphosphate.

The trees contained in bullets became well established in the wet medium of undecomposed, undisturbed peat. Almost all roots grew through the slots in the plastic cartouche (bullet). The gun-planting of the bullets was fast and easy and the bullets were pushed firmly into the peat. However, several tree-tops were broken by the mechanism, possibly through the fault of the inexperienced operators. The roots which stuck out of the bullets were pruned by hand before "loading" the gun. The effects on the seedlings will be the same as those of root pruning in the nursery described by Sutton (1969). Many of the 2-2 bS trees showed desiccated terminal shoots at the time of planting; this occurred possibly during the extended period of cold storage in bales and boxes. There is also a distinct possibility that the provenience of the bS nursery trees was not suitable for peatland reforestation, because during the growing season of 1969 many of the seedlings were in a state of "check", i.e., did not wilt or die but did not grow either.

Jack pines (2-2) generally became well established, though the plants were too large for easy planting and the roots were more prone to damage by desiccation during the interval between lifting and planting. Functional losses of parts of the root system were perhaps the cause of "needle drop" of all but 1-year-old needles. This was observed on many of the jP, but in spite of this the 4-year-old jack pines showed the relatively largest height increment of all species planted.

In the year preceding the establishment of the experiment, snowmobiles caused considerable damage to planted and residual young trees. Many terminal shoots were broken above the snow. Because of this, the area was well marked with signs to avoid damage to the experimental trees.

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APPENDIX "A"

Table I. Analysed chemical properties of oven dry organic soils from the upper 24 inches

| Association | Site | pH(1N KCl) | Percent | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | | N | P | K | C | C/N | Ash |
| *Sphagno chamaedaphnetum calyculatae*, without tree cover | P1 | 3.1 | 0.70 | .045 | .20 | 51.7 | 74 | 2.8 |
| | P4 | 2.9 | 1.35 | .045 | .05 | 41.2 | 31 | 2.0 |
| *Sphagno Piceetum marianae ledetosum*, with trees | 48 | 2.8 | 1.30 | .045 | .01 | 55.0 | 42 | 1.4 |
| | P2 | 2.8 | 1.15 | .060 | .10 | 56.2 | 49 | 2.1 |
| | P3 | 3.1 | 0.70 | .050 | .20 | 46.8 | 67 | 6.8 |

Table II. Chemical analyses of oven dry foliar tissues of black spruce

| | | % | | | | | ppm | | | | % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Association | Site | N | P | K | Ca | Mg | Zn | Cu | Fe | Mn | Ash |
| *Sphagno chamaedaphnetum calyculatae* | 5 | .96 | .100 | .60 | 5.06 | .122 | 5 | 9 | 250 | 1875 | 2.0 |
| | 4 | .96 | .148 | .60 | 5.06 | .101 | 15 | 8 | 300 | 980 | 2.0 |
| *Sphagno piceetum marianae ledetosum* | 48 | .90 | .097 | .65 | 5.06 | .203 | 25 | 3 | 200 | 1100 | 2.0 |
| | P3 | .97 | .090 | .65 | 5.06 | .104 | 5 | 8 | 250 | 900 | 2.0 |
| | 50 | 1.60 | .100 | .63 | 3.38 | .135 | 145 | 8 | 25 | 1300 | 1.8 |
| | 25 | .90 | .095 | .60 | 5.06 | .152 | 5 | 3 | 250 | 1050 | 1.8 |
| | 47 | 1.20 | .130 | .40 | 5.74 | .105 | 140 | 5 | 200 | 1550 | 1.7 |
| | 24 | .85 | .100 | .55 | 5.74 | .118 | 15 | 21 | 300 | 940 | 1.9 |

Table III. The number of trees used in the experimental design

| Type of planting stock | Species | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | sB | | | jP | | | lP | | |
| | Experi-mental unit | Buffer zone | Spares for analysis | Experi-mental unit | Buffer zone | Spares for analysis | Experi-mental unit | Buffer zone | Spares for analysis |
| Plastic bullet | 700 | - | 93 | 700 | - | 244 | 700 | - | 225 |
| Nursery stock 2-2 | 700 | 3136 | 175 | 700 | 4704 | 280 | - | - | - |

Table IV. Approximate composition and price of fertilizers[1] used in the experiment in per cent

| Code | Fertilizer | Formula | Total N | Total $P_2O_5$ | Water Soluble $K_2O$ | Total CaO | Total MgO | Total S | Total Cu | 1968 Price/ton[2] $ |
|---|---|---|---|---|---|---|---|---|---|---|
| (P) | Mineral rock phosphate | $Ca_3(PO_4)2$ | - | 20-30 | - | 28-42 | - | - | - | 45.00 |
| (N) | Urea | $CO(NH_2)2$ | 45 | - | - | - | - | - | - | 103.00 |
| (K) | Potassium sulphate | $K_2SO_4$ | - | - | 48-52 | 0-2.5 | - | 16-19 | - | 92.00 |
| (Cu) | Copper sulphate | $CuSO_4.5H_2O$ | - | - | - | - | - | 13 | 26 | 8.50[5] |
| (Ma) | Air-dried sewage sludge | - | 2 | 2 | Trace | 2.5 | 0.5 | 0.2 | - | 10.00[4] |
| (P3)[3] | Superphosphate "double" | - | - | 45-50 | - | 17-20 | 0.5 | 1.0 | - | 100.00 |

1/ Based on Jacob and Uexküll (1963)

2/ Canad. $ per short ton (2000 lb (907.19 kg)) F.O.B.

3/ Equivalent to Triple Superphosphate

4/ Cost for loading, transportation and unloading

5/ Cost per kg laboratory grade A.C.S. specification

Table V. Dosages anc costs of individual fertilizers applied in Studies A and B

| | | Amount per tree | | | | Cost in $ per | |
|---|---|---|---|---|---|---|---|
| Code | Fertilizer | Measure | grams | oz. | lb/acre | acre | 100 trees |
| (P) | Mineral rock phosphate | 1/2 cup | 169.8 | 6.0 | 375 | 8.40 | 0.80 |
| ($P_2$) | Mineral rock phosphate | 1 cup | 339.6 | 12.0 | 750 | 16.80 | 1.60 |
| ($P_3$) | Superphosphate "double"1/ | 1/3 cup | 76.4 | 2.7 | 166 | 8.30 | 0.80 |
| (N) | Urea | 1 tsp. | 14.1 | 0.5 | 32 | 1.60 | 0.15 |
| (K) | Potassium sulphate | 1 tbsp. | 28.3 | 1.0 | 63 | 5.70 | 0.55 |
| (O) | Control | - | - | - | - | - | - |

1/ "Double" superphosphate is sold frequently as triple superphosphate. The amounts of $P_2O_5$ applied as $P_3$ are equivalent to those applied as P.

Table VI. Treatments in Studies A and B[1]

| | Plastic Bullets | | | 2-2 Nursery Stock | |
|---|---|---|---|---|---|
| Code | sB | jP | lP | sB | jP |
| (O) | 1 | 8 | 15 | 22 | 29 |
| (P) | 2 | 9 | 16 | 23 | 30 |
| (NP) | 3 | 10 | 17 | 24 | 31 |
| (KP) | 4 | 11 | 18 | 25 | 32 |
| (NPK) | 5 | 12 | 19 | 26 | 33 |
| ($P_2$) | 6 | 13 | 20 | 27 | 34 |
| ($P_3$) | 7 | 14 | 21 | 28 | 35 |

[1] Code explained in Table V; distribution of treatments shown in figure 3.

