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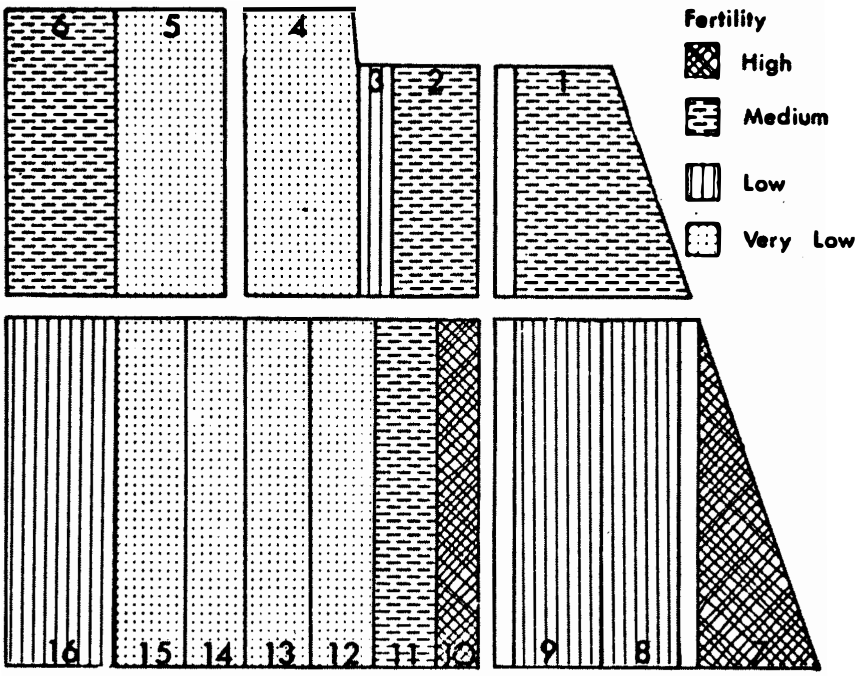
SOIL FERTILITY STATUS OF THE SEEDBED AREA OF THE PRINCE ALBERT TREE NURSERY, SASKATCHEWAN

by I. K. Edwards



INFORMATION REPORT NOR-X-46
DECEMBER, 1973

NORTHERN FOREST RESEARCH CENTRE
EDMONTON, ALBERTA

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by

I. K. Edwards*

ABSTRACT

Soil samples were collected from the seedbed area (fields 1-16) of the Prince Albert Tree Nursery and analysed for texture, pH, electrical conductivity, nitrate nitrogen, phosphorus and potassium. The results indicated that the area is predominantly sandy; portions of fields 5, 6, 15, and 16 (all contiguous) are sandy loam.

The soils are alkaline; pH ranged from 7.1 in the plow layer to 8.2 at the 18 - 24-inch depth. Of the major nutrients, nitrogen was in least supply. Only three fields, 7, 10, and 11, had adequate nitrogen, whereas 50% of the fields had sufficient phosphorus and potassium. Fields 7 and 10 were of the highest fertility.

The peat supply was slightly acid, high in potassium, and could increase the water-holding capacity of the soils almost five-fold.

The alkalinity of the irrigation water was due mainly to bicarbonates but could be neutralized with aluminum sulphate without impairment of its quality.

Applications of fertilizers, peat, and sulphur are recommended.

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INTRODUCTION

The Prince Albert Tree Nursery is situated on an excessively drained, sandy, alluvial plain near Prince Albert, Saskatchewan. A layout of fields at the nursery is shown in Figure 1.

The topography of the eastern portion (fields 1-21) is generally smooth, but owing to the slight southward slope, soil is washed and accumulates at the southern end of the fields. The topography of the western section (fields 22-53) is slightly to moderately undulating. Soil is eroded from knolls and accumulates in depressions.

As the profile often consists of fine sandy loam or loamy sand over coarse sand, the denuded areas tend to be excessively drained and infertile while the depressions are moist and productive. This is amply demonstrated in the alternating pattern of seedling growth. Dispersed deposits of clay also restrict drainage and lead to poor growth.

Production is mainly for reforestation; jack pine and white spruce are the most important species. However, soil conditions have not been ideal for the growth of conifers. The soils are alkaline and, for the most part, infertile throughout the root zone. Owing to their coarse texture, the soils have a low water-holding capacity. The irrigation water supply, which is a nearby surface stream, was also found to be alkaline. A high concentration of salts was confirmed[1] in the surface soil of a field exhibiting white crusting but the extent of salinity at the nursery had not been described.

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[1] Baker, J. 1970. A preliminary report on the soils of the Prince Albert Nursery. File report, Northern Forest Research Centre, Edmonton, November 1970.

