PROCESSING SOIL AND PLANT DATA PRINT-OUTS

AND

RECOMMENDATIONS

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INTRODUCTION

This presentation will concern itself with the practical application of soil and plant results obtained from the Forest Soils Laboratory. Laboratory procedures have been explained to you by the previous speaker, Prof. R.J. Fessenden of the Faculty of Forestry and Landscape Architecture, University of Toronto, just a few moments ago. To achieve this, the whole presentation is subdivided into twenty steps, each step will be illustrated with a slide bearing the same number. Also, subtitles will be numbered in the manner as Appendicies are numbered and attached to this paper. It is further subdivided into five major steps. These are as follows:

A. Input - Soil and Plant Data
B. Output - Soil Data
C. Nursery Reports
D. Output - Plant Data
E. Output - Plant Quality Data

A. INPUT

Appendix 1

The soil sample report includes information shown in Appendix 1. Each sample is identified by a laboratory number, field number, compartment number and plant sample which was produced on this soil. The pH is analyzed in water, organic carbon (O.C.) by wet combustion (Walkley-Black) method, Phosphorus (P) as "available", phosphorus in mg/100g. Potassium (K), Calcium (Ca) and Magnesium (Mg) are presented as "exchangeable" in meg/100g. Sometimes micronutrient analyses are done for problem samples. No analyses are done for nitrogen (N). At the present time we are aiming for the following concentrations in the soil:

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TABLE 1

Optimum pH and Nutrient Concentrations

Analysis	Species				
	White Pine	Red Pine	Jack Pine	Spruce	Hard-woods
pH	6.0-6.5	5.2-6.0	5.0-5.6	6.0-6.5	6.5 +
O.C.%	3.0	3.0	3.0	:3.0	3.0
P mg/100g	30.0	30.0	30.0	30.0	30.0
K meg/100g	0.30	0.30	0.30	0.30	0.30
Ca meg/100g	1.5	0.8	0.5	3.0	3.0
Mg meg/100g	0.5	0.2	0.15	0.7	0.5

Soil samples are collected each year between June 1 and June 10 from all compartments which are to be sown in the fall. Then again, at the end of growing season, just before freeze-up, soil samples are collected from all active compartments and analyzed for nutrient concentrations and pH. In a fall no analyses are done for organic carbon (O.C.), because organic amendments are possible only when compartments are fallow between rotations.

Appendix 2

Soil and plant sampling procedures have been demonstrated in the field, therefore, it will not be necessary to go into this at this time. Seedling heights (cm), diameter (mm) and root area indices (cm^2) are recorded for each seedling within a sample. Shoot and root dry weights (g) are obtained for each sample only. In the past all foliage N, P and K concentrations were done for every plant sample, but now we feel it is not necessary. Only problem and control plant samples are analyzed for N, P, K, Ca and Mg concentrations. Also, sometimes we check on micronutrients.

Appendix 3

When laboratory soil data is checked by comparison to previous

analyses and soil amendments, it is coded on the automatic data processing document (ADP) for key-punching on a tape. All soil data, with the exception of problem samples, is coded on a form as illustrated by Appendix 3. At the present time, our computer is not programmed to process problem samples. It is done manually. Coding of regular soil samples is done twice a year, the first is in early summer for sowing in the fall and the second time, early in winter for samples collected at the end of the growing season. Both print-outs are identical.

Appendix 4

In similar manner, plant data is coded for key punching as shown in Appendix 4. It is to be noted that in addition to the laboratory data, there are columns to indicate the type of stock grown. The codes are as follows:

1. - Stock ready to ship.
5. - Seedling stock being nursed for seedling ship.
7. - Transplant stock being nursed for transplant ship.
9. - Seedling stock being nursed for transplanting.

B. OUTPUT - SOIL DATA

Appendix 5

The first report that comes out of a computer is a "validate" report showing rejections and warnings of possible errors in input. This applies to all soil and plant inputs. These reports are checked and corrections and re-codings are made if necessary and the sheets are sent back to automatic data processing.

Appendix 6

The second print-out is shown in Appendix 6. It is a simple tabular presentation of all physical and chemical analyses for each nursery by compartments. These data are the basis for the proposed soil amendment programme for land preparation before seeding or transplanting in spring or fall.

Appendix 7

Appendix 7 illustrates a programme showing proposed additions to a soil in elemental lb/ac, with the exception of peat, which is in cubic yards per acre. Blank spaces indicate that no amend-

ments are necessary for elements or organic carbon for the compartments shown. Every nurseryman has to convert elemental units into fertilizer units by referring to Table 8, page 77 of the "Forest Tree Nursery Soil Management and Related Practices". Please note that calcium (Ca) appears twice, the first one is to raise the pH and the second one, is to increase Ca concentrations in the soil. We do not analyze our soil samples for soil nitrogen (N). The rates of applications by species and age classes are established by conducting fertility trials at all major nurseries.

Soil adjustments as shown on a print-out (Appendix 7) are calculated as follows:

1. Calculation of pH Adjustment (assume optimum pH range is 5.0-6.0).
   a. Reduction of pH - addition of sulphur (S). Experience has shown that at pH 7.0-7.5 the rate of application is approximately linear with addition of sulphur (S) and 500 lb/ac of sulphur reduces the pH by 0.5 unit. Thus to reduce pH from 7.0 to 5.5, about 1500 lb/ac of sulphur should be applied. Nevertheless, sulphur applications in excess of 1000 lb/ac are undesirable as they might cause a reduction in seedling survival and growth. Therefore a formula has been developed to keep sulphur applications between 250 and 1000 lb/ac. It is based on assumption that 100 lb/ac will reduce the pH by 0.1 unit. For red and jack pine when the pH is 6.1 or higher, an attempt would be made to reduce to 5.5 .

      Example:
      If pH of soil is greater than 6.0, subtract 6.0 from soil pH. Multiply the difference by 500 and add 250. Result is amount of sulphur in lb/ac.

      (i) 7.2 - 6.0 = 1.2

      (ii) (1.2 x 500) + 250 = 850 lb/ac

      See Appendix 6 and 7, compartment 49.

   b. Increase of pH - Addition of Calcium Dolomitic limestone is one of the most common materials used in liming operations. Table 9 in the Soils Manual sets out a "rule of thumb" guide based on Ontario experience.

      Example:
      If pH of soil is less than 5.0 subtract soil pH from 5.0 . Multiply by 1000. Result is amount of calcium to be added in lb/ac.

(i) 5.0 - 4.3 = 0.7

(ii) 0.7 x 1000 = 700 lb/ac (elemental)

It is to be noted that if pH values are between 5.0-6.0, no sulphur or calcium additions are made.