Table VII. Fertilizer treatments of Study C--dosages applied and costs of chemicals

| Code | Applied to plots # | Amounts in oz of fertilizer per tree | | | | | Cost $ 100 trees |
|---|---|---|---|---|---|---|---|
| | | (N) | (P) | (K) | (Cu) | (Ma) | |
| (O) | 69 | - | - | - | - | - | - |
| (P) | 48 | - | 12.00 | - | - | - | 1.60 |
| (NP) | 49 | 2.60 | 12.00 | - | - | - | 2.41 |
| (KP) | 50 | - | 12.00 | 3.20 | - | - | 2.52 |
| (NPK) | 51 | 2.60 | 12.00 | 3.20 | - | - | 3.33 |
| (NPKCu) | 70 | 2.60 | 12.00 | 3.20 | 0.07 | - | 4.63 |
| (Ma) | 52 | - | - | - | - | 48.00 | 0.02 |

APPENDIX "B"

PLOT 48

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 1 | tL | 1.1 | 10.0 | D |
| 4 | bS | 2.9 | 17.0 | CD |
| 7 | bS | 3.2 | 18.0 | CD |
| 9 | bS | 3.0 | 18.0 | D |
| 11 | bS | 1.0 | 8.0 | S |
| 12 | bS | 1.1 | 10.0 | CD |
| 13 | bS | 3.7 | 20.0 | CD |
| 15 | bS | 2.7 | 17.0 | CD |
| 19 | bS | 3.1 | 20.0 | D |
| 20 | bS | 2.8 | 16.0 | CD |
| 21 | bS | 2.5 | 16.5 | D |
| 24 | bS | 3.4 | 18.0 | D |
| 26 | bS | 1.4 | 11.0 | CD |
| 27 | bS | 0.5 | 6.0 | I |
| 28 | bS | 1.0 | 10.0 | I |
| 29 | tL | 4.7 | 28.0 | D |
| 30 | bS | 3.1 | 24.5 | D |
| 33 | bS | 2.2 | 12.5 | CD |
| 36 | bS | 2.2 | 13.0 | CD |
| 41 | bS | 4.1 | 25.0 | D |
| 43 | bS | 2.2 | 15.0 | CD |
| 44 | bS | 1.4 | 10.0 | D |
| 45 | tL | 0.5 | 6.0 | D |
| 46 | bS | 3.7 | 21.0 | D |
| 47 | tL | 0.6 | 7.0 | CD |
| 50 | bS | 1.6 | 12.0 | S |
| 51 | bS | 2.5 | 15.0 | CD |
| 53 | bS | 1.7 | 11.0 | CD |
| 54 | bS | 0.5 | 7.0 | I |
| 56 | bS | 3.5 | 21.0 | CD |
| 57 | bS | 2.7 | 15.5 | CD |
| 58 | bS | 0.5 | 7.0 | I |
| 59 | bS | 2.1 | 15.0 | I |
| 60 | bS | 3.8 | 23.0 | D |
| 61 | bS | 1.7 | 12.0 | D |
| 62 | bS | 0.6 | 7.0 | D |
| 63 | tL | 2.8 | 17.0 | D |
| 64 | bS | 1.6 | 13.0 | CD |
| 67 | bS | 3.3 | 19.0 | D |
| 71 | bS | 0.5 | 6.0 | I |
| 72 | bS | 0.5 | 6.5 | S |
| 73 | bS | 2.7 | 15.0 | CD |

PLOT 48 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 78 | bS | 1.8 | 13.0 | CD |
| 83 | bS | 0.7 | 7.5 | CD |
| 84 | bS | 0.7 | 8.0 | CD |
| 85 | bS | 2.4 | 12.0 | CD |
| 90 | bS | 1.5 | 14.0 | I |
| 93 | bS | 3.2 | 18.0 | CD |
| 98 | bS | 1.3 | 8.0 | S |
| 100 | bS | 1.7 | 12.0 | I |
| 567 | bS | 0.5 | 6.0 | I |
| 568 | bS | 0.6 | 6.0 | I |
| 570 | bS | 1.5 | 11.0 | CD |
| 571 | bS | 0.7 | 7.5 | CD |
| 573 | bS | 0.6 | 7.0 | I |
| 574 | bS | 0.6 | 7.0 | I |
| 575 | bS | 1.7 | 11.0 | CD |
| 576 | bS | 1.0 | 9.5 | I |
| 579 | bS | 1.2 | 11.0 | CD |
| 583 | bS | 1.7 | 13.0 | CD |
| 589 | bS | 2.0 | 14.0 | I |
| 591 | bS | 3.3 | 18.0 | D |
| 594 | bS | 1.8 | 13.0 | CD |
| 599 | bS | 2.8 | 16.0 | CD |
| 600 | bS | 3.2 | 17.0 | CD |
| 598 | bS | 2.1 | 13.0 | CD |
| 686 | bS | 3.2 | 23.0 | D |
| 688 | bS | 2.1 | 13.0 | CD |
| 689 | bS | 1.0 | 7.5 | I |
| 690 | bS | 1.1 | 8.5 | I |
| 691 | bS | 0.6 | 6.5 | I |
| 692 | bS | 0.8 | 8.0 | I |
| 694 | bS | 0.5 | 6.0 | I |
| 695 | bS | 1.0 | 9.0 | I |
| 697 | bS | 1.5 | 11.5 | CD |
| 800 | bS | 1.5 | 11.0 | CD |
| 302 | bS | 1.7 | 12.0 | CD |
| 315 | bS | 4.2 | 24.0 | D |
| 329 | bS | 1.5 | 11.0 | CD |
| 335 | bS | 1.0 | 10.0 | I |
| 338 | bS | 1.7 | 10.5 | I |
| 340 | bS | 1.0 | 7.0 | S |
| 341 | bS | 1.5 | 10.0 | I |
| 344 | bS | 1.7 | 10.0 | I |
| 348 | bS | 2.0 | 12.0 | CD |

PLOT 48 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 350 | bS | 2.6 | 14.0 | CD |
| 352 | bS | 4.1 | 17.1 | D |
| 353 | bS | 1.6 | 10.8 | CD |
| 357 | bS | 2.4 | 14.6 | CD |
| 359 | bS | 1.3 | 9.3 | I |
| 362 | bS | 4.22 | 19.6 | D |
| 364 | bS | 3.3 | 16.5 | CD |
| 365 | bS | 3.1 | 16.8 | CD |
| 699 | bS | 1.0 | 8.0 | I |
| 745 | bS | 2.4 | 15.0 | CD |
| 748 | bS | 2.6 | 16.0 | CD |
| 751 | bS | 2.3 | 16.0 | CD |
| 752 | bS | 1.5 | 12.0 | S |
| 754 | wB | 0.5 | 6.0 | D |
| 755 | tL | 1.5 | 12.0 | D |
| 757 | bS | 0.5 | 7.0 | S |
| 759 | bS | 0.5 | 7.0 | S |
| 760 | bS | 1.5 | 11.0 | I |
| 762 | bS | 2.7 | 16.0 | CD |
| 764 | bS | 1.7 | 12.0 | I |
| 765 | bS | 1.0 | 7.5 | CD |
| 766 | bS | 1.4 | 11.0 | I |
| 768 | bS | 1.1 | 9.0 | CD |
| 773 | bS | 2.0 | 12.0 | I |
| 776 | bS | 2.4 | 15.0 | CD |
| 781 | bS | 1.7 | 14.0 | S |
| 785 | bS | 3.4 | 20.0 | CD |
| 786 | bS | 0.6 | 8.0 | I |
| 790 | bS | 2.4 | 15.5 | CD |
| 791 | bS | 1.8 | 11.0 | S |
| 794 | bS | 0.7 | 7.0 | S |
| 797 | bS | 2.2 | 14.5 | CD |
| 798 | bS | 1.2 | 11.0 | S |

PLOT 49

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 103 | bS | 1.1 | 10.0 | CD |
| 104 | bS | 0.5 | 7.0 | I |
| 105 | bS | 1.6 | 13.0 | D |
| 106 | tL | 0.4 | 7.5 | CD |
| 107 | bS | 1.2 | 10.0 | D |
| 108 | bS | 1.7 | 14.0 | CD |
| 110 | bS | 0.5 | 8.0 | CD |
| 111 | bS | 0.4 | 5.0 | D |
| 114 | bS | 2.7 | 22.0 | D |
| 119 | bS | 3.0 | 21.0 | D |
| 123 | bS | 0.6 | 7.0 | CD |
| 125 | bS | 0.4 | 6.0 | CD |
| 127 | bS | 2.7 | 17.0 | D |
| 128 | bS | 0.6 | 7.0 | I |
| 129 | bS | 0.5 | 7.0 | I |
| 130 | tL | 0.4 | 6.0 | D |
| 131 | tL | 0.4 | 7.0 | D |
| 133 | bS | 1.7 | 15.0 | CD |
| 135 | bS | 1.0 | 9.0 | CD |
| 136 | bS | 1.1 | 11.0 | CD |
| 140 | bS | 3.1 | 17.0 | D |
| 141 | bS | 1.0 | 10.0 | D |
| 145 | bS | 1.2 | 11.0 | S |
| 146 | tL | 0.6 | 8.0 | D |
| 148 | bS | 0.5 | 8.0 | CD |
| 150 | bS | 1.7 | 13.0 | CD |
| 151 | bS | 0.4 | 5.0 | CD |
| 153 | bS | 0.6 | 9.0 | I |
| 159 | bS | 1.2 | 12.0 | CD |
| 160 | bS | 1.3 | 12.0 | CD |
| 164 | bS | 1.4 | 13.0 | I |
| 166 | bS | 0.6 | 7.0 | I |
| 168 | bS | 0.5 | 6.0 | S |
| 169 | bS | 2.5 | 14.0 | CD |
| 170 | bS | 0.4 | 6.0 | S |
| 171 | bS | 0.8 | 7.0 | I |
| 172 | bS | 2.0 | 15.0 | CD |
| 173 | bS | 3.3 | 24.0 | D |
| 174 | tL | 0.4 | 6.0 | D |
| 176 | bS | 2.2 | 16.0 | CD |
| 178 | bS | 1.6 | 12.0 | CD |
| 181 | bS | 3.4 | 23.0 | D |
| 182 | bS | 0.5 | 6.0 | I |
| 183 | tL | 3.2 | 18.0 | D |