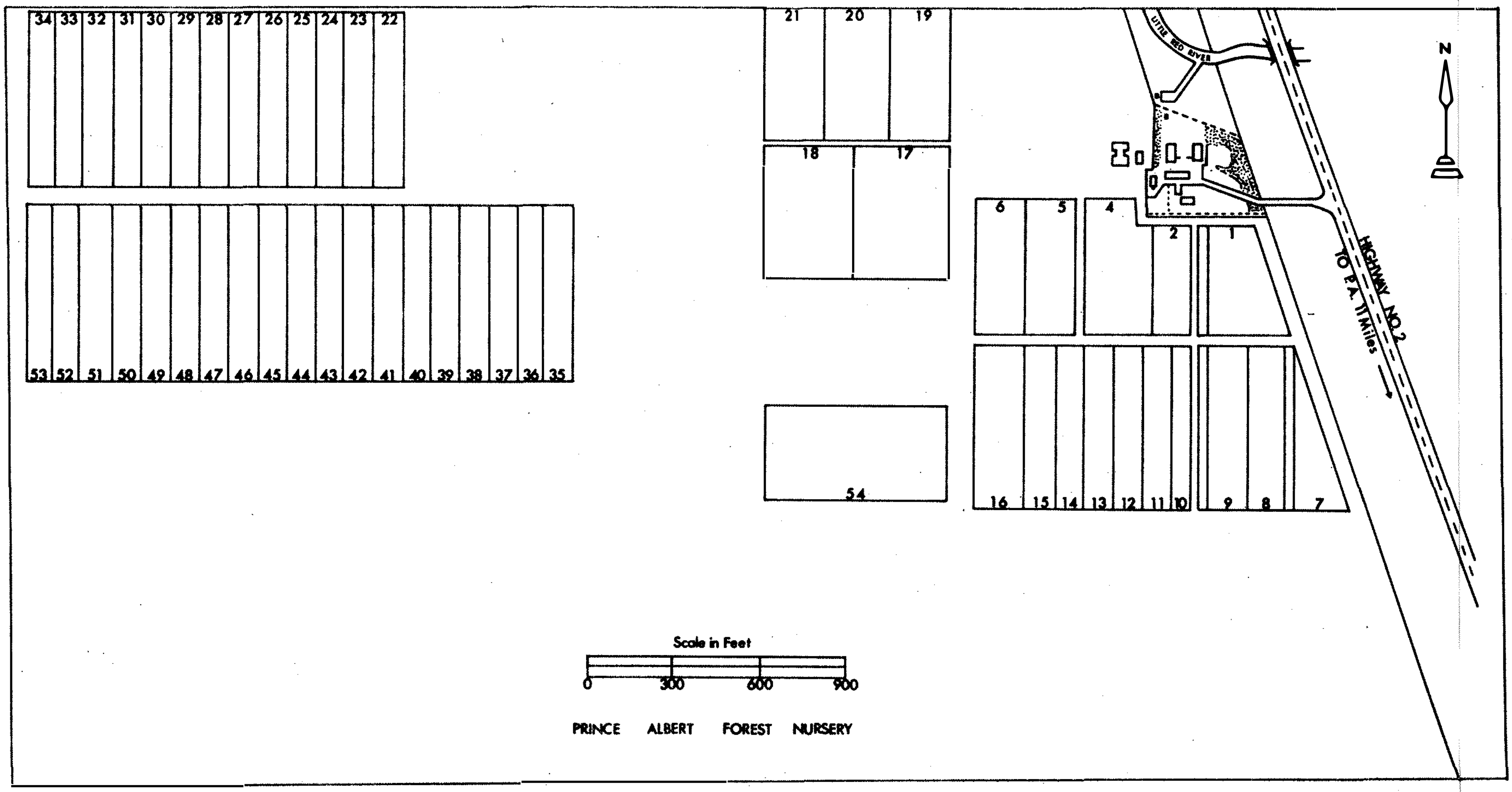

Figure 1. Field Layout of the Prince Albert Forest Nursery.

A survey of the nursery was undertaken to determine its soil fertility status. The peat and water supplies at the nursery were also analysed chemically. These results will form the basis for recommending amelioration of the soil and irrigation water. Details of acidification of the water, using aluminum sulphate, were requested.

This interim report concerns the soil survey results that have been obtained for the original seedbed area, the first 16 of 53 fields and an analysis of the water supply at the nursery. On the completion of the remaining analyses, a report for the entire nursery will be submitted.

METHODS

Soil Sampling

Four cores were taken in each field, except for fields 1 and 3, in which five cores and three cores, respectively, were taken. Sampling was done by extracting six-inch cores to a depth of two feet. In addition, three soil pits were dug in the seedbed area to a depth of three feet and sampled by horizons.

Increments for each core were analyzed separately to determine soil variability but the data given represent the mean of an increment for all cores within the field. The samples were air-dried, crushed and mixed prior to analysis.

Chemical Analysis

Soil All core samples were analyzed for pH, electrical conductivity, nitrate nitrogen, available phosphorus and exchangeable potassium.

In addition to these analyses, the soil horizons were analyzed for organic matter, water holding capacity and exchangeable cations. Analysis of samples from the soil pits was intended to broadly characterize the seedbed area. Core samples were analyzed specifically for information on the nutrient status of each field.

Electrical conductivity and pH were measured in a 1: 1 soil: water mixture using a conductivity bridge and a glass electrode, respectively (Jackson, 1958).

Exchangeable cations were determined by an atomic absorption spectrophotometer following extraction with ammonium acetate (Peech, _et. al._, 1947). Nitrate nitrogen and phosphorus were determined colorimetrically after extraction with copper sulphate (Jackson, 1958), and sodium bicarbonate (Watanabe and Olsen, 1965), respectively. Water-holding capacity was calculated as the difference between the percentage moisture held at 1/3 atmosphere tension and that at 15 atmospheres tension (United States Salinity Laboratory Staff, 1954).