2. Increase of organic carbon - calculation of peat addition. We assume that 3% organic carbon in the soil is optimum for seedling growth. Historical records of additions of peat and soil analyses for organic carbon levels have lead us to the following rule. Each 50 cu. yd./ac addition of peat will increase the organic carbon level by 0.4 percent (oven dry weight basis). If it is desirable to raise an organic carbon level in the soil by 1.0 percent, then the following calculation is made:

   1.0/0.4 x 50 = 125 cu. yd./ac. is required. Estimated peat requirements as shown on the print-out, are calculated as follows:

   Subtract soil analysis organic carbon percent from 3.00 . Multiply the difference by 125. Result is amount of peat needed in cubic yards per acre to be added.

   Example:
   (i) 3.00 - 1.87 = 1.13

   (ii) 1.13 x 125 = 141 cu. yd./ac.

   Please note that if difference in calculation is negative, computer does not proceed. The multiplication factor from organic carbon into organic matter is 1.724.

3. Increase of Phosphorus (P) - Calculation of P addition (assume 30 mg/100g optimum). Theoretical increase per 20 lb of elemental P per acre is 0.53 mg/100g (approximately 0.5 mg/100g). But since the majority of our soils are much below optimum, and, because we feel that P applications exceeding 200 lb/ac are undesirable, expensive and probably harmful to the trees, we decided to build up P concentrations at a much slower pace. We established a formula for the calculation for P application as follows:

   Subtract soil analysis P from 30. Multiply difference by 20. Result is amount of P in lb/ac to be added.

   Example:
   (i) 30.00 - 14.60 = 15.40

   (ii) 15.40 x 20 = 308 lb/ac.

Additional applications of up to 100 lb/ac would be applied during the rotation period of two to three years.

4. Increase of Potassium (K) - Calculation of K addition. (Assume 0.30 meq/100g is optimum).

An addition of 7.8 lb/ac of elemental K, will increase soil K concentration by 0.01 meg/100g. Therefore, to increase soil K concentration by 1 meq/100g it will be necessary to apply:

7.8 0.01 = 780 lb/ac

It is calculated as follows:

Subtract soil analysis exchange K from 0.30 . Multiply the difference by 780. Result is amount of K in lb/ac to be added.

Example:
(i) 0.30 - 0.23 = 0.07

(ii) 0.07 x 780 = 55 lb/ac.

If difference of K is negative, the computer does not proceed.

5. Increase of calcium (Ca) - Calculation of calcium addition.

It has been established that an addition of 400 lb/ac of elemental Ca will raise Ca concentration in the soil by 1.00 meg/100g. We are aiming for 1.50 meq/100g regardless of species. Therefore, the calculation of application rates is made as follows:

Subtract soil analysis exchange Ca from 1.50 . Multiply difference by 400. Result is amount of Ca in lb/ac to be added.

Example:
(i) 1.50 - 0.77 = 0.73

(ii) 0.73 x 400 = 292 lb/ac.

If difference in calculation is negative, computer does not proceed.

It is to be noted that there is a weakness in the above calculation, because it disregards different species requirements. Therefore, the print-out is adjusted for different

species requirements for Ca as follows:

Pw - 1.50 meq/100g

Pr - 0.80 meq/100g

Pj - 0.50 meq/100g

Sw - 3.00 meq/100g

6. Increase of Magnesium (Mg) - Calculation of Mg Additions. (Assume optimum exchange Mg is 0.50 meg/100g).

An addition of 2.43 lb/ac of elemental Mg per acre will raise Mg soil concentration by 0.01 meq/100g. To raise Mg concentration by 1.00 meq/100g it will be necessary to apply 243 lb/ac of Mg. An estimate of applications is made as follows:

Subtract soil Mg analysis from 0.50 . Multiply difference by 243. Result is amount of Mg in lb/ac to be added.

Example:
(i) 0.50 - 0.30 = 0.20

(ii) 0.20 x 243 = 49 lb/ac.

If difference is negative, computer does not proceed.

The print-out is adjusted for magnesium as for calcium, to compensate for different species, requirements as follows:

Pw - 0.50 meq/100g

Pr - 0.20 meq/100g

Pj - 0.15 meq/100g

Sw - 0.70 meq/100g

Appendix 8

Appendix 8 is similar to Appendix 6, except that it is for fall soil samples collected at the end of growing season. In the fall all fields are resampled after land preparation for fall seeding. *We* do this in order to check and evaluate the effects of soil amendments. "A" in column 2 indicates that samples were collected after land preparation, "F" indicates fall sample, collected at the end of growing season.

Appendix 9

From soil data, illustrated in Appendix 8, a Proposed Soil Amendment Programme for top dressing is prepared. Rates for nitrogen (N) applications are established from fertility trial plots for each major nursery. A Proposed Soil Amendment Programme is illustrated by Appendix 9, which is similar to Appendix 7, but based on spring soil data. It should be noted that Ca, S and peat (O.C.) are not applied as top-dressing. The computer in preparing Appendix 9 goes through the same calculations as for Appendix 7.

C. NURSERY REPORTS

Appendix 10

This is a page of a report from Kemptville Nursery on land preparation for seeding or transplanting. It indicates the application rates of fertilizer, herbicide, fungicide and peat by compartments in lb/ac (peat in cu. yd./ac).

Appendix 11

Appendix 11 is an illustration of a report on top-dressing with chemicals by compartment in lb/ac. The time of application is shown by cumulative growing degree days, ^{o}C or ^{o}F, in lb/ac of active ingredient.

Appendix 12

This is another illustration of a herbicide, fungicide and insecticide report by compartments and species for Orono Nursery. Application rates shown are in lb/ac of material applied.

D. OUTPUT-PLANT DATA

Appendix 13

This is an example which shows plant data as obtained from the computer. It provides us with mean, standard deviation, standard error and five size classes with percent of trees in each size class for height (cm), diameter (mm), height over diameter ratio, root area index (cm^2), seedling index, oven dry shoot weight (g), oven dry root weight (g), total oven dry weight (g) and shoot over root ratio (based on oven dry weight). The ranges for each

size class are based on one half of the standard deviation.

Appendix 14

For a comparison of the quality between nurseries averaged for all compartments within a particular nursery, a report illustrated by Appendix 14 is obtained. This report is used to check on quality of stock by species and age class and disregards differences between compartments.

Appendix 15

Since we have differences in growing conditions between southern and northern Ontario, summaries have been prepared for the above mentioned main parts of the province. Appendix 15 shows nursery plant analyses for southern Ontario. Similar print-outs are available for northern Ontario and the whole of Ontario.

Appendix 16

Soil data as illustrated in Appendicies 8, 9, 10 and 11 and plant data Appendicies 13, 14 and 15 are the basis for the preparation of a top-dressing programme. The rates of application are in elemental lb/ac and kg/ha by cumulative growing degree days in °C and °F. This is necessary because we are in a transition period from English into Metric system.