PLOT 49 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 184 | bS | 0.7 | 7.0 | CD |
| 186 | bS | 0.4 | 6.0 | CD |
| 187 | bS | 1.0 | 8.0 | I |
| 191 | bS | 1.8 | 12.0 | I |
| 193 | bS | 0.4 | 5.0 | S |
| 194 | bS | 0.5 | 7.0 | I |
| 196 | bS | 0.7 | 9.0 | S |
| 198 | bS | 0.6 | 7.0 | CD |
| 199 | bS | 2.7 | 17.0 | CD |
| 200 | tL | 3.3 | 20.0 | CD |
| 203 | bS | 1.8 | 10.0 | CD |
| 207 | bS | 1.4 | 10.0 | CD |
| 209 | bS | 1.6 | 11.0 | CD |
| 210 | bS | 0.4 | 6.0 | D |
| 211 | bS | 2.2 | 16.0 | D |
| 212 | bS | 0.4 | 5.0 | CD |
| 213 | bS | 0.4 | 5.0 | CD |
| 214 | bS | 3.4 | 21.0 | D |
| 216 | bS | 3.0 | 17.0 | CD |
| 217 | bS | 2.0 | 13.0 | CD |
| 219 | bS | 2.8 | 19.0 | D |
| 221 | bS | 1.0 | 8.0 | CD |
| 225 | bS | 2.0 | 12.0 | CD |
| 230 | bS | 2.9 | 17.0 | D |
| 233 | bS | 0.6 | 7.0 | S |
| 234 | bS | 0.6 | 7.0 | I |
| 238 | bS | 0.8 | 7.0 | S |
| 239 | bS | 0.8 | 7.0 | I |
| 241 | bS | 4.0 | 23.0 | D |
| 244 | bS | 0.5 | 6.0 | CD |
| 243 | tL | 0.6 | 6.0 | D |
| 245 | bS | 1.1 | 8.0 | I |
| 251 | bS | 1.85 | 16.0 | CD |
| 253 | bS | .90 | 8.0 | INT. |
| 255 | bS | 1.7 | 12.8 | CD |
| 259 | bS | .50 | 5.50 | INT. |
| 260 | bS | .45 | 5.60 | INT. |
| 262 | bS | 1.70 | 15.5 | CD |
| 267 | bS | 1.00 | 8.30 | INT. |
| 269 | bS | 1.90 | 13.0 | CD |
| 270 | bS | 1.48 | 10.0 | CD |
| 271 | bS | 3.25 | 19.7 | D |
| 273 | bS | .60 | 7.7 | INT. |
| 274 | bS | 2.95 | 17.5 | CD |

PLOT 49 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 275 | bS | 0.80 | 6.8 | INT. |
| 277 | bS | 1.7 | 12.8 | CD |
| 279 | bS | 3.05 | 21.0 | D |
| 280 | bS | 2.80 | 18.6 | CD |
| 285 | bS | 2.30 | 14.5 | CD |
| 287 | bS | .45 | 5.3 | INT. |
| 290 | bS | 2.0 | 12.4 | INT. |
| 292 | bS | 1.68 | 12.5 | CD |
| 294 | tL | 4.3 | 21.6 | D |
| 297 | bS | .70 | 7.10 | INT. |
| 300 | bS | 1.20 | 9.80 | INT. |
| 303 | bS | 1.25 | 11.0 | INT. |
| 307 | bS | 1.80 | 15.5 | CD |
| 309 | bS | 2.0 | 16.0 | CD |
| 312 | bS | 1.0 | 9.0 | INT. |
| 314 | bS | 1.05 | 9.0 | INT. |
| 315 | bS | .60 | 6.0 | INT. |
| 318 | bS | 1.28 | 10.4 | INT. |
| 321 | bS | .40 | 5.5 | INT. |
| 323 | bS | 1.10 | 9.4 | INT. |
| 324 | bS | 2.20 | 14.3 | CD |
| 325 | bS | 1.6 | 12.0 | CD |
| 327 | bS | 2.34 | 16.0 | CD |
| 331 | bS | 2.40 | 16.5 | CD |
| 333 | bS | .70 | 7.0 | INT. |
| 335 | bS | 3.10 | 18.6 | D |
| 340 | bS | 1.95 | 15.0 | CD |
| 342 | bS | 2.10 | 16.0 | CD |
| 343 | bS | 2.80 | 19.8 | CD |
| 345 | bS | 2.35 | 16.5 | CD |
| 349 | bS | 1.90 | 16.0 | CD |
| 352 | bS | 1.92 | 11.8 | CD |
| 357 | bS | 1.60 | 11.3 | CD |
| 359 | bS | .90 | 7.5 | INT. |

PLOT 50

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 1113 | tL | 0.5 | 6.0 | D |
| 1114 | tL | 0.5 | 8.0 | D |
| 1115 | bS | 0.5 | 7.0 | D |
| 1116 | bS | 2.2 | 14.0 | D |
| 1118 | tL | 2.2 | 14.5 | D |
| 1119 | bS | 0.5 | 7.0 | I |
| 1126 | bS | 2.1 | 15.0 | CD |
| 1132 | bS | 0.5 | 7.0 | I |
| 1137 | bS | 1.0 | 10.0 | I |
| 1138 | bS | 1.6 | 11.0 | CD |
| 1141 | bS | 0.6 | 7.5 | I |
| 1143 | bS | 2.2 | 14.5 | CD |
| 1147 | bS | 0.7 | 7.0 | I |
| 1149 | bS | 0.6 | 8.0 | I |
| 1156 | bS | 0.6 | 7.5 | I |
| 1157 | bS | 3.3 | 22.0 | D |
| 1160 | bS | 1.8 | 14.5 | CD |
| 1162 | bS | 0.6 | 6.0 | S |
| 1163 | bS | 1.5 | 11.0 | D |
| 1165 | bS | 2.9 | 15.0 | CD |
| 1166 | bS | 1.4 | 11.0 | CD |
| 1167 | bS | 0.6 | 8.0 | D |
| 1168 | bS | 0.6 | 8.0 | CD |
| 1170 | bS | 2.1 | 14.0 | D |
| 1171 | tL | 0.6 | 8.0 | CD |
| 1172 | bS | 0.7 | 8.0 | I |
| 1175 | bS | 1.6 | 10.5 | CD |
| 1177 | tL | 0.5 | 7.5 | CD |
| 1178 | bS | 1.1 | 10.0 | D |
| 1179 | bS | 0.6 | 7.0 | I |
| 1180 | tL | 0.6 | 9.0 | CD |
| 1181 | bS | 1.0 | 9.0 | I |
| 1183 | bS | 2.0 | 12.0 | CD |
| 1187 | bS | 1.8 | 12.0 | CD |
| 1188 | bS | 0.6 | 7.0 | S |
| 1191 | bS | 2.2 | 14.0 | CD |
| 1193 | bS | 1.6 | 12.0 | CD |
| 1195 | bS | 2.2 | 14.0 | CD |
| 1196 | tL | 1.0 | 9.0 | CD |
| 1198 | bS | 2.0 | 13.0 | CD |
| 841 | bS | 3.1 | 19.0 | D |
| 843 | bS | 1.7 | 14.0 | CD |
| 845 | bS | 1.0 | 10.0 | CD |
| 847 | tL | 0.6 | 8.0 | D |