Peat. Samples of the nursery supply were analysed for nutrients similar to those described for soils. In addition, organic matter was determined by the wet-oxidation method using chromic acid (Greweling and Peech, 1969). Various quantities of peat were added to samples of soil to determine its effect on water-holding capacity.

Water. A sample was analysed for pH, electrical conductivity, dissolved solids, hardness, alkalinity, cations and anions according to procedures described by Rainwater and Thatcher (1960). Reagent-grade aluminum sulphate was used in acidification tests on the water.

RESULTS AND DISCUSSION

Soil Analysis

Figure 2 shows the textural distribution of soils within the seedbed area. Analytical results for fields 1 - 8 are shown in Table 1 while results for fields 9 - 16 are shown in Table 2.

Soil Reaction

All fields were strongly alkaline except for field 3, which was neutral to slightly acidic throughout the depth sampled. In fields, 1, 2 and 14, pH decreased slightly with depth although the profiles remained alkaline but pH increased with depth in all other fields. The pH of surface soil ranged from 7.40 - 7.93 while that of the 18 - 24-inch layer varied from 7.91 - 8.18.

In growing conifers, the optimum range in soil pH is 5.0 - 5.5 and therefore the need for acidification is evident. This fact has already been recognized in view of the Saskatchewan DNR study[1] of pH reduction in the nursery (now in progress) and involving peat, hops, sulphur and aluminum sulphate.

In order to get some idea of the amount of acid that is required to lower the pH of these surface soils, samples from fields 6 and 9 representing heavy and light textures, respectively, were titrated with sulphuric acid. The data in Table 3 show the amounts of acid required to reduce the pH to 5.0 and the equivalent amounts of sulphur on an acre/six-inch basis. Approximately 0.5 tons sulphur per acre are required by the light non-calcareous sands in field 9 (representative of the seedbed area) whereas 5.0

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[1] Personal communication with Mr. F.W. Flavelle of the Saskatchewan Department of Natural Resources, Prince Albert, Saskatchewan.