E. OUTPUT-PLANT QUALITY DATA

Appendix 17

Table 1A, Appendix 17, shows primary size standards by age classes for white pine. Similar tables are available for the other major species. The ranges of acceptable total oven dry weight, diameter, root area index and cull limits are listed by age classes. This is our guideline for an estimate of a percentage cull a year or two before shipping age.

Appendix 18

This illustration is very similar to the previous one, except that it deals with heights and shoot over root ratios. We call these the secondary standards, because they are not as dependable

as primary size standards. The application of these data is the same as for the oven dry weight, diameter and root area index data.

Appendix 19

All information as shown in Appendix 17, is plotted on a graph as illustrated by Appendix 19. The main purpose of a graph is to find out what kind of stock a nurseryman is producing a year or two before shipping.

Appendix 20

This is the final illustration in the use of plant analysis data to forecast quality of shipping nursery stock. Anticipated cull percentages for total oven dry weight, diameter, root area index, height and shoot over root ratio are estimated. An average cull in percent is also shown for each batch of trees by compartment, species and age class. The "average" percent of cull is to be applied against annual inventory in order to estimate a cull in percent at nursing age of stock. This is a new development. How it will work, we don't know yet. At this time we hope to merge successfully plant analysis data with inventory data.

The third last line is H/D ratio. The second last line provides us with seedling index (SI) and the last line with quality index (QI). Formulas can be found on page 37 of the "Forest Tree Nursery Soil Management and Related Practices", by K.A. Armson. We hope to work on this in the near future, therefore, at this time there is no point in going into details.

This presentation was a detailed one, but an attempt has been made to cover all the steps that one should go through from the time when laboratory data is received until implemented at a nursery.

REFERENCES

K.A. Armson and V. Sadreika, 1974, Forest Tree Nursery Soil Management and Related Practices. Ontario Ministry of Natural Resources, Division of Forests, Forest Management Branch. pp 177.

W.R. Bunting. The Use of Plant and Soil Samples in an Intensive Nursery Soil Programme. Ontario Department of Lands and Forests, Reforestation Section, Timber Branch, Nurserymen's Meeting, Swastika, 1966. mimeo, pp. 20-34.

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Nursery Kemptville

APPENDIX 1
ONTARIO MINISTRY OF NATURAL RESOURCES
SOIL SAMPLE ANALYSES

Date: Dec. 3, 1975

Purchase Order No: A-198853

Lab. No.	Field No.	Plant Lab. No.	Comp. No.	PH	O.C. %	N %	P kg/100g	K meq/100g	Ca meq/100g	Mg meq/100g	REMARKS
1	19	19	29	5.25	1.86	-	37.2	0.16	1.06	0.35	
2	20	20	58	5.53	2.01	-	35.1	0.19	0.75	0.30	
3	21	21	8	5.72	1.50	-	26.5	0.13	1.51	0.41	
Etc.											

APPENDIX 2
ONTARIO MINISTRY OF NATURAL RESOURCES
PLANT SAMPLE ANALYSES

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Date Dec. 1, 1975

Purchase Order No. A-213198

Tree	Ht	Diam	RAI	REMARKS
1	4.0	1.3	5.2	
2	3.1	0.8	2.2	
3	2.4	0.6	1.5	
4	3.0	0.8	3.5	
5	Etc.			
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20	2.4	0.5	1.5	