PLOT 50 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 849 | bS | 1.3 | 10.0 | I |
| 857 | bS | 1.5 | 10.0 | CD |
| 859 | tL | 2.4 | 16.0 | D |
| 860 | bS | 1.6 | 12.5 | CD |
| 861 | bS | 1.2 | 11.0 | CD |
| 862 | tL | 1.8 | 13.0 | D |
| 866 | bS | 1.8 | 10.5 | CD |
| 1121A | bS | 2.7 | 17.0 | D |
| 871 | bS | 0.6 | 7.0 | CD |
| 874 | bS | 0.6 | 7.0 | I |
| 875 | bS | 0.5 | 6.0 | I |
| 876 | bS | 1.3 | 7.0 | CD |
| 877 | bS | 1.3 | 9.0 | I |
| 880 | bS | 2.5 | 14.0 | CD |
| 881 | bS | 2.9 | 17.0 | CD |
| 883 | bS | 2.8 | 15.5 | I |
| 884 | bS | 3.5 | 21.0 | CD |
| 885 | bS | 3.6 | 23.0 | CD |
| 886 | bS | 0.5 | 6.5 | I |
| 889 | bS | 0.5 | 6.0 | S |
| 896 | bS | 0.5 | 6.0 | S |
| 897 | bS | 1.2 | 12.0 | CD |
| 900 | bS | 2.9 | 18.0 | D |
| 691 | bS | 1.1 | 9.0 | CD |
| 693 | bS | 1.0 | 9.0 | D |
| 697 | bS | 2.6 | 17.0 | CD |
| 698 | bS | 1.3 | 11.0 | S |
| 20 | bS | 1.2 | 11.0 | I |
| 21 | bS | 2.1 | 15.0 | CD |
| 24 | bS | 0.4 | 5.0 | S |
| 26 | bS | 1.0 | 11.0 | S |
| 27 | bS | 0.5 | 7.0 | S |
| 51 | bS | 3.4 | 21.0 | CD |
| 67 | bS | 2.0 | 13.0 | I |
| 561 | bS | 3.8 | 22.0 | D |
| 564 | bS | 0.8 | 8.0 | CD |
| 566 | wB | 2.1 | 10.0 | CD |
| 98 | bS | 1.1 | | S |

PLOT 51

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 701 | bF | 3.8 | 20.0 | CD |
| 708 | tL | 2.3 | 22.0 | CD |
| 712 | bF | 0.9 | 7.5 | CD |
| 713 | bS | 3.1 | 20.0 | D |
| 715 | bS | 2.8 | 14.0 | I |
| 716 | bS | 2.3 | 14.5 | CD |
| 717 | tL | 0.6 | 10.0 | CD |
| 718 | bS | 2.6 | 14.0 | D |
| 720 | bS | 1.0 | 8.5 | CD |
| 721 | bS | 2.8 | 11.0 | D |
| 722 | bS | 1.0 | 9.0 | D |
| 723 | bS | 3.5 | 17.0 | D |
| 724 | bS | 0.8 | 7.5 | D |
| 726 | bS | 2.9 | 17.0 | CD |
| 727 | bS | 2.4 | 14.0 | D |
| 728 | bS | 2.2 | 15.0 | CD |
| 729 | bS | 1.4 | 12.0 | S |
| 730 | bS | 6.5 | 29.0 | D |
| 731 | bS | 4.8 | 27.5 | D |
| 732 | tL | 2.1 | 20.0 | CD |
| 735 | bS | 2.8 | 16.0 | D |
| 744 | bS | 2.8 | 19.0 | CD |
| 745 | bS | 1.4 | 10.0 | I |
| 746 | bS | 1.4 | 11.0 | S |
| 754 | bS | 4.2 | 25.0 | D |
| 756 | bS | 2.1 | 22.0 | CD |
| 759 | bS | 1.0 | 8.0 | I |
| 760 | bS | 1.0 | 7.5 | S |
| 762 | bS | 2.0 | 14.0 | CD |
| 764 | bS | 2.5 | 17.0 | I |
| 767 | bS | 2.1 | 17.0 | S |
| 771 | bS | 3.7 | 24.0 | D |
| 772 | bS | 1.4 | 9.5 | CD |
| 773 | tL | 0.8 | 8.0 | CD |
| 774 | tL | 0.5 | 7.0 | D |
| 775 | bS | 1.1 | 8.0 | D |
| 776 | bS | 0.8 | 7.0 | D |
| 778 | bS | 2.6 | 18.0 | D |
| 779 | bS | 1.3 | 9.5 | CD |
| 780 | bS | 1.7 | 11.0 | D |
| 781 | tL | 0.6 | 8.0 | D |
| 782 | tL | 1.0 | 10.0 | D |
| 784 | bS | 1.5 | 11.0 | I |
| 785 | bS | 2.5 | 21.0 | CD |

PLOT 51 (Continued

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 787 | bS | 2.6 | 22.0 | CD |
| 791 | bS | 1.2 | 9.0 | I |
| 794 | bS | 2.0 | 18.0 | I |
| 800 | bS | 1.7 | 15.0 | S |

PLOT 52

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 1 | sB | 2.60 | 18.9 | CD |
| 2 | sB | 1.90 | 11.2 | CD |
| 3 | sB | 1.55 | 9.5 | I |
| 5 | sB | 1.80 | 10.7 | CD |
| 7 | sB | 1.7 | 8.5 | I |
| 8 | sB | 1.06 | 9.0 | I |
| 9 | tL | 0.9 | 10.5 | CD |
| 10 | sB | 3.08 | 20.0 | CD |
| 11 | sB | 0.60 | 7.6 | I |
| 12 | sB | 0.35 | 6.7 | I |
| 13 | sB | 2.65 | 16.2 | CD |
| 14 | tL | 2.30 | 15.2 | CD |
| 15 | sB | 0.50 | 7.3 | I |
| 16 | sB | 0.42 | 6.6 | CD |
| 17 | sB | 0.81 | 7.2 | I |
| 18 | sB | 0.55 | 6.7 | I |
| 19 | sB | 0.65 | 6.9 | I |
| 20 | sB | 1.59 | 10.5 | CD |
| 21 | sB | 2.80 | 19.5 | CD |
| 22 | tL | 2.50 | 16.1 | CD |
| 23 | sB | 1.38 | 10.8 | CD |
| 24 | sB | 0.90 | 7.8 | CD |
| 25 | sB | 1.20 | 10.2 | CD |
| 26 | sB | 1.50 | 13.8 | CD |
| 27 | sB | 0.60 | 6.2 | I |
| 28 | sB | 0.80 | 8.1 | CD |
| 29 | sB | 1.30 | 11.1 | CD |
| 30 | sB | 1.42 | 10.9 | CD |
| 31 | sB | 0.50 | 6.4 | I |
| 32 | sB | 5.80 | 36.4 | CD |
| 33 | sB | 1.52 | 12.0 | CD |
| 34 | sB | 1.35 | 10.7 | CD |
| 35 | sB | 0.66 | 7.7 | I |
| 36 | sB | 1.35 | 8.8 | CD |
| 37 | sB | 2.70 | 17.9 | CD |
| 38 | sB | 0.60 | 6.1 | I |
| 39 | sB | 2.28 | 13.6 | CD |
| 40 | sB | 1.7 | 12.8 | CD |
| 41 | sB | 0.8 | 8.0 | CD |
| 42 | sB | 0.45 | 6.2 | CD |
| 43 | tL | 0.45 | 6.8 | CD |
| 44 | sB | 3.80 | 30.5 | CD |
| 45 | sB | 4.75 | 22.1 | CD |
| 46 | sB | 2.81 | 19.2 | CD |