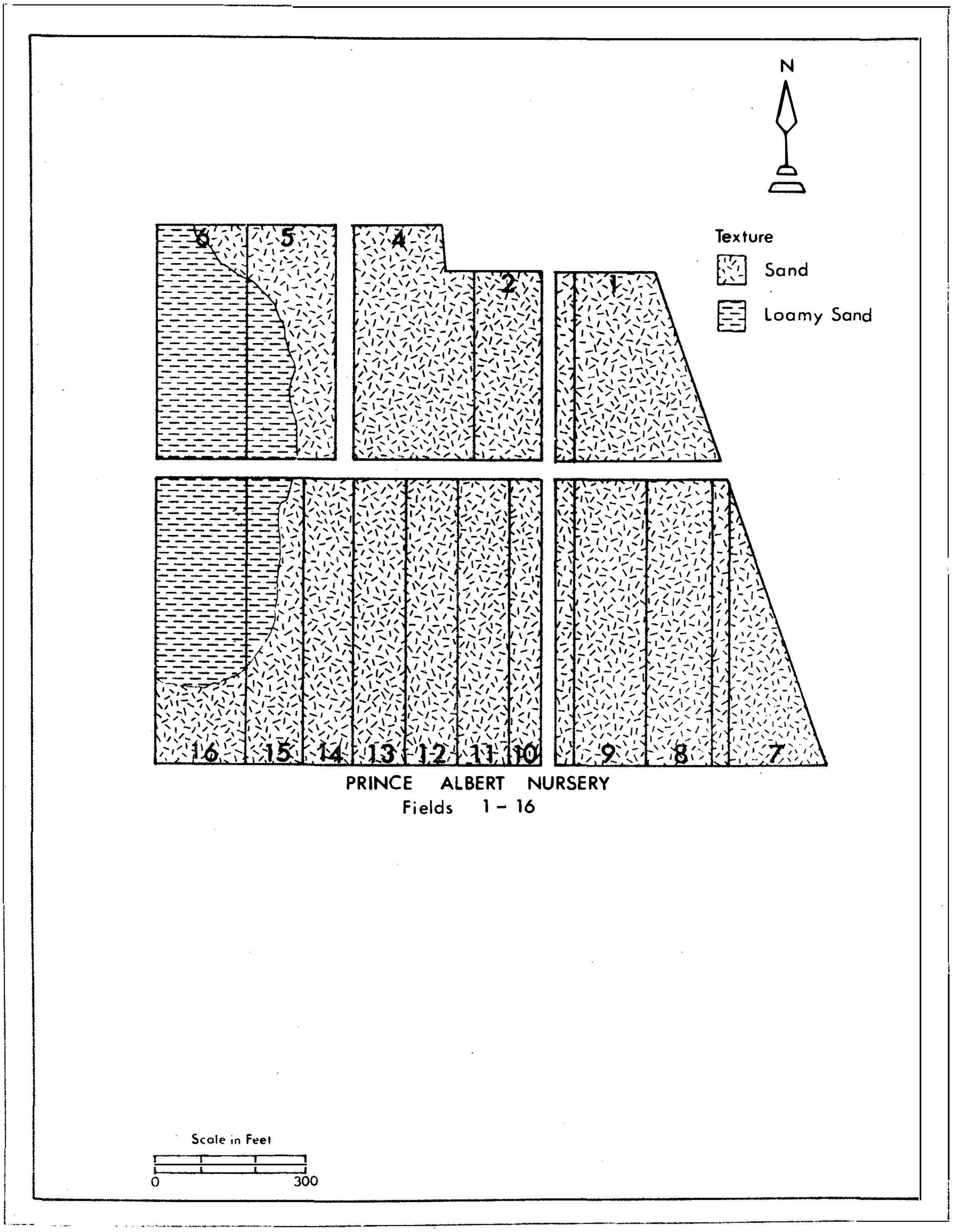

Figure 2. Textural distribution of soils within the seedbed area.

TABLE 1. SOILS ANALYSIS FOR FIELDS 1-8 OF THE PRINCE ALBERT TREE NURSERY[1]

Field No.	Depth (in.)	pH[2]	E.C.[3] (mmhos/cm)	NO_3-N[4]	P	K	Field No.	Depth (in.)	pH	E.C. (mmhos/cm)	No_3-N	P	K
				(pounds per acre)							(pounds per acre)		
	0-6	7.62	0.242	21.42	55.22	193.58		0-6	7.44	0.409	24.24	17.60	154.88
1	6-12	7.40	0.163	13.80	43.76	186.44	5	6-12	7.44	0.320	14.86	9.52	133.14
	12-18	7.25	0.156	12.90	24.20	181.02		12-18	7.88	0.302	9.60	6.18	119.72
	18-24	7.22	0.162	14.94	17.98	166.02		18-24	7.91	0.327	9.00	7.32	123.74
	0-6	7.49	0.357	13.22	41.34	185.64		0-6	7.71	0.475	32.00	41.42	211.34
2	6-12	7.45	0.249	19.12	36.76	183.70	6	6-12	7.75	0.561	18.02	31.36	187.50
	12-18	7.44	0.229	14.38	17.20	163.16		12-18	7.88	0.513	14.06	19.20	181.78
	18-24	7.43	0.209	14.74	11.68	168.70		18-24	8.01	0.531	19.74	12.44	151.06
	0-6	7.07	0.147	10.48	40.64	169.34		0-6	7.43	0.512	44.70	88.36	189.04
3	6-12	6.67	0.118	9.08	32.60	158.40	7	6-12	7.59	0.479	31.28	23.64	169.88
	12-18	6.52	0.091	6.94	22.70	141.48		12-18	7.79	0.472	36.18	17.84	141.14
	18-24	6.85	0.118	8.30	12.36	137.34		18-24	8.06	0.476	28.00	9.54	159.80
	0-6	7.58	0.182	12.34	26.98	163.94		0-6	7.40	0.326	19.96	35.86	192.48
4	6-12	7.73	0.185	7.62	19.44	154.94	8	6-12	7.51	0.333	18.00	28.12	176.32
	12-18	7.74	0.161	8.44	19.68	152.06		12-18	7.66	0.287	16.66	18.58	151.96
	18-24	7.84	0.180	9.86	12.48	132.38		18-24	7.80	0.326	22.00	9.82	139.20

[1] For fields 1 and 3, each value represents the mean of 5 cores and 3 cores, respectively. Four cores were taken from all other fields.

[2] Soil:water ratio of 1:1

[3] Electrical conductivity expressed in millimhos per cm. It is an indirect measure of total soluble salt concentration.

[4] Nitrate nitrogen.

TABLE 2. SOILS ANALYSIS FOR FIELDS 9-16 OF THE PRINCE ALBERT TREE NURSERY[1]

Field No.	Depth (in.)	pH	E.C. (mmhos/cm)	NO_3-N (pounds per acre)	P (pounds per acre)	K (pounds per acre)	Field No.	Depth (in.)	pH	E.C. (mmhos/cm)	NO_3-N (pounds per acre)	P (pounds per acre)	K (pounds per acre)
	0-6	7.54	0.374	33.40	46.82	175.96		0-6	7.65	0.227	14.30	26.48	147.70
9	6-12	7.76	0.327	16.18	18.36	151.74	13	6-12	7.61	0.234	15.46	22.32	123.46
	12-18	7.88	0.398	28.06	6.42	125.76		12-18	7.43	0.169	14.44	19.32	123.68
	18-24	8.03	0.382	39.80	8.08	113.98		18-24	7.75	0.227	10.06	21.36	111.60
	0-6	7.60	0.560	43.26	42.90	191.74		0-6	7.93	0.427	18.94	32.38	155.38
10	6-12	7.68	0.271	17.64	32.72	152.52	14	6-12	7.86	0.392	14.14	17.16	126.36
	12-18	7.96	0.280	13.34	13.36	123.88		12-18	7.83	0.333	9.84	12.96	118.02
	18-24	7.89	0.324	11.50	11.54	107.48		18-24	7.68	0.340	15.02	11.56	111.28
	0-6	7.80	0.397	28.46	51.08	183.70		0-6	7.86	0.556	30.52	38.58	144.56
11	6-12	7.90	0.318	15.78	22.64	132.64	15	6-12	7.82	0.391	14.64	27.34	120.10
	12-18	7.70	0.207	11.86	23.86	174.54		12-18	7.83	0.552	27.82	30.12	120.04
	18-24[2]	-	-	-	-	-		18-24	7.95	0.500	16.44	13.54	125.08
	0-6	7.80	0.241	15.92	26.02	155.26		0-6	7.84	0.558	43.44	22.10	104.44
12	6-12	7.74	0.206	12.96	17.40	149.34	16	6-12	8.00	0.486	42.70	14.26	99.04
	12-18	7.83	0.209	11.40	11.98	123.96		12-18	8.09	0.497	31.86	10.62	87.90
	18-24	7.93	0.170	9.70	10.74	145.48		18-24	8.18	0.407	31.38	6.72	91.96