Nursery Kemptville

Field No. 28-1

Comp. No. 29

Age 1+0

Species Pr

No. of Seedlings 20

Site Region 6205

Density 35

Stock Type 3+0

Plant Analysis

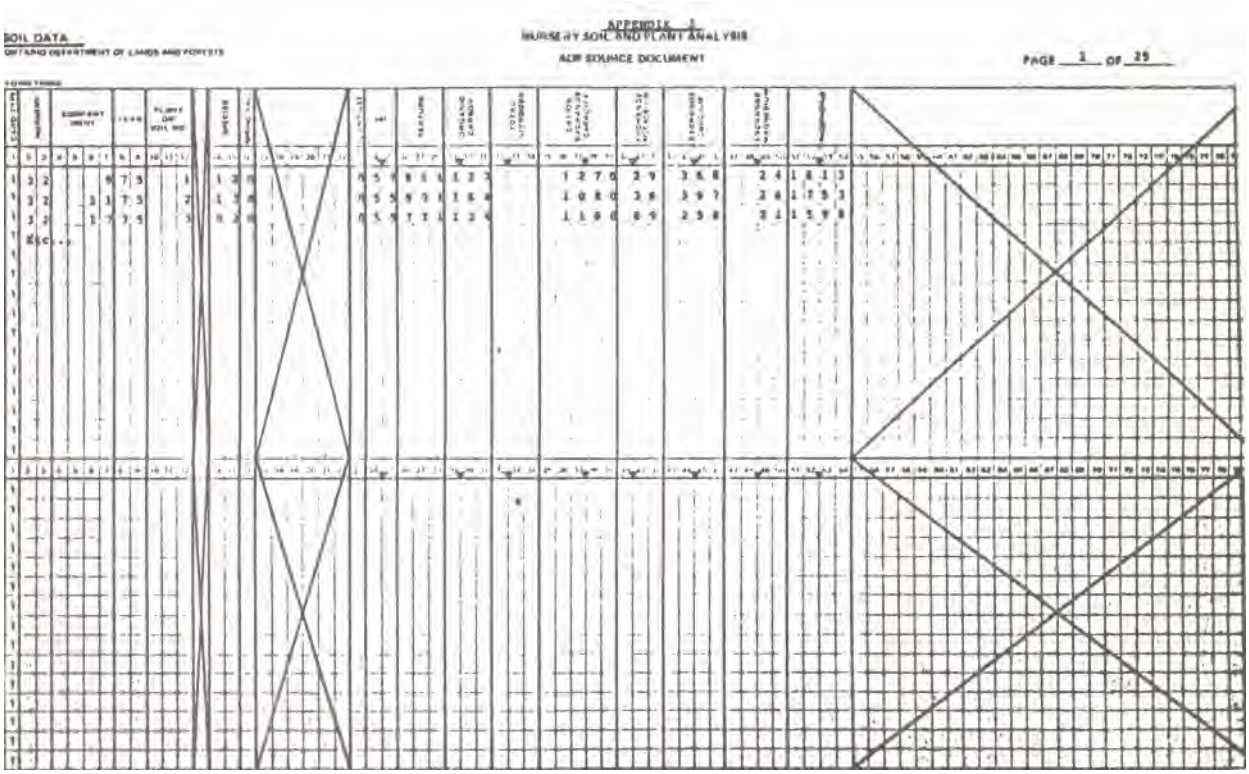
Date Analyzed Dec. 20, 1975

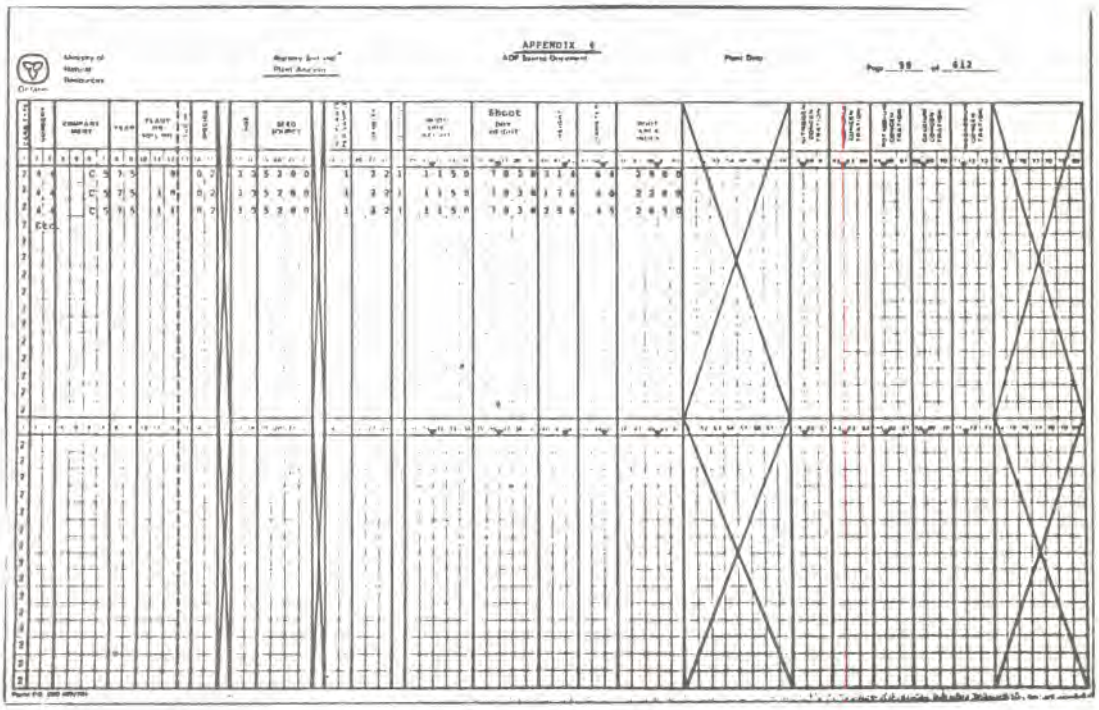
Dry Weight (Grams)

Roots	Shoots	Total		
0.692	2.810			

Element Analysis

N	P	K	Ca	Mg		
1.75	0.21	0.84	0.19	0.09		


SOIL DATA
APPENDIX 1
NURSERY SOIL AND PLANT ANALYSIS
ADP SOURCE DOCUMENT
PAGE 1 OF 25


APPENDIX 2
ADP Source Document
Plant Data

APPENDIX 5

ONTARIO MINISTRY OF NATURAL RESOURCES
NURSERY SOIL AND PLANT ANALYSIS

VALIDATE REPORT
SOIL DATA

DATE
PAGE

..........CARD-IMAGE..........		DIAGNOSTIC
1A0 J4750360000A	57000137000000000100170002027627000000000000000000000000000	WARNING
1A0 H4750370000A	51000177000000000120175001729260000000000000000000000000000	WARNING
1A0 B1075042000A	56000117000000000090292002273130000000000000000000000000000	WARNING
1A0 B1175043000A	55000155000000000080109001722130000000000000000000000000000	WARNING
1A0 B1275044000A	56000179000000000100156001821670000000000000000000000000000	WARNING
1A0 C575046000A	54000142000000000080117001426870000000000000000000000000000	WARNING
1A0 C1075051000A	58000135000000000090201003133730000000000000000000000000000	WARNING
1A0 C1175052000A	54000170000000000110132002126660000000000000000000000000000	WARNING
1A0 C1275053000A	56000190000000000130165002425260000000000000000000000000000	WARNING
1A0 J1175055000A	54000098000000000210124002227470000000000000000000000000000	WARNING
1A0 J1375056000A	56000089000000000170097002018000000000000000000000000000000	WARNING
1A0 B1175057000A	53000177000000000240234003224870000000000000000000000000000	WARNING
1A0 B1275058000A	55000128000000000090134001519270000000000000000000000000000	WARNING

APPENDIX 6.

ONTARIO MINISTRY OF NATURAL RESOURCES

KEMPTVILLE NURSERY SOIL ANALYSIS

PAGE

YR	COMP	S/F	PH	TEXTURE			OC	N	OC/N	P	K	CA	MG	CEC
75	5	S	6.5	0	0	0	1,87			14.60	.23			
	6	S	5.6	0	0	0	1,81			22.50	.22	4.09	.65	
	9	S	5.8	0	0	0	1,91			30.17	.17	2.84		
	15	S	6.4	0	0	0	2,14			18.07	.26	7.35		
	17	S	5.4	0	0	0	2,15			23.40	.17	2.19	.65	
	22	S	5.1	0	0	0	2,08			24.07	.13	.77	.30	
	25	S	5.1	0	0	0	2,61			23.16	.16		.64	
	28	S	5.8	0	0	0	1,89			22.27	.20	2.71	.86	
	31	S	5.1	0	0	0	2,18			23.60	.19		.53	
	39	S	6.4	0	0	C	1,65			11.73	.14	4.13	1.24	
	42	S	7.0	0	0	0	2,36			9.50	.25	7.73	2.03	
	43	S	6.7	0	0	0	1,85			8.50	.18	6.66	1.39	
	45	S	6.2	0	0	0	1,46			18,83	.22		.92	
	47	S	6.6	0	0	0	1,69			8.93	.13			
	49	S	7.2	0	0	0	1,59			6,00	.20			
	55	S	5.4	0	0	0	1,91			24.67	.17		.35	
	59	S	5.2	0	0	0	1,60			18.00	.16	.79	.27	

SOIL COMPOSITION % SAND % SILT % CLAY

APPENDIX 7.