PLOT 52 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 47 | sB | 3.35 | 4.8 | I |
| 48 | sB | 3.82 | 21.5 | CD |
| 49 | sB | 9.95 | 38.4 | D |
| 50 | sB | 1.45 | 10.0 | I |
| 51 | sB | 2.32 | 16.9 | CD |
| 52 | sB | 7.5 | 35.1 | CD |
| 53 | sB | 3.0 | 19.85 | CD |
| 54 | sB | 2.1 | 13.6 | I |
| 55 | sB | 2.44 | 15.7 | CD |
| 56 | sB | 1.80 | 11.2 | I |
| 57 | sB | 2.72 | 17.2 | CD |
| 58 | sB | 2.35 | 16.1 | CD |
| 59 | sB | 1.14 | 8.4 | I |
| 60 | sB | 2.5 | 14.2 | CD |
| 61 | sB | 2.8 | 18.0 | CD |
| 62 | sB | .82 | 8.0 | I |
| 63 | sB | 1.18 | 10.0 | I |
| 64 | sB | 1.1 | 8.6 | I |
| 65 | sB | .49 | 5.2 | I |
| 66 | sB | 1.83 | 12.1 | CD |
| 67 | sB | .40 | 5.4 | I |
| 68 | sB | 1.3 | 10.6 | I |
| 69 | sB | 2.92 | 19.0 | CD |
| 70 | sB | .65 | 5.9 | I |
| 71 | sB | .40 | 5.2 | I |
| 72 | Larix | .40 | 5.8 | I |
| 73 | sB | .75 | 7.5 | I |
| 74 | sB | 2.31 | 13.5 | CD |
| 75 | sB | 1.40 | 8.5 | I |
| 76 | sB | .50 | 5.0 | I |
| 77 | sB | .84 | 7.8 | I |
| 78 | sB | 1.7 | 12.7 | CD |
| 79 | sB | .85 | 7.9 | I |
| 80 | sB | 2.0 | 13.25 | CD |
| 81 | sB | .50 | 4.6 | I |
| 82 | sB | .63 | 5.9 | I |
| 83 | sB | 2.55 | 16.7 | CD |
| 84 | sB | 1.68 | 13.4 | CD |
| 85 | sB | 2.14 | 15.8 | CD |
| 86 | Larix | .50 | 6.9 | I |
| 87 | sB | 1.35 | 10.9 | CD |
| 88 | sB | 6.70 | 27.5 | D |
| 89 | sB | 2.1 | 12.9 | CD |
| 90 | sB | .70 | 6.0 | I |

PLOT 52 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 91 | sB | .45 | 5.0 | I |
| 92 | sB | .96 | 8.5 | I |
| 93 | sB | .67 | 6.6 | I |
| 94 | sB | .55 | 6.3 | I |
| 95 | sB | 3.1 | 17.5 | CD |
| 96 | sB | 3.13 | 20.2 | CD |
| 97 | Larix | 3.6 | 22.4 | CD |
| 99 | sB | .40 | 6.3 | I |
| 100 | sB | 2.3 | 21.2 | CD |
| 101 | sB | .70 | 6.5 | I |
| 102 | sB | 3.38 | 21.5 | CD |
| 103 | sB | .40 | 4.6 | I |
| 104 | sB | 1.3 | 9.2 | I |
| 105 | sB | .50 | 6.0 | I |
| 106 | sB | .70 | 7.0 | I |
| 107 | sB | .60 | 5.0 | I |
| 108 | sB | .87 | 7.5 | I |
| 109 | sB | 2.04 | 13.3 | CD |
| 110 | sB | 2.18 | 14.0 | CD |
| 111 | sB | 1.1 | 9.0 | I |
| 112 | sB | 2.28 | 13.6 | CD |
| 113 | sB | 2.19 | 16.1 | CD |
| 114 | sB | .40 | 5.6 | I |
| 115 | Larix | .30 | 5.5 | I |
| 116 | sB | 1.09 | 8.2 | I |
| 117 | sB | 2.62 | 16.8 | CD |
| 118 | sB | 1.90 | 13.3 | CD |
| 119 | sB | 1.64 | 12.8 | CD |
| 120 | sB | 2.35 | 20.0 | CD |
| 121 | sB | .30 | 5.2 | I |
| 122 | sB | .86 | 7.8 | I |
| 123 | sB | .35 | 4.5 | I |
| 124 | sB | 3.13 | 22.8 | CD |
| 125 | sB | .30 | 5.6 | I |
| 126 | sB | .40 | 5.0 | I |
| 127 | sB | 4.8 | 32.3 | D |
| 128 | sB | .20 | 5.0 | I |
| 129 | sB | .45 | 5.7 | I |
| 130 | Larix | .10 | 4.5 | I |
| 131 | Larix | .15 | 5.5 | I |
| 132 | sB | .15 | 4.6 | I |
| 133 | Abies | 1.1 | 7.3 | I |
| 134 | sB | .83 | 8.3 | I |
| 135 | sB | .50 | 5.4 | I |

PLOT 52 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 136 | sB | .40 | 5.3 | I |
| 137 | sB | .52 | 6.7 | I |
| 138 | sB | .40 | 5.3 | I |
| 139 | sB | 2.80 | 10.8 | CD |
| 140 | sB | 6.7 | 31.1 | D |
| 141 | sB | .40 | 5.7 | I |
| 142 | sB | .30 | 5.0 | I |
| 143 | sB | 2.44 | 14.6 | CD |
| 144 | sB | 1.78 | 11.6 | CD |
| 145 | sB | 1.75 | 11.6 | CD |
| 146 | Larix | 2.76 | 18.2 | CD |
| 147 | sB | .20 | 4.5 | I |
| 148 | sB | 1.25 | 8.6 | I |
| 149 | sB | .60 | 7.0 | I |
| 150 | sB | .40 | 5.4 | I |
| 151 | sB | .60 | 6.7 | I |
| 152 | sB | .30 | 4.3 | I |
| 153 | Larix | .10 | 5.6 | I |
| 154 | sB | .10 | 4.7 | I |
| 451 | bS | 1.2 | 9.0 | I |
| 455 | bS | 1.7 | 16.0 | I |
| 456 | bS | 1.0 | 9.0 | CD |
| 457 | bS | 5.5 | 31.0 | D |
| 458 | bS | 2.0 | 14.0 | I |
| 461 | bS | 1.1 | 9.0 | I |
| 467 | bS | 1.0 | 10.0 | CD |
| 469 | bS | 1.3 | 9.5 | CD |
| 472 | bS | 1.3 | 11.0 | CD |
| 476 | bS | 1.8 | 12.0 | CD |
| 477 | bS | 5.2 | 32.0 | D |
| 483 | bS | 1.3 | 10.0 | CD |
| 486 | bS | 0.5 | 6.0 | CD |
| 487 | tL | 4.0 | 22.0 | D |
| 490 | bS | 1.0 | 8.0 | I |
| 491 | bS | 0.5 | 6.0 | CD |
| 492 | bS | 1.2 | 9.0 | CD |
| 493 | tL | 1.2 | 10.5 | CD |
| 496 | bS | 2.1 | 14.0 | I |
| 497 | bS | 1.6 | 13.0 | CD |
| 500 | bS | 0.5 | 6.0 | I |
| 866 | tL | 0.7 | 10.5 | D |
| 867 | bS | 0.5 | 7.5 | CD |
| 868 | bS | 0.6 | 7.0 | CD |
| 869 | bS | 0.7 | 7.0 | CD |

PLOT 52 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 871A | bS | 4.7 | 30.0 | D |
| 872 | bS | 0.5 | 7.0 | CD |
| 876 | bS | 3.1 | 20.0 | CD |
| 877 | bS | 2.8 | 17.0 | CD |
| 883 | bS | 0.5 | 8.0 | I |
| 885 | bS | 1.4 | 11.0 | I |
| 889 | bS | 3.2 | 23.0 | CD |
| 893 | bS | 1.2 | 11.0 | S |
| 895 | bS | 2.0 | 17.0 | I |
| 898 | bS | 0.6 | 7.0 | CD |
| 899 | bS | 0.5 | 6.0 | CD |
| 900 | bS | 1.5 | 11.0 | CD |
| 186 | bS | 1.8 | 13.0 | CD |
| 187 | bS | 1.4 | 12.0 | CD |
| 188 | bS | 2.8 | 19.0 | D |
| 189 | bS | 0.7 | 8.0 | S |
| 191 | bS | 2.3 | 20.0 | CD |
| 196 | bS | 3.0 | 21.1 | CD |