[1] Each value represents the mean of 4 cores.

[2] No samples were taken at this depth. The soil was too compact for penetration of the sampler.

TABLE 3. ACID REQUIREMENT OF TWO SOILS FROM THE SEEDBED AREA.

Surface Soil of field #	Texture	Carbonate Content	Initial pH	m.e. H_2SO_4[1] per 100 g soil	Tons sulphur[2] per acre
6	Sandy loam	High	7.85	28.38	5.0
9	Sand	Nil	7.10	2.35	0.5

[1] Amount of sulphuric acid required to lower soil pH to 5.0.

[2] Approximate equivalent of sulphur, assuming some loss to subsoil.

tons sulphur per acre are required by the calcareous sandy loam found only in fields 6 and 16. Supplementary sulphur will be required even though applications of ammonium sulphate and aluminum sulphate in fertilizer and water, respectively, are already being considered.

Electrical Conductivity

Measurement of electrical conductivity reflects the concentration of soluable salts in the soil. Tables 1 and 2 show that electrical conductivity generally decreases with depth and suggest that evaporation plays a role in the concentration of salts in the surface horizons. Although fields 6, 7, 15, and 16 have consistently higher values than other fields in the seedbed area, the salt concentration is not high enough to restrict plant growth. The growth of most plants is not affected below a concentration corresponding to 4.0 millimhos per cm (United States Salinity Laboratory Staff, 1954) and so these values indicate that no threat from salinity exists at the present time.

Subsurface clay has been found in fields 6 and 16 and vertical drainage is probably restricted in these fields. Lateral movement of water from adjoining fields followed by evaporation could be responsible for their relatively high salt concentration.

It should be pointed out that electrical conductivity was determined on 1:1 soil/water mixtures and therefore results in lower concentrations than those actually present in the root environment. However, a check using the more representative (but time-consuming) soil-extract method, showed that the conductivity of surface soil of field 16 was less than 1.2

millimhos per cm (equivalent to about 0.05% salt in the soil), and therefore well within the range of acceptability for plant growth.

Nitrate Nitrogen

Nitrate nitrogen, rather than total nitrogen, was determined for the sake of convenience and is a measure of available nitrogen. Nitrate levels of 40 - 50 lbs per acre have been found to be the minimum requirement for conifers in Ontario (Armson and Carman, 1961), British Columbia (van der Driessche, 1969) and the Lake States (Stoeckeler and Jones, 1957). If it is assumed that the requirement is similar on the prairies, then only fields 7, 10, and 16 appear to have adequate available nitrogen.

Fields 5, 9 and 10 and part of 11 have received approximately 91 lbs N per acre over the last two years (1970 and 1971) while fields 14 and 15 have received 181 lbs N per acre during the same period (Table 4). Yet, fields 7 and 16 contain more nitrogen than any of the fertilized fields. Fields 14 and 15 contain only 19 lbs/ac. and 31 lbs/ac., respectively, in spite of their heavy applications of nitrogen.

In addition to the amount that may have been lost through crop uptake, substantial losses have occurred. Since fields 7 and 16 (unfertilized) have relatively high levels of nitrate nitrogen, it may be assumed that nitrification is adequate. Loss of nitrogen by leaching was probably high but without proper monitoring of gallonage applied and the losses resulting therefrom, no firm conclusions can be reached.

TABLE 4. TOTAL AMOUNTS (LBS/ACRE) OF N, P, AND K APPLIED TO SEEDBED AREA IN 1970 and 1971.[1]

FIELD	N	P	K
5	90.5	52.8	38.6
9	90.5	52.8	38.6
10	90.5	52.8	38.6
11 (E. 1/2)	90.5	52.8	38.6
14	181.0	86.6	100.4
15	181.0	86.6	100.4

[1] Data supplied by the Saskatchewan Department of Natural Resources.

Phosphorus

The minimum level of phosphorus required for conifers in prairie nurseries is around 40 lbs/ac. (Stoeckeler and Jones, 1957). Only the eight fields shown in Table 5 contain sufficient phosphorus ranging from 41 lbs/ac (field 3) to 88 lbs/ac (field 7). Of the recently-fertilized fields (Table 4) only fields 9, 10 and 11 contain adequate phosphorus.