ONTARIO MINISTRY OF NATURAL RESOURCES — KEMPTVILLE NURSERY - PROPOSED SOIL AMENDMENTS IN LB/AC — PAGE 1

YR	COMP	SAMPLE NO.	PH CALCIUM	PH SULPHUR	ORGANIC CARBON PEAT - CU. YD.	PHOSPHORUS	POTASSIUM	CALCIUM	MAGNESIUM
74	5	0016		5.0	141	308	55		
	6	0026			149	158	62		
	7	0036			130		101		
	15	0056		4.0	100	239	51		
	17	0066			106	132	101		
	22	0086			115	119	133	292	84
	25	0096			84	157	109		
	28	0106			139	155	78		
	31	0116			103	128	86		91
	34	0126		4.0	169	365	125		
	40	0146		7.0	80	410	39		
	41	0156		6.0	148	430	94		
	45	0176		4.0	143	223	62		
	47	0186		5.0	164	421	133		
	49	0196		6.0	176	480	78		
	55	0216			136	107	101		36
	57	0226			175	248	109	284	56

APPENDIX 8.

ONTARIO MINISTRY OF NATURAL RESOURCES — KEMPTVILLE NURSERY SOIL ANALYSIS — PAGE 1

YR	LOMP	S/E	PH	TEXTURE	OC	N	OC/N	P	K	CA	Mg	LEC
74	1	A	5.7	0 0 0	1.71			26.33	.24	2.67	.55	
	2	F	5.2	0 0 0				27.27	.23		.46	
	3	A	6.5	0 0 0	1.77			12.13	.18	4.35	1.04	
	4	F	4.4	0 0 0				26.27	.24		1.43	
	16	F	5.3	0 0 0				22.85	.17		.66	
	17	A	5.5	0 0 0	2.09			10.33	.31	2.25	.51	
	18	A	5.6	0 0 0	2.14			19.87	.35	2.15	.56	
	11	F	5.6	0 0 0				30.33	.12		.09	
	12	F	4.7	0 0 0				29.40	.30		.22	
	13	F	6.3	0 0 0				21.50	.29		1.47	
	17	F	5.2	0 0 0				27.83	.14		.60	
	18	A	5.9	0 0 0	2.35			25.33	.09	1.07	.24	
	19	F	5.2	0 0 0				26.27	.16		.39	
	20	F	5.6	0 0 0				25.60	.17		.45	
	22	A	5.4	0 0 0	3.55			16.67	.12	1.10	.25	
	23	F	4.5	0 0 0				26.67	.15		.14	
	23	F	5.3	0 0 0				31.27	.22		.47	
	24	F	6.2	0 0 0				44.13	.29		1.81	
	25	A	5.4	0 0 0	1.81			16.00	.15	2.22	.61	
	25	F	5.1	0 0 0				23.60	.15		.36	
	26	A	5.2	0 0 0	1.71			20.33	.23	1.46	.39	
	27	F	4.9	0 0 0	2.05			24.13	.32	2.65	.53	
	27	F	6.4	0 0 0				36.17	.20		1.39	
	28	F	5.4	0 0 0				29.27	.20		.56	
	29	F	4.7	0 0 0				32.73	.17		.43	
	30	A	5.6	0 0 0	1.65			24.13	.35	1.84	.40	
	31	F	4.6	0 0 0				26.67	.23		.43	
	33	A	4.4	0 0 0	1.53			16.80	.19	1.24	.17	
	34	F	5.4	0 0 0				27.83	.22		.43	
	35	F	6.0	0 0 0	2.63			36.33	.24	1.63	.38	
	37	F	5.2	0 0 0	2.26			23.27	.20	1.40	.33	
	39	F	6.6	0 0 0	2.45			26.33	.21	4.04	1.46	
	45	F	4.3	0 0 0				32.17	.23		.11	

APPENDIX 9.

ONTARIO MINISTRY OF NATURAL RESOURCES — KEMPTVILLE NURSERY - PROPOSED SOIL AMENDMENTS IN LB/AC — PAGE 1

YR	COMP	SAMPLE NO.	PH CALCIUM	PH SULPHUR	ORGANIC CARBON PEAT - CU. YD.	PHOSPHORUS	POTASSIUM	CALCIUM	MAGNESIUM
74	1	0490			161	73	47		
	4	0090				55	55		18
	5	0150		450		75	47		
	5	0340		500	154	357	94		
	6	0200				143	101		
	7	0350			114	233			
	8	0360			108	203			
	9	0100					140		
	12	0110	30			12			68
	15	0210		400		170	78		
	17	0220				43	94		
	18	0370			81	93	164	172	53
	19	0120				75	109		27
	20	0130				88	101		12
	22	0230	50			67	117		87
	22	0360				267	140	160	61
	23	0020					62		7
	14	0010		350			8		
	25	0240				126	117		34

APPENDIX 10.

KEMPTVILLE NURSERY

SAMPLING AFTER SEEDBED PREPARATIONS - FALL 1975

COMPARTMENT 5
- Summer Fallow
- Peat 240 cu yds per acre
- Triple Superphosphate 700 lbs/acre
- Sulphate of Potash 300 lbs/acre
- Chlorodane 25G 20 lbs/acre
- Dacthal 75W 12 lbs/acre

COMPARTMENT 6
- Summer Fallow
- Triple Superphosphate 450 lbs/acre
- Sulphate of Potash 300 lbs/acre
- Chlorodane 25 G 20 lbs/acre
- Dacthal 75W 12 lbs/acre

COMPARTMENT 15
- Summer Fallow
- Triple Superphosphate 700 lbs/acre
- Sulphate of Potash 160 lbs/acre
- Chlorodane 25G 20 lbs/acre
- Dacthal 75W 12 lbs/acre

COMPARTMENT 17
- Summer Fallow
- Triple Superphosphate 400 lbs/acre
- Sulphate of Potash 200 lbs/acre
- Chlorodane 25G 20 lbs/acre
- Dacthal 75W 12 lbs/acre

APPENDIX 11.

COMPARTMENT 4-14 - White Spruce 1-2 for ship 1-2
- Norway Spruce 1-2 for ship 1-2
- White Cedar 2-1 for ship 2-2
- Hemlock 2-1 for ship 2-2
- Soil Sample No. 10, Plant Samples 55 - 61

TOP DRESSING

Type	Rate	Growing Degree Days (Celsius)	Date	
Triple Superphosphate	300 lbs/acre	344	20-5-75	
Sulphate of Potash	200 lbs/acre	344	20-5-75	
Ammonium Nitrate	50 lbs/acre	344	20-5-75	
Ammonium Nitrate	50 lbs/acre	702	10-6-75	
Ammonium Nitrate	50 lbs/acre	1239	7-7-75	
Sulphate of Potash	250 lbs/acre	1306	10-7-75	Spruce
Ammonium Nitrate	50 lbs/acre	1918	7-8-75	
Ammonium Nitrate	50 lbs/acre	2496	11-9-75	
S.P. TOTAL	450 lbs/acre			
A.N. TOTAL	250 lbs/acre			

CHEMICAL WEED CONTROL

Cytrol	3 qts/acre	690	9-6-75	Spruce
Simazine 80W	3 lbs/acre	702	10-6-75	Cedar
Simazine 80W	2 lbs/acre	702	10-6-75	Hemlock
Simazine 80W	3 lbs/acre	1175	4-7-75	Spruce
Esso 350	40 gal/acre	1287	9-7-75	Cedar
Esso 350	40 gal/acre	1690	28-7-75	Spruce
Esso 350	40 gal/acre	2174	21-8-75	Spruce & Cedar

HERBICIDE, FUNGICIDE & INSECTICIDE APPENDIX 12.