PLOT 69

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 1 | bS | 2.2 | 14.1 | CD |
| 2 | bS | 2.24 | 15.3 | CD |
| 3 | bS | 1.05 | 7.5 | I |
| 4 | tL | 2.1 | 15.0 | CD |
| 5 | bS | 0.85 | 7.4 | CD |
| 6 | bS | 0.8 | 7.4 | CD |
| 7 | tL | 0.4 | 5.0 | CD |
| 8 | bS | 0.6 | 5.1 | I |
| 9 | bS | 1.2 | 8.6 | CD |
| 10 | bS | 0.5 | 5.0 | I |
| 11 | bS | 0.86 | 6.8 | CD |
| 12 | bS | 0.54 | 5.4 | I |
| 13 | bS | 0.8 | 6.6 | CD |
| 14 | bS | 0.75 | 6.4 | CD |
| 15 | bS | 0.2 | 4.8 | I |
| 16 | bS | 4.9 | 24.6 | D |
| 17 | bS | 2.65 | 15.3 | CD |
| 18 | bS | 0.97 | 8.0 | CD |
| 19 | bS | 1.15 | 8.7 | CD |
| 20 | bS | 0.55 | 5.8 | I |
| 21 | bS | 1.93 | 13.4 | CD |
| 22 | bS | 1.1 | 8.8 | CD |
| 23 | bS | 1.54 | 9.7 | CD |
| 24 | bS | 1.65 | 10.6 | CD |
| 25 | bS | 0.64 | 6.0 | CD |
| 26 | bS | 1.67 | 10.8 | CD |
| 27 | bS | 0.6 | 5.3 | CD |
| 28 | bS | 0.52 | 5.3 | I |
| 29 | tL | 0.62 | 7.8 | CD |
| 30 | bS | 4.0 | 23.4 | D |
| 31 | bS | 0.82 | 7.9 | CD |
| 32 | bS | 0.56 | 5.1 | I |
| 33 | bS | 1.0 | 8.4 | CD |
| 34 | bS | 1.3 | 9.3 | CD |
| 35 | bS | 1.85 | 11.3 | CD |
| 36 | bS | 1.65 | 11.1 | CD |
| 37 | bS | 4.56 | 26.8 | D |
| 38 | bS | 2.15 | 12.4 | CD |
| 39 | bS | 1.90 | 13.0 | CD |
| 40 | bS | 1.25 | 8.6 | CD |
| 41 | bS | 1.30 | 9.4 | CD |
| 42 | bS | 0.95 | 7.8 | CD |
| 43 | tL | 0.40 | 5.3 | CD |
| 44 | bS | 0.84 | 8.0 | CD |

PLOT 69 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 45 | tL | 0.40 | 6.1 | CD |
| 46 | tL | 0.45 | 4.6 | CD |
| 47 | tL | 0.54 | 7.7 | CD |
| 48 | bS | 1.20 | 9.0 | CD |
| 49 | bS | 0.58 | 5.7 | CD |
| 50 | tL | 2.30 | 14.8 | CD |
| 51 | bS | 0.55 | 6.0 | CD |
| 52 | bS | 0.70 | 7.2 | CD |
| 53 | bS | 1.90 | 12.8 | CD |
| 54 | tL | 0.45 | 5.9 | I |
| 55 | bS | 1.34 | 9.2 | CD |
| 56 | bS | 1.00 | 8.6 | CD |
| 57 | tL | 0.30 | 5.4 | I |
| 58 | bS | 0.85 | 8.4 | CD |
| 59 | tL | 1.05 | 9.8 | CD |
| 60 | bS | 0.60 | 6.6 | CD |
| 61 | bS | 1.35 | 9.0 | CD |
| 62 | bS | 2.04 | 12.8 | CD |
| 63 | bS | 1.04 | 9.2 | I |
| 64 | bS | 1.18 | 9.7 | CD |
| 65 | bS | 1.48 | 10.1 | CD |
| 66 | bS | 1.24 | 9.8 | CD |
| 67 | bS | 4.00 | 22.0 | D |
| 68 | bS | 1.40 | 8.6 | CD |
| 69 | bS | 0.96 | 7.1 | CD |
| 70 | bS | 4.08 | 20.0 | CD |
| 71 | bS | 1.50 | 9.1 | CD |
| 72 | bS | 0.45 | 5.2 | I |
| 73 | bS | 1.50 | 9.7 | CD |
| 74 | bS | 0.75 | 7.4 | CD |
| 75 | bS | 1.20 | 8.7 | CD |
| 76 | bS | 0.80 | 6.4 | I |
| 77 | bS | 0.50 | 4.6 | I |
| 78 | bS | 1.38 | 9.8 | CD |
| 79 | bS | 1.60 | 11.8 | CD |
| 80 | bS | 1.80 | 12.3 | CD |
| 81 | bS | 1.65 | 11.9 | CD |
| 82 | bS | 2.00 | 12.9 | CD |
| 83 | bS | 1.90 | 11.8 | CD |
| 84 | bS | 1.55 | 9.1 | CD |
| 85 | bS | 2.30 | 13.7 | CD |
| 86 | bS | 1.80 | 12.5 | CD |
| 87 | bS | 3.45 | 19.7 | CD |
| 88 | bS | 0.70 | 6.8 | I |

PLOT 69 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 89 | bS | 1.05 | 8.9 | I |
| 90 | bS | 5.45 | 29.7 | CD |
| 91 | bS | 0.92 | 8.75 | I |
| 92 | tL | 0.75 | 7.1 | I |
| 93 | tL | 0.65 | 7.4 | I |
| 94 | bS | 0.30 | 5.1 | I |
| 95 | tL | 0.45 | 7.8 | CD |
| 96 | tL | 0.30 | 5.5 | CD |
| 97 | tL | 0.60 | 7.6 | CD |
| 98 | tL | 0.30 | 5.0 | CD |
| 99 | tL | 0.75 | 8.1 | CD |
| 100 | bS | 0.98 | 8.5 | CD |
| 101 | bS | 0.43 | 5.7 | CD |
| 102 | bS | 4.90 | 25.7 | CD |
| 103 | bS | 0.80 | 8.3 | CD |
| 104 | bS | 0.54 | 6.2 | CD |
| 105 | tL | 0.70 | 7.6 | CD |
| 106 | tL | 0.34 | 5.5 | I |
| 107 | tL | 0.4 | 7.4 | CD |
| 108 | tL | 0.55 | 8.0 | CD |
| 109 | tL | 0.40 | 6.0 | CD |
| 110 | tL | 1.85 | 15.2 | CD |
| 111 | tL | 0.55 | 6.7 | CD |
| 112 | tL | 1.30 | 10.5 | CD |
| 113 | bS | 1.65 | 11.8 | CD |
| 114 | bS | 0.31 | 5.1 | CD |
| 115 | bS | 1.5 | 11.2 | CD |
| 116 | bS | 0.94 | 8.9 | CD |
| 117 | tL | 0.40 | 6.5 | CD |
| 118 | bS | 1.30 | 11.2 | CD |

TREES MEASURED FOR AGES

| Species | Height | Diameter | Ages |
|---|---|---|---|
| bS | 22. | 3.4 | 58 |
| bS | 5.9 | 0.6 | 27 |
| bS | 11.0 | 1.4 | 43 |
| bS | 10.0 | 1.4 | 45 |
| bS | 10.5 | 1.2 | 47 |
| bS | 18.0 | 3.0 | 60 |
| bS | 22.0 | 3.3 | 58 |
| bS | 32. | 5.0 | 66 |
| bS | 9.0 | 1.1 | 44 |
| bS | 9.5 | 1.2 | 47 |
| bS | 11.0 | 1.9 | 51 |
| bS | 23.2 | 3.5 | 51 |
| bS | 12.4 | 1.8 | 60 |
| bS | 12.5 | 1.7 | 38 |
| bS | 7.0 | 0.7 | 28 |
| bS | 11.3 | 1.6 | 35 |
| bS | 19.0 | 2.8 | 62 |