The availability of phosphorus is lower in neutral and alkaline soils than in acid soils. Larger applications are necessary in alkaline soils to satisfy plant requirements and therefore acidification is of major importance.

Potassium

Table 5 shows that only seven fields have adequate levels of potassium (180 lb/ac.) for nursery-grown conifers (Stoeckeler and Jones, 1957). Fields 7 and 10 are again represented, indicating that, within the seedbed area, these fields are of the highest fertility. Figure 3 shows the ranking of the various fields as to their fertility status.

With the exception of field 16, the potassium-supplying potential of these soils is high. Potassium is easily leached from the root zone and would therefore tend to be low in irrigated sands. However, high potassium levels in fields 1, 6, and 8 (all unfertilized) indicate natural replenishment of exchangeable potassium by the minerals present.

TABLE 5. ADEQUACY OF N, P, AND K IN THE SEEDBED AREA OF THE NURSERY.

Adequate N 40 + lb/a	Adequate P 40 + lb/a	Adequate K 180 + lb/a
Field #	Field #	Field #
7 *	1	1
10 *	2	2
16	3	6
	6	7 *
	7 *	8
	9	10 *
	10 *	11
	11	

* Represented in all three categories and therefore of highest fertility.

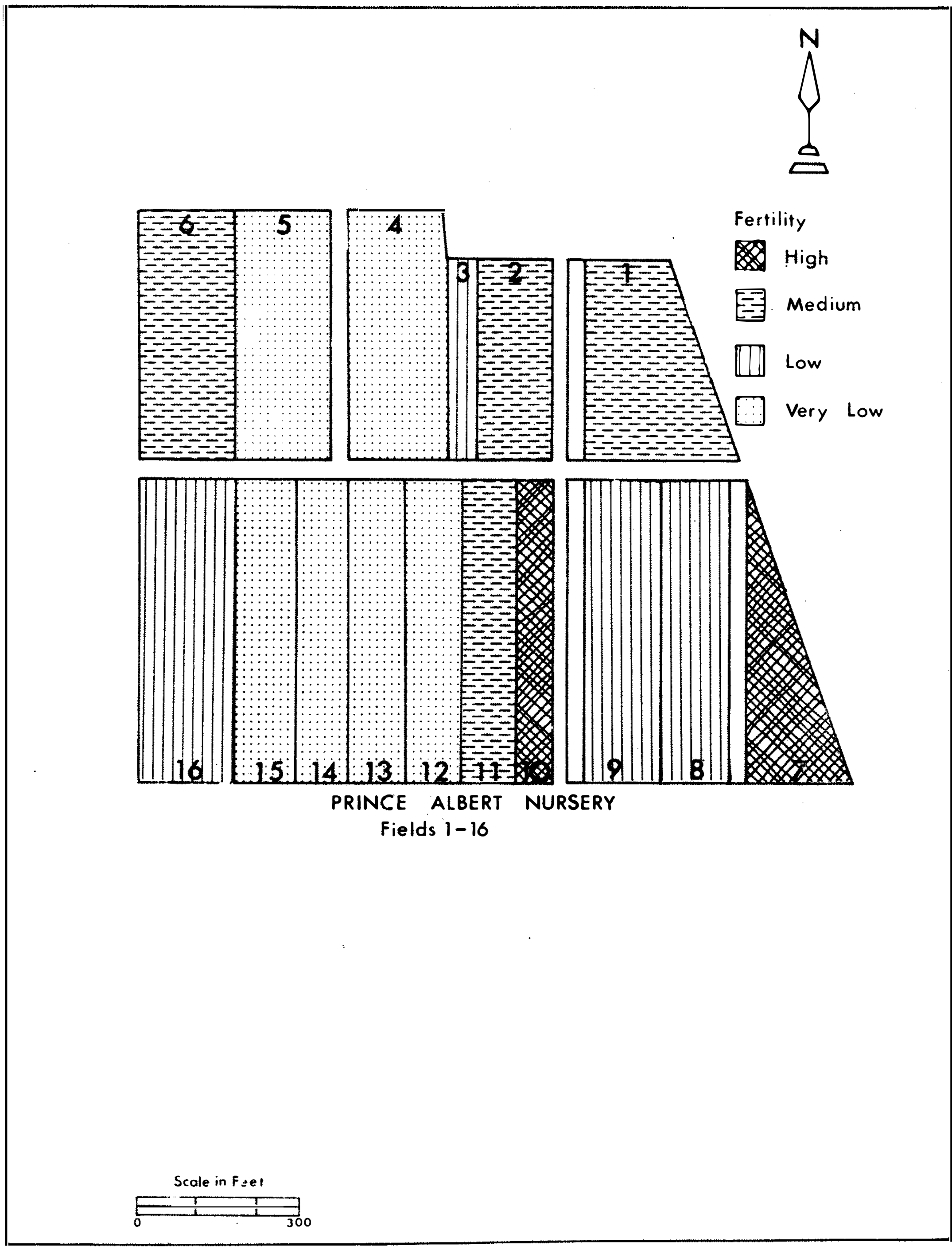

Figure 3. Fertility status of soils within the seedbed area.