APPLICATIONS 1975 - ORONO

Application rates shown are in "Material" used per Acre

Compt. #	Species	Date of Application	Fungicide	Herbicide	Insecticide	Amount/acre
# 6	Land Prep.	Sept. 22			Chlordane	50 lbs. Total
# 11	Poplar Stools	May 28			Furadan 10 G	10 lbs/acre
		May 29			Cygon	20 oz/100 30 gal/acre
		June 4			Cygon	" "
		June 11			Furadan 10 G	10 lb/acre
		June 24			Cygon	20 oz/100 30 gal/acre
# 13/16	White Pine 1-0	May 27		Dacthal		6 lb/acre
		June 2		Varsol		15 gal/acre
		June 11		Varsol		25 gal/acre
		June 18		Varsol		25 gal/acre
		June 26		Varsol		25 gal/acre
		July 8		Dacthal		6 lb/acre
		Aug. 7		Varsol		20 gal
		Sept. 2		Varsol		20 gal
		Sept. 30		Dacthal		5 lb/acre
# 18	Sw Pr Pw 1-0	May 16		Varsol		30 gal/acre
		June 3		Varsol		30 gal/acre
		July 9 paths only		Varsol		30 gal/acre
	Pr only	July 14	Maneb			3 lb/acre
	Sw only	July 22		Varsol		30 gal
	Pr only	July 31	Maneb			3 lb/acre
	Sw only	Aug. 7		Varsol		30 gal/acre
	Pr only	Aug. 18	Maneb			3 lb/acre
	Pr only	Sept 3	Maneb			3 lb/acre
	Pr only	Sept 16	Maneb			3 lb/acre
	Pr only	Oct 3	Maneb			3 lb/acre

APPENDIX 13.

ONTARIO MINISTRY OF NATURAL RESOURCES — PAGE 2

KEMPTVILLE NURSERY PLANT ANALYSIS

YR	OR	AGE	SP	COMP		FREQUENCY	MEAN	STD-DEV	STD-ERR	V-SMALL	SMALL	MEDIUM	LARGE	V-LARGE
					S/R	49	2.097	.494	.070571	32.65%	1.727- 1.973 %	1.974- 2.220 22.44%	2.221- 2.467 24.49%	20.40%
79	1	30	22	9	HT	26	22.615	5.348	1.048833	23.07%	18.605- 21.278 15.38%	21.279- 23.952 19.23%	23.953- 26.626 26.92%	15.38%
					DIA	26	3.042	.798	.156501	30.76%	2.444- 2.842 19.23%	2.843- 3.241 7.69%	3.242- 3.640 11.53%	30.76%
					H/D	26	7.594	1.339	.262601	19.23%	6.590- 7.259 19.23%	7.260- 7.928 26.92%	7.929- 8.598 7.69%	26.92%
					RAI	26	37.385	18.582	3.644244	26.92%	23.449- 32.739 19.23%	32.740- 42.030 23.07%	42.031- 51.321 11.53%	19.23%
					RI	26	6.204	2.703	.530104	30.76%	4.177- 5.528 7.69%	5.529- 6.879 26.92%	6.880- 8.231 15.38%	19.23%
					DSW	26	3.931	.167	.032752	42.30%	3.806- 3.889 %	3.890- 3.972 %	3.973- 4.056 %	57.69%
					DRW	26	1.010			42.30%	1.003- 1.007 %	1.008- 1.012 %	1.013- 1.017 57.69%	%
					TDW	26	4.941	.173	.033920	42.30%	4.812- 4.897 %	4.898- 4.984 %	4.985- 5.070 %	57.69%
					S/R	26	3.892	.134	.026280	42.30%	3.742- 3.858 %	3.859- 3.925 %	3.926- 3.992 %	57.69%
79	1	30	02	12	HT	116	29.561	7.014	.651253	25.86%	24.281- 27.787 17.24%	27.788- 31.294 10.34%	31.295- 34.801 21.55%	25.00%
					DIA	116	4.206	1.315	.122098	27.58%	3.220- 3.877 12.06%	3.878- 4.534 25.00%	4.535- 5.192 14.65%	20.69%
					H/D	116	7.309	1.480	.137798	29.09%	6.193- 6.934 14.65%	6.935- 7.676 20.68%	7.677- 8.418 10.10%	10.10%

APPENDIX 14.

ONTARIO MINISTRY OF NATURAL RESOURCES — PAGE 1

KEMPTVILLE NURSERY PLANT ANALYSIS

YR	OR	AGE	SP	RECRD		FREQUENCY	MEAN	STD-DEV	STD-ERR	V-SMALL	SMALL	MEDIUM	LARGE	V-LARGE
75	1	18	61	25	HT	25	38.920	13.695	2.739000	28.00%	28.449- 35.496 16.00%	35.497- 42.543 16.00%	42.544- 49.591 20.00%	20.00%
					DIA	25	3.904	.845	.169000	28.00%	3.271- 3.692 12.00%	3.693- 4.115 20.00%	4.116- 4.537 12.00%	28.00%
					H/D	25	9.824	2.046	.409200	12.00%	8.292- 9.314 32.00%	9.315- 10.337 24.00%	10.338- 11.360 12.00%	20.00%
					DSW	25	1.672	.084	.016800	56.00%	1.610- 1.651 %	1.652- 1.693 %	1.694- 1.735 %	44.00%
					DRW	25	1.861	.105	.021000	44.00%	1.783- 1.834 %	1.835- 1.887 %	1.888- 1.939 %	56.00%
					TDW	25	3.533			44.00%	3.526- 3.530 %	3.531- 3.535 %	3.536- 3.540 %	56.00%
					S/R	25	.906	.100	.020000	56.00%	.830- .879 %	.880- .929 %	.930- .979 %	44.00%
75	1	18	72	30	HT	30	49.403	23.344	4.262187	30.00%	32.094- 43.767 16.66%	43.768- 55.439 10.00%	55.440- 67.111 16.66%	26.66%
					DIA	30	5.253	1.922	.350922	30.00%	4.312- 5.272 13.33%	5.273- 6.233 16.66%	6.234- 7.194 10.00%	30.00%
					H/D	30	8.205	1.942	.354574	16.66%	6.829- 7.799 16.66%	7.800- 8.770 23.33%	8.771- 9.741 30.00%	13.33%
					DSW	30	5.043	1.971	.359849	33.33%	3.565- 4.550 33.33%	4.551- 5.535 %	5.536- 6.521 %	33.33%
					DRW	30	10.079	2.837	.517984	33.33%	8.752- 10.169 33.33%	10.170- 11.588 %	11.589- 13.006 %	33.33%
					TDW	30	15.922	4.887	.877676	33.33%	12.317- 14.720 33.33%	14.721- 17.123 %	17.124- 19.527 %	33.33%
					S/R	30	.049	.055	.010042	33.33%	.008- .035 33.33%	.036- .062 %	.063- .090 %	33.33%

APPENDIX 15.