PLOT 70

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 1 | bS | 0.7 | 6.6 | I |
| 2 | bS | 3.36 | 22.0 | CD |
| 3 | bS | 0.6 | 5.9 | I |
| 4 | bS | 1.48 | 11.2 | CD |
| 5 | bS | 0.82 | 7.3 | CD |
| 6 | bS | 0.68 | 7.0 | I |
| 7 | bS | 1.40 | 9.8 | CD |
| 8 | bS | 3.10 | 19.1 | CD |
| 9 | bS | 0.90 | 9.2 | I |
| 10 | bS | 0.72 | 8.2 | I |
| 11 | tL | 0.95 | 10.2 | CD |
| 12 | bS | 1.19 | 10.3 | CD |
| 13 | bS | 3.00 | 18.4 | CD |
| 14 | bS | 3.32 | 21.2 | CD |
| 15 | bS | 1.75 | 12.6 | CD |
| 16 | bS | 1.90 | 14.3 | CD |
| 17 | bS | 4.98 | 31.0 | D |
| 18 | bS | 1.65 | 11.9 | CD |
| 19 | bS | 0.90 | 8.8 | I |
| 20 | bS | 0.89 | 7.8 | I |
| 21 | bS | 1.32 | 10.1 | CD |
| 22 | bS | 1.23 | 11.0 | CD |
| 23 | bS | 1.38 | 10.8 | CD |
| 24 | bS | 0.66 | 6.9 | I |
| 25 | bS | 2.20 | 18.2 | CD |
| 26 | bS | 4.58 | 22.3 | D |
| 27 | bS | 1.00 | 7.5 | I |
| 28 | bS | 0.95 | 8.2 | I |
| 29 | bS | 1.55 | 12.2 | CD |
| 30 | bS | 1.01 | 8.8 | I |
| 31 | bS | 4.30 | 26.3 | D |
| 32 | bS | 1.36 | 9.9 | I |
| 33 | bS | 4.47 | 23.3 | CD |
| 34 | bS | 2.65 | 16.5 | CD |
| 35 | bS | 1.24 | 9.5 | I |
| 36 | bS | 0.35 | 5.0 | I |
| 37 | tL | 0.70 | 8.7 | CD |
| 38 | bS | 0.25 | 4.5 | I |
| 39 | bS | 0.26 | 5.0 | I |
| 40 | bS | 1.81 | 15.3 | CD |
| 41 | bS | 1.22 | 9.6 | CD |
| 42 | bS | 2.15 | 17.6 | CD |
| 43 | bS | 0.37 | 5.1 | I |
| 44 | bS | 1.00 | 8.8 | CD |

PLOT 70 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 45 | bS | 3.25 | 19.4 | CD |
| 46 | tL | 0.38 | 5.7 | CD |
| 47 | bS | 0.80 | 7.1 | CD |
| 48 | bS | 0.69 | 7.1 | CD |
| 49 | bS | 0.75 | 7.4 | CD |
| 50 | bS | 1.60 | 11.3 | CD |
| 51 | bS | 1.70 | 12.5 | CD |
| 52 | bS | 0.70 | 6.6 | I |
| 53 | bS | 0.98 | 8.3 | I |
| 54 | tL | 0.30 | 5.0 | CD |
| 55 | bS | 0.75 | 8.0 | CD |
| 56 | tL | 0.39 | 5.2 | CD |
| 57 | bS | 0.38 | 5.5 | I |
| 58 | bS | 5.25 | 29.6 | D |
| 59 | bS | 0.26 | 5.4 | I |
| 60 | bS | 1.90 | 10.9 | CD |
| 61 | bS | 0.28 | 5.0 | I |
| 62 | bF | 1.45 | 9.0 | CD |
| 63 | bS | 1.68 | 12.5 | I |
| 64 | bS | 1.80 | 12.4 | CD |
| 65 | tL | 0.10 | 4.4 | I |
| 66 | bS | 1.34 | 9.5 | I |
| 67 | bS | 1.30 | 12.1 | CD |
| 68 | bS | 0.35 | 4.5 | I |
| 69 | bS | 2.1 | 15.6 | CD |
| 70 | bS | 2.28 | 15.3 | CD |
| 71 | bS | 1.40 | 12.2 | CD |
| 72 | bS | 0.70 | 7.2 | CD |
| 73 | bS | 0.28 | 5.4 | I |
| 74 | bS | 0.79 | 8.0 | I |
| 75 | bS | 3.50 | 23.2 | CD |
| 76 | tL | 1.41 | 12.0 | CD |
| 77 | bS | 2.70 | 17.0 | CD |
| 78 | bS | 2.68 | 16.0 | CD |
| 79 | bS | 2.96 | 18.4 | CD |
| 80 | - | | | |
| 81 | bS | 3.90 | 23.0 | CD |
| 82 | bS | 0.93 | 8.8 | CD |
| 83 | bS | 3.90 | 23.0 | D |
| 84 | bS | 2.76 | 17.6 | CD |
| 85 | bS | 0.58 | 6.2 | I |
| 86 | bS | 2.03 | 13.3 | CD |
| 87 | bS | 1.50 | 9.8 | CD |
| 88 | bS | 1.69 | 11.1 | CD |

PLOT 70 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 89 | bS | 3.47 | 21.8 | CD |
| 90 | bS | 2.60 | 15.9 | CD |
| 91 | bS | 3.89 | 22.9 | D |
| 92 | bS | 2.59 | 14.9 | CD |
| 93 | bS | 2.29 | 13.2 | CD |
| 94 | bS | 1.60 | 11.3 | CD |
| 95 | bS | 0.55 | 7.5 | I |
| 96 | bS | 0.80 | 7.5 | I |
| 97 | bS | 0.50 | 6.4 | I |
| 98 | bS | 2.57 | 15.6 | CD |
| 99 | bS | 2.87 | 19.1 | CD |
| 100 | bF | 0.40 | 4.9 | CD |
| 101 | tL | 0.35 | 6.6 | CD |
| 102 | tL | 0.50 | 6.7 | CD |
| 103 | bS | 4.39 | 25.0 | D |
| 104 | bS | 0.30 | 5.4 | I |
| 105 | bS | 0.75 | 6.8 | CD |
| 106 | bS | 3.36 | 20.9 | CD |
| 107 | tL | 0.25 | 5.0 | I |
| 108 | bS | 1.80 | 10.2 | CD |
| 109 | bS | 2.50 | 14.3 | CD |
| 110 | bS | 1.80 | 13.5 | CD |
| 111 | bS | 1.69 | 12.1 | CD |
| 112 | bS | 1.20 | 8.4 | CD |
| 113 | bS | 3.41 | 20.0 | CD |
| 114 | bS | 1.90 | 12.9 | CD |
| 115 | bS | 0.50 | 5.9 | I |
| 116 | - | | | |
| 117 | bS | 5.0 | 24.0 | D |
| 118 | bS | 2.27 | 15.3 | CD |
| 119 | bS | 2.76 | 17.0 | CD |
| 120 | bS | 3.56 | 18.5 | CD |
| 121 | bS | 0.62 | 7.2 | I |
| 122 | bF | 0.40 | 5.2 | I |
| 123 | bS | 1.10 | 8.6 | CD |
| 124 | bS | 0.40 | 6.7 | I |
| 125 | bS | 3.40 | 22.1 | CD |
| 126 | bS | 2.34 | 14.8 | CD |
| 127 | bS | 5.08 | 23.9 | D |
| 128 | bS | 2.10 | 15.5 | CD |
| 129 | bS | 0.70 | 7.0 | CD |

PLOT 70 (Continued)

| Tree no. | Species | d.b.h. in | Height ft | Crown class |
|---|---|---|---|---|
| 130 | bS | 0.35 | 5.1 | I |
| 131 | tL | 0.40 | 5.0 | I |
| 132 | bS | 2.14 | 12.7 | CD |
| 133 | bS | 2.90 | 15.8 | CD |
| 134 | bS | 2.95 | 20.0 | CD |
| 135 | bS | 1.50 | 12.0 | CD |
| 136 | bS | 2.00 | 15.1 | CD |
| 137 | bS | 1.55 | 12.2 | CD |
| 138 | bS | 0.45 | 7.0 | I |

APPENDIX "C"

Figure 1. Location of the fertilization experiments.