PEAT ANALYSIS

Chemical Composition

Table 6 shows the results of analysis of peat being used at the nursery. It is moderately acid and low in soluble salts, nitrate nitrogen and phosphorus. The exchangeable bases are predominantly calcium and magnesium and since the cation exchange capacity is quite large (more than 106 me/100 g), mixing of the peat with mineral soil would be very beneficial. Also, the organic matter content is 50% and although it is only partially decomposed, its water-holding capacity is approximately 90%.

Effect on Water Holding Capacity

The effect of peat on water holding capacity of the mineral soil is shown in Table 7. Various amounts of peat were mixed with sandy loam and sands from fields 6 and 9, respectively. The data indicate that on the loamy soil, 9 inches of peat can more than double the available water, whereas the same amount applied to sandy soils gives a five-fold increase. The use of peat as an amendment to the nursery is well demonstrated.

QUALITY OF IRRIGATION WATER

The results of analysis of irrigation water from the nursery are shown in Table 8. The water is distinctly alkaline and of medium salinity hazard as indicated by electrical conductivity. Generally, conductivity values below 0.750 millimhos per cm are satisfactory for irrigation of most crops (United States Salinity Laboratory Staff, 1954). With the

TABLE 6. ANALYSIS OF PEAT IN USE AT PRINCE ALBERT TREE NURSERY.

pH	6.28
Elect. Cond. (mmhos/cm)	0.310
Nitrate - N (lb/acre)	16.3
Phosphorus (lb/acre)	2.0
Potassium (lb/acre)	428.8
Exchangeable Cations (me/100 g)	
Calcium	74.99
Magnesium	27.06
Sodium	1.20
Potassium	2.75
Moisture Content (%) at:	
Field capacity (1/3 atm)	247.31
Wilting Point (15 atm)	157.54
Organic Matter (%)	50.25

TABLE 7. EFFECT OF PRINCE ALBERT PEAT ON THE WATER-HOLDING CAPACITY OF THE SEEDBED AREA.

Mixture	Field #6[1] W.H.C. (%)	Field # 9[2] W.H.C. (%)
Peat only	89.77	89.77
Soil only	15.07	6.73
6" soil + 1.5" peat	21.04	7.48
6" soil + 3.0" peat	25.14	11.51
6" soil + 4.5" peat	27.84	23.33
6" soil + 6.0" peat	37.72	27.10
6" soil + 7.5" peat	39.11	29.39
6" soil + 9.0" peat	41.91	30.84

[1] Field #6 is loamy texture.

[2] Field #9 is sandy texture.

TABLE 8. CHEMICAL ANALYSIS OF IRRIGATION WATER AT THE PRINCE ALBERT TREE NURSERY

pH		8.00
Electrical conductivity (mmhos/cm)		0.744
Dissolved solids (ppm)		492
Hardness as $CaCO_3$ (ppm)		284
Alkalinity as $CaCO_3$ (ppm)		223
Calcium	(me/l)	2.12
Magnesium	(me/l)	4.19
Sodium	(me/l)	0.91
Potassium	(me/l)	0.17
Carbonate	(me/l)	NIL
Bicarbonate	(me/l)	4.38
Sulphate	(me/l)	2.85
Chloride	(me/l)	0.21
Residual sodium carbonate (me/l)		NIL
Sodium adsorption ratio		0.51

Date of Sampling: September 30, 1971

rapid drainage prevailing in most of the nursery, no adverse effects on conifer growth are foreseen.

The next important feature of the water is that its sodium hazard or sodium adsorption ratio,[1] 0.51, is low. If the proportion of sodium in the water relative to calcium and magnesium is very high, sodium accumulates in the soil resulting in poor structure and drainage. With the present salt concentration, the sodium adsorption ration could be as high as 6.0 without any sodium-related problems from the water. This is confirmed by the absence of any residual sodium carbonate[2].

Treatment of Irrigation Water

The high pH of the water is due chiefly to bicarbonate ion (HCO_3), and the pH can be reduced by neutralization. Because of the known preference[3] for aluminum sulphate as an acidifying agent, the salt, (reagent grade) was mixed in varying proportions with samples of the water. Table 9 shows the weight of salt added to the water and the corresponding pH. To reduce the pH to 6.1, it is calculated that about 5.0 lbs aluminum sulphate/1000 gallons of water are required. These values are intended only as guides since pH of the water supply changes from time to time and the formulation of industrial grade aluminum sulphate could differ from the reagent grade used in the laboratory.

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[1] Sodium adsorption ration = $\dfrac{Na}{\sqrt{\dfrac{Ca + Mg}{2}}}$

[2] Residual sodium carbonate = $(CO_3 + HCO_3) - (Ca + Mg)$

[3] Personal communication with Mr. F. Flavelle of the Saskatchewan DNR.

TABLE 9. EFFECT OF ALUMINUM SULPHATE (A.S.)[1] ON pH OF WATER FROM PRINCE ALBERT NURSERY.

St. A.S. per 100 ml water (gm)	Calcd[2] wt. A.S. per 1000 gal. water (lb)	pH
0	0	8.00
0.0250	2.50	7.05
0.0500	5.01	6.07
0.0750	7.52	4.70
0.1000	10.02	4.45
0.2500	25.05	4.20
0.5000	50.10	4.05

[1] Reagent grade with the formula $Al_2(SO_4)_3 \cdot 16H_2O$

[2] 4.5461 litres = 1 Imp. gal., 453.59 gm. = 1 lb.