ONTARIO MINISTRY OF NATURAL RESOURCES

SOUTHERN NURSERY PLANT ANALYSIS

PAGE 1

YR	DN	AGE	SP	RECDS	FREQUENCY		MEAN	STD-DEV	STD-ERR	V-SMALL	SMALL	MEDIUM	LARGE	V-LARGE
										SIZE CLASSES				
75	1	10	5N	129	HT	129	41.547	15.557	1.369695	24.03%	29.840- 37.657 11.62%	37.658- 45.436 20.93%	45.437- 53.214 19.38%	24.03%
					DIA	129	5.189	1.597	.140606	20.15%	3.992- 4.789 20.93%	4.790- 5.588 23.25%	5.589- 6.386 13.95%	21.70%
					H/D	129	8.349	3.283	.289047	24.80%	5.887- 7.528 20.15%	7.529- 9.169 16.27%	9.170- 10.811 22.48%	16.27%
					DSW	129	3.461	1.469	.129336	35.65%	2.360- 3.093 9.30%	3.094- 3.828 7.75%	3.829- 4.562 17.62%	29.45%
					DRW	129	9.974	3.106	.273464	37.20%	7.645- 9.197 15.50%	9.198- 10.750 %	10.751- 12.303 9.30%	37.98%
					TDW	129	13.435	4.498	.396028	37.20%	10.062- 12.310 15.50%	12.311- 14.559 %	14.560- 16.808 9.30%	37.98%
					S/R	129	.337	.063	.005547	26.35%	.290- .321 8.52%	.322- .352 %	.353- .384 37.98%	27.13%
75	1	10	61	120	HT	120	30.557	12.708	1.160124	23.33%	41.027- 47.380 10.83%	47.381- 53.734 23.33%	53.735- 60.098 19.16%	23.33%
					DIA	120	4.428	1.376	.125616	21.66%	3.397- 4.084 23.33%	4.085- 4.772 20.83%	4.773- 5.460 13.33%	20.83%
					H/D	120	12.184	4.111	.375297	25.00%	9.101- 11.156 22.50%	11.157- 13.211 15.83%	13.212- 15.267 12.50%	24.16%
					DSW	120	2.939	1.185	.108186	20.83%	2.051- 2.642 37.50%	2.643- 3.235 %	3.236- 3.827 18.33%	23.33%
					DRW	120	2.149	.602	.054957	29.16%	1.698- 1.998 29.16%	1.999- 2.299 %	2.300- 2.600 23.33%	18.33%
					TDW	120	5.088	1.716	.156658	31.66%	3.802- 4.659 26.66%	4.660- 5.517 %	5.518- 6.375 9.16%	32.50%

APPENDIX 16.

R2-11-3-1

Kemptville NURSERY

4.

PROPOSED SOIL AMENDMENT PROGRAMME 1976

OMP. NO.	Sp.	Rising Age Class	Element	Elemental		Cumulative Degree Days		Proposed Fertiliz
				Kg/ha	lb/ac	+ 1°C	+ 34°F	
22	Pr, Pw	1+0	N	22	20	330	600	A.N.
			N	22	20	550	1000	A.N.
			N	22	20	770	1400	A.N.
			P	18	32	880	1600	S.S.P.
			K	56	50	880	1600	P.S.
			Mg	39	35	880	1600	Mg.S.
			N	22	20	990	1800	A.N.
			N	22	20	1210	2200	A.N.
			N	22	20	1430	2600	A.N.
			N	22	20	1650	3000	A.N.
			K	56	50	1760	3200	P.S.
			Mg	39	35	1760	3200	Mg.S.
			N	22	20	1870	3400	A.N.
			N	22	20	2090	3800	A.N.
			N	22	20	2310	4200	A.N.
23	Sw	3+0	K	35	31	55	100	P.S.
			Mg	44	39	55	100	Mg.S.
			N	28	25	55	100	A.S.
			N	28	25	275	500	A.S.
			N	28	25	660	1200	A.S.
			N	28	25	1375	2500	A.S.
			N	28	25	1925	3500	A.S.
24	Sw, Cw	3+0	K	106	95	55	100	P.S.
			N	28	25	55	100	A.S.
			N	28	25	275	500	A.S.
			N	28	25	660	1200	A.S.
			N	28	25	1375	2500	A.S.
			N	28	25	1925	3500	A.S.

Table 1A

01 - White Pine

Primary Size Standards

Southern Ontario

APPENDIX 17.

Age Class	Size Class	Total O.D. Weight g				Diameter mm				Root Area Index cm^2			
		Cull	Min.	Mean	Max.	Cull	Min.	Mean	Max.	Cull	Min.	Mean	Max.
1+0	S	0.15	0.16	0.18	0.20	1.0	1.0	1.1	1.2	3.5	3.6	4.0	4.4
	M	0.15	0.21	0.23	0.25	1.0	1.3	1.4	1.5	3.5	4.5	5.0	5.5
	L	0.15	0.26	0.28	0.30	1.0	1.6	1.7	1.8	3.5	5.6	6.0	6.4
2+0	S	1.2	1.3	1.5	1.7	2.1	2.2	2.3	2.4	16	17	18	19
	M	1.2	1.8	2.0	2.2	2.1	2.5	2.6	2.7	16	20	22	24
	L	1.2	2.3	2.5	2.7	2.1	2.8	2.9	3.0	16	25	26	27
3+0	S	3.9	4.0	4.4	4.8	3.5	3.5	3.7	3.9	27	26	30	34
	M	3.9	4.9	5.4	5.9	3.5	4.0	4.2	4.4	27	35	40	45
	L	3.9	6.0	6.4	6.8	3.5	4.5	4.7	4.9	27	46	50	54
2+1	S	2.0	2.1	4.0	4.4	2.7	2.8	3.1	3.4	27	28	40	47
	M	2.0	4.5	5.0	5.5	2.7	3.5	3.8	4.1	27	48	55	62
	L	2.0	5.6	6.0	6.4	2.7	4.2	4.5	4.8	27	63	70	77
2+2	S	4.9	5.0	10.0	11.0	3.5	3.6	4.0	4.4	45	36	50	64
	M	4.9	12.0	13.0	14.0	3.5	4.5	5.0	5.5	45	69	80	95
	L	4.9	15.0	16.0	17.0	3.5	5.6	6.0	6.4	45	96	110	124