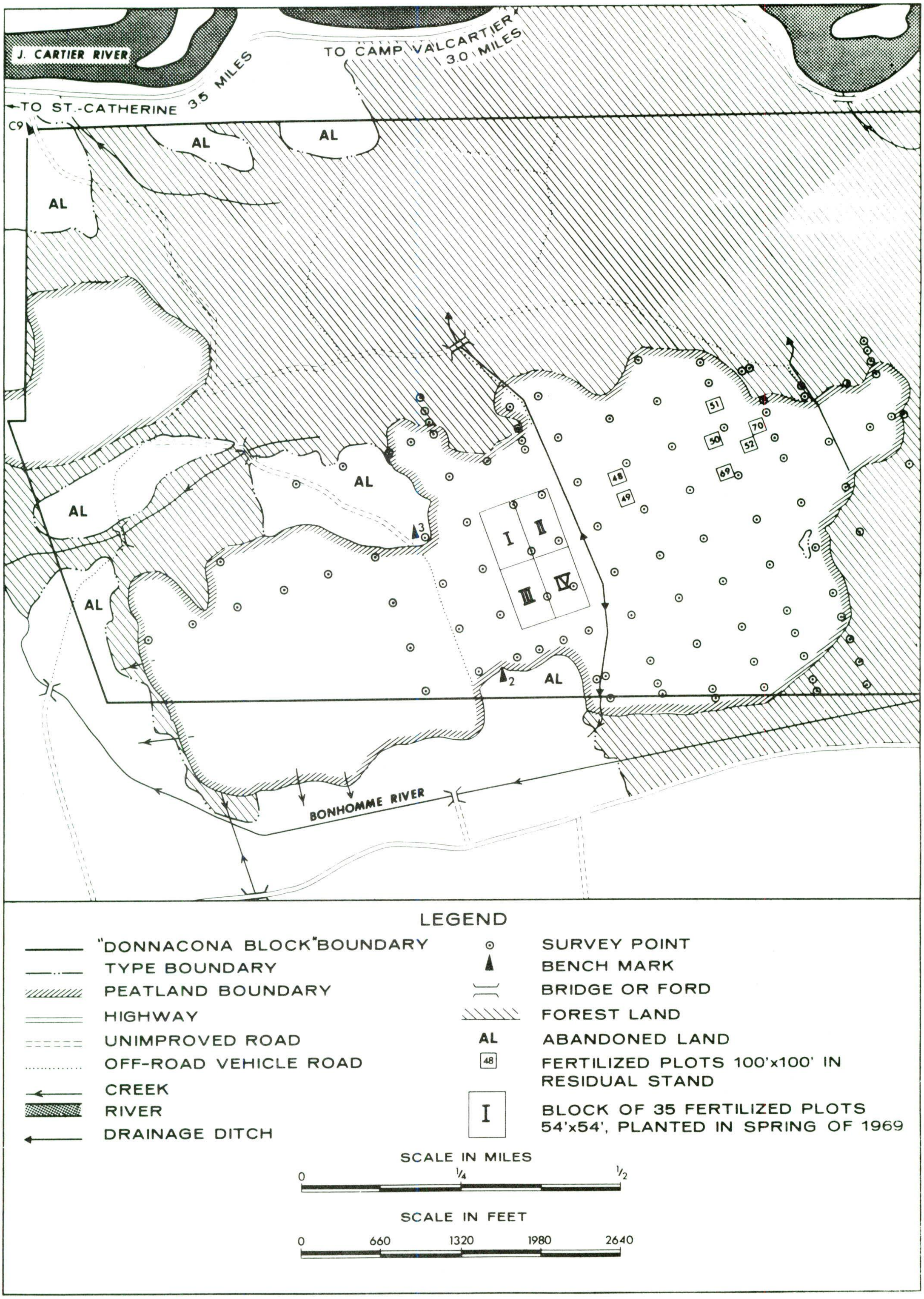
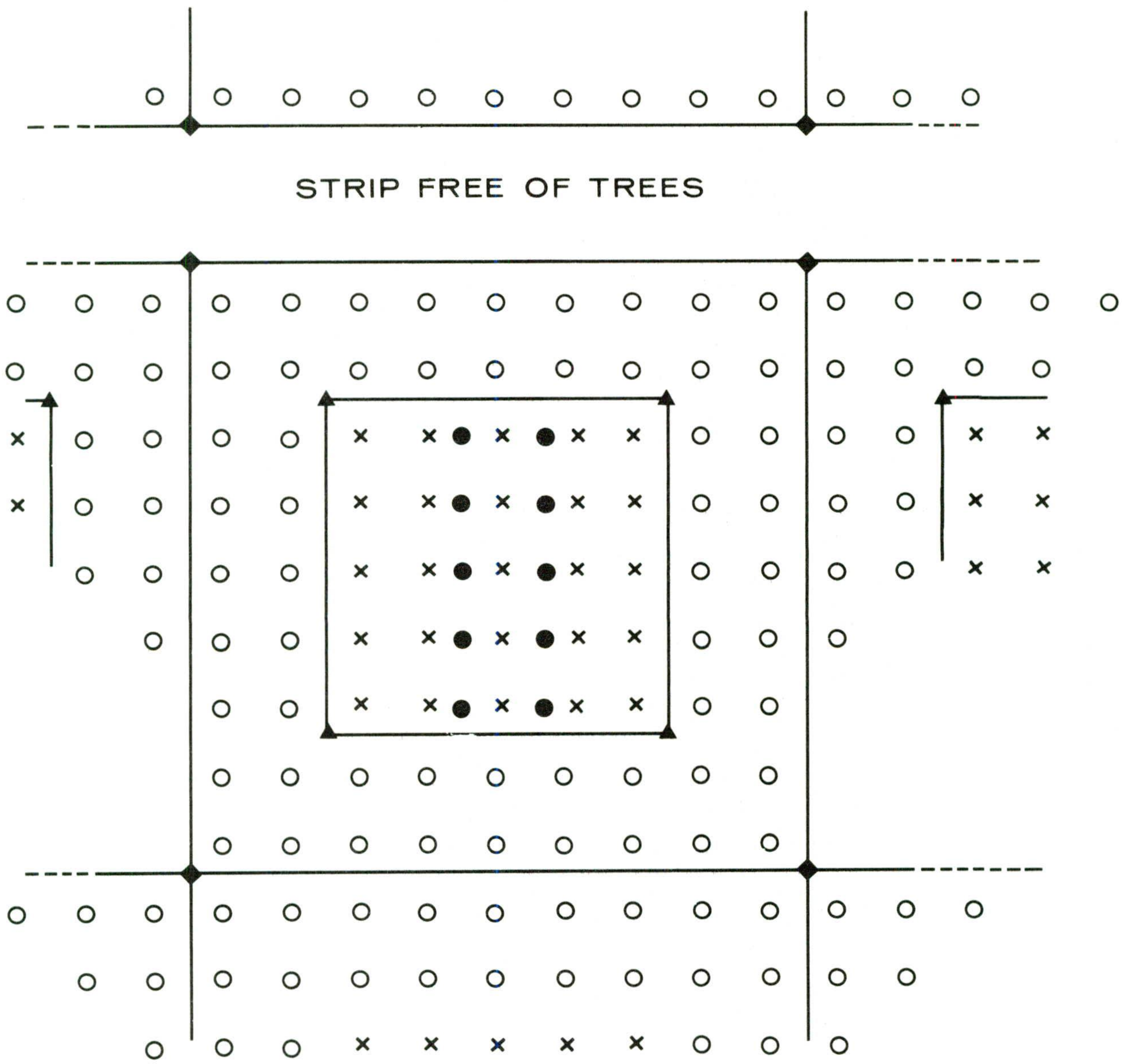

J. CARTIER RIVER
TO CAMP VALCARTIER 3.0 MILES
TO ST.-CATHERINE 3.5 MILES
C9
AL
BONHOMME RIVER
51
50
70
52
69
48
49
I
II
III
IV
3
2
LEGEND
"DONNACONA BLOCK" BOUNDARY
TYPE BOUNDARY
PEATLAND BOUNDARY
HIGHWAY
UNIMPROVED ROAD
OFF-ROAD VEHICLE ROAD
CREEK
RIVER
DRAINAGE DITCH
SURVEY POINT
BENCH MARK
BRIDGE OR FORD
FOREST LAND
AL ABANDONED LAND
48 FERTILIZED PLOTS 100'x100' IN RESIDUAL STAND
I BLOCK OF 35 FERTILIZED PLOTS 54'x54', PLANTED IN SPRING OF 1969
SCALE IN MILES
0
1/4
1/2
SCALE IN FEET
0
660
1320
1980
2640

Figure 2. Experimental unit of Study A and Study B.




SCALE 1 CM. = 6 FT.

× = OBSERVATIONAL UNIT (SEEDLINGS)

● = SEEDLINGS TO BE REMOVED FOR CHEMICAL ANALYSES

○ = BUFFER ZONE OF 2-2 JACK PINES OR BLACK SPRUCES

◆ = PICKETS 4"x4" WITH TREATMENT LABELS

▲ = PICKETS 2"x2"

—— = IMAGINARY BOUNDARY - LARGE PLOT 54x54 FT.;
- EXPERIMENTAL UNIT 30x30 FT.

Figure 3. Arrangement of experimental units of Studies A and B.

SCALE 1 CM. = 54 FT.