Table 10 shows the effect of acidifying with aluminum sulphate on ionic constituents of the water. At a pH of 4.70, the bicarbonate ion is completely neutralized, but the sulphate ion increases accordingly to maintain ionic balance. The relative concentrations of the major cations are scarcely affected.

GENERAL OBSERVATIONS

Texture

Most of the seedbed area (fields 1-16) is sandy but there are areas of heavier-textured soil. Fields 6 and 16 are loamy on the surface but both are underlain at the 18 - 24 inch depth by clay horizons 6 - 12 inches thick. A similar situation exists in parts of fields 5 and 15. Besides the heavier textured soil in these four fields, carbonates are present in the surface horizons whereas in other fields, carbonates, when found, were at least 18 inches from the surface. Salt accumulation due to improper drainage should be anticipated for this smaller area. Less frequent irrigation should be necessary.

Compaction

Much evidence of compaction was found in fields 11 and 13 with a lesser amount in field 15. This was apparently caused by movement of heavy machinery over the beds. Soil compaction results in higher bulk density and reduced pore space. Drainage is impeded and root growth is restricted. Deeper plowing is necessary to break up dense, compacted layers.

TABLE 10. EFFECT OF ALUMINUM SULPHATE (A.S.) ON CATIONS AND ANIONS IN NURSERY WATER.

	A.S. not added pH of water = 8.00	0.075 gm. A.S. added to 100 ml water pH 4.70
Cations	me/l	me/l
Ca	2.12	2.04
Mg	4.19	4.27
Na	0.91	0.84
K	0.17	0.20
Total	7.39	7.35
Anions	me/l	me/l
CO_3	Nil	Nil
HCO_3	4.38	Nil
SO_4	2.85	7.12
Cl	0.21	0.26[1]
Total	7.44	7.38

[1] Reagent grade aluminum sulphate contains 0.003% chloride

RECOMMENDATIONS

1. At least six inches of peat (400,000 lbs/ac) should be plowed into the top 6 inches of soil. Fields 6 and 16 may be omitted.
2. To acidify the soils, plow into the top soil 0.5 tons sulphur per acre. Fields 6 and 16 may require up to 4 tons per acre. The latter application may be made over a two-year period. Maintain check on soil pH annually since acidic fertilizers will be applied.
3. Fertilization schedule

   (a) Application at seeding

   400 lbs/ac 11 - 48 - 0 Ammonium phosphate

   Mix into the topsoil just prior to seeding.

   (b) Application to 1 - 0 stock

   400 lbs/a 21 - 0 - 0 Ammonium sulphate

   200 lbs/a 11 - 48 - 0 Ammonium phosphate

   Water it into the soil after applying.

   (c) Application to 2 - 0 stock

   200 lbs/a 21 - 0 - 0 Ammonium sulphate

   100 lbs/a 0 - 0 - 62 Muriate of potash

A year's application may be split (over a 4-week period, for example) but should be completed by early July. After applying fertilizers, irrigate lightly to wash crystals into the soil. Annual applications are made to offset leaching losses due to irrigation.

4, Following lifting of seedlings, grow and turn under a green cereal or, preferably, leguminous crop. Summer-fallow for one year.

5. Sample soil for N-P-K check in the fall preceding the next seeding of tree crops.

6. Maintain a record of output of the irrigation system i.e. gallonage supplied, time period applied and area covered. For example, 22,650 Imperial gallons spread over an acre is equivalent to 1 acre-inch, but the rate of application should be carefully controlled to prevent undue leaching.

7. Install tensiometers at the 6- and 18-inch depths. Irrigate only when the soil moisture tension exceeds 75 centibars and cease application when the tension returns to zero.

8. Always irrigate intermittently. Frequent short wetting periods are more useful than lengthy ones. To avoid undue leaching it may be necessary to apply say an inch of water over 8 - 16 hours.

9. Acidify the irrigation water by dissolving 5 - 6 lbs of aluminum sulphate per 1000 gallons. Any precipitate should be filtered and the clear solution used. A storage tank fitted with a motor-driven propeller shaft may be suitable for mixing large volumes. This will help to maintain the increased soil acidity already being sought.

10. Maintain a check on the pH of the water supply before and after acidification in order that the appropriate adjustments may be made.

The foregoing recommendations have been made with a minimum of research data from the nursery and are subject to review and change as additional results become available from experiments now being planned and as the soil pH is lowered.

Soils from the seedbed area of the Prince Albert Tree Nursery (fields 1-16) were sampled and analyzed for physical and chemical constituents including nitrate nitrogen, phosphorus, and potassium. Most soils were low in nitrogen but they were more adequately supplied with phosphorus and potassium.

The peat supply at the nursery was found to be low in nitrogen and phosphorus but its use is beneficial because of its high water-holding capacity.

The irrigation water was very alkaline on account of the bicarbonate ion. However aluminum sulphate applied at a rate equivalent to 5.0 lbs/1000 gallons reduced the pH from 8.0 to 6.1.

A number of recommendations dealing with the application of peat, sulphur, fertilizers, and water were made.

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