Table 1B

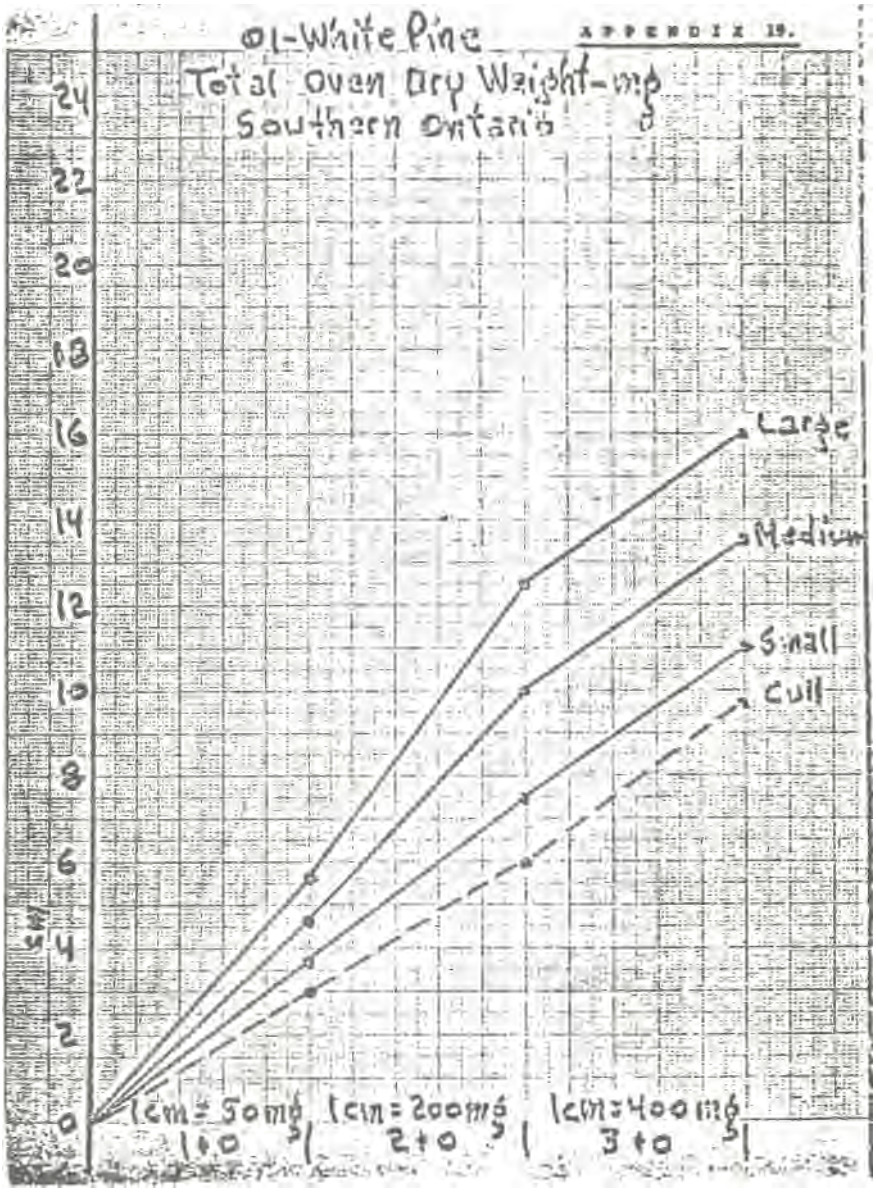
01 - White Pine

Secondary Size Standards

Southern Ontario

APPENDIX 18.

Age Class	Size Class	Height-cm				S/R Ratio			
		Cull	Min.	Mean	Max.	Cull	Min.	Mean	Max.
1+0	S	3.1	3.2	4.3	4.4	2.1	2.0	1.5	1.0
	M	3.1	4.5	4.6	4.7	2.1	2.0	1.5	1.0
	L	3.1	4.8	4.9	5.0	2.1	2.0	1.5	1.0
2+0	S	4.5	4.6	7.8	8.1	2.5	2.4	1.9	1.4
	M	4.5	8..	8.5	8.8	2.5	2.4	1.9	1.4
	L	4.5	8.9	9.2	9.5	2.5	2.4	1.9	1.4
3+0	S	14	15	20	21	3.8	3.7	2.8	1.9
	M	14	22	23	24	3.8	3.7	2.8	1.9
	L	14	25	26	27	3.8	3.7	2.8	1.9
2+1	S	10	11	12	13	1.8	1.7	1.3	0.9
	M	10	14	15	16	1.8	1.7	1.3	0.9
	L	10	17	18	19	1.8	1.7	1.3	0.9
2+2	S	14	15	17	18	2.5	2.4	1.9	1.4
	M	14	19	20	21	2.5	2.4	1.9	1.4
	L	14	22	23	24	2.5	2.4	1.9	1.4



MINISTRY OF NATURAL RESOURCES — APPENDIX 20

KEMPTVILLE NURSERY PLANT QUALITY FORECAST 1975 — PAGE-NO 12

COMP-NO	SPECIES	AGE	OBJ	SO-SC	DENSITY	FREQUENCY		MEAN	SIZE	CULL-PERC	AVERAGE EST.CULLS
28	01	38	1	6208	38	27	QUALITY INDEX	0.454			
28	01	38	1	6208	23	23	OVEN DRY WEIGHT	8.811	VL	0.00%	
					23	23	DIAMETER	4.730	L	13.04%	
					23	23	RAI	48.674	L	17.39%	
					23	23	HEIGHT	28.161	VL	0.00%	
					23	23	S/R-RATIO	3.454		0.00%	
					23	23	EST.CULLS				21.74%
					23	23	H/D RATIO	6.284			
					23	23	SEEDLING INDEX	14.468			
					23	23	QUALITY INDEX	0.945			
29	02	29	5	6208	14	55	OVEN DRY WEIGHT	5.826	VL	0.00%	
					14	55	DIAMETER	3.942	VL	7.27%	
					14	55	RAI	48.055	VL	1.82%	
					14	55	HEIGHT	9.975	L	3.64%	
					14	55	S/R RATIO	3.253		20.00%	
					14	55	EST.CULLS				25.45%
					14	55	H/D RATIO	7.579			
					14	55	SEEDLING INDEX	3.752			
					14	55	QUALITY INDEX	1.018			