NURSERY SOIL FERTILITY STUDIES - HAMEL NURSERY.

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SUMMARY:

A chemical study has been made of several groups of surface soils at Hamel Nursery. These soils ranged from virgin grassland soil adjacent to the nursery, to the old pine nursery beds.

The chief differences observed in the soils were that the nursery cropping has caused a decline in soil organic matter (as measured by organic carbon and nitrogen values), and this decrease in soil organic matter is accompanied by a decrease in the cation exchange capacity of the soil.

INTRODUCTION:

During April, 1958, a series of composite surface soils (0-4½") were collected from Hamel Nursery.

The samples were collected from the following areas in the nursery -

(1) Old pine nursery beds North of the shadehouse.
(2) " " " " " "
(3) " " " South " "
(4) Old deciduous stock beds North of the shadehouse.
(5) New pine nursery neds South of the shadehouse. (These had grown one crop of P. radiata).
(6) Virgin grassland soil adjacent to the nursery.

Three composite soil samples were collected from each area, each composite sample being the mean of nine individual samples collected with a constant volume soil sampler. All samples from West side of Samson Brook.

The samples were analysed at Dwellingup in an attempt to determine any changes in soil fertility which may have occurred as a result of the long term cropping for nursery stock.

The Soils.

The soils at Hamel are a black earth formed from alluvial deposits. Below the surface soil this sub-soil is very variable and ranges from a sand to an olive brown silty clay.

Analytical Data.

The analytical data for the six groups of soils is tabulated in Appendix (1).

(1) Mechanical Analysis.

The soils are moderately textured, being generally loams or silty loams. The main features of the mechanical analysis data is the high percentage of fine sand and silt, and this feature is usually characteristic of certain types of alluvial soils.

(2) Soil Reaction.

The soils are acid in reaction, with pH values ranging from 5.2-5.7. Apparently the nursery cropping has had no effect on soil acidity.

(3) Soluble Salts.

There are moderate amounts of soluble salts present in the soil, values ranging from 0.037% to 0.058%, but the nursery crops have had very little effect on the soluble salt concentration in the soil.

Water soluble chlorides (expressed as NaCl) are extremely low in all samples, being 0.001% in all samples.

(4) Organic Matter.

Organic matter, as measured by organic carbon and total nitrogen, is very high in these soils, even after long cropping. The organic carbon and nitrogen values range from 2.67 to 5.93% and 0.153 to 0.317% respectively.

There has been a marked change in soil organic matter as a result of the cropping rotations. Soil nitrogen has declined from 0.317% in the virgin soil to an average value of 0.186% in the old nursery beds. Similarly organic carbon values have decreased from 5.93% to 3.01% in the virgin soil and old nursery beds respectively.

This decline in organic matter is one of the biggest changes that have occurred as a result of the nursery cropping. Fortunately Hamel has a very big reserve of soil organic matter, but this loss of organic carbon could be a very important factor in forest nurseries where the original soil organic matter level is low.

(5) Exchangeable Cations.

The soils have a high cation exchange capacity (34.3 to 44.8 m.e.%), and are very largely base unsaturated.

Calcium is the dominant exchangeable cation, occupying 50 to 68% of the exchangeable metal ions. Magnesium is next in importance (16-39%), and this is followed by potassium (5-14%). Exchangeable sodium is very low in all soils.

The nursery cropping has caused a decline in the cation exchange capacity of these soils from 44.8 m.e.% in the virgin soil down to an average value of 37.2 m.e.% in the old beds. This decline in cation exchange capacity is considered to be due to the decline in soil organic matter, as this material has a very high exchange capacity.

The exchangeable cations show considerable changes, both in amounts and percent composition as a result of the various rotations. (Table 1.)

Exchangeable Cations. Table 1.

	Old Nursery Beds				Virgin Soil	
	Conifer		Deciduous			
Ex. Ca^{++} m.e.% + %	4.0	65	8.0	60	4.5	50
Ex. Mg^{++} " "	1.4	23	1.5	22	3.6	39
Ex. K^{+} " "	0.48	8	0.59	14	0.54	9
Ex. Na^{+} " "	0.27	4	0.15	4	0.22	2
	6.15	100	10.24	100	8.86	100

The most noticeable changes are the increase in exchangeable calcium in the deciduous stock beds, and the decline in exchangeable magnesium in all beds as a result of cropping. From the data in Appendix (1) this decline in exchangeable magnesium appears to take place very early in the history of the beds.

It was also observed that there is an increase in total exchangeable cations under the conditions of cropping in the deciduous beds, but further sampling is required to verify this point.

Discussion.

From the chemical data it appears that the most important change in the Hamel Nursery soils due to the cropping rotations used has been a decline in the soil organic matter. This decline in organic matter represents a loss of some 2,000 lbs. of nitrogen per acre 4½ inches.

In addition to the direct loss of organic matter which is the cause of the decline in cation exchange capacity, there are other effects which can be very important in the management of the nursery soil. The chief of these is the effect on soil structure, which has not been dealt with in this report. Soil organic matter plays a very important part in the maintenance of good soil structure, and the decline in organic matter may be one of the causes of the increased clod structure in the old nursery beds at Hamel. A further set of samples have been collected to investigate any changes in soil structure that may have occurred in the old nursery beds.

APPENDIX I.

HAMEL NURSERY

Mechanical and Chemical Analyses

	Old Conifer Nursery Beds			Old Deciduous Nursery Bed	New Conifer Nursery Beds 1 crop	Virgin Soil Grass Land
	1	2	3			
Depth (ins).	0 - 4½"	0 - 4½"	0 - 4½"	0 - 4½"	0 - 4½"	0 - 4½"
Physical Analysis.						
Gravel %	-	-	-	-	-	-
Coarse Sand %	25.4	22.9	16.2	25.3	18.0	25.3
Fine Sand %	30.1	30.5	39.7	32.3	37.8	27.1
Silt %	23.9	22.8	29.5	25.2	26.7	23.8
Clay %	20.6	23.7	14.6	17.3	17.4	23.8
Texture (Triangle)	S.L.-L.	S.L.-L	S.L.	S.L.-L.	S.L.	L.
Chemical Analysis.						
pH	5.3	5.4	5.4	5.7	5.2	5.6
Total Soluble Salts %	0.037	0.039	0.057	0.068	0.041	0.058
Chloride (NaCl) %	0.001	0.001	0.001	0.001	0.001	0.001
Loss on Ignition %	12.40	13.00	15.10	12.70	16.2	16.1
Air Dry Moisture %	4.50	4.60	5.40	4.60	5.0	5.6
Organic Carbon %	3.01	2.93	3.43	2.67	4.38	5.93
Nitrogen %	0.166	0.153	0.229	0.197	0.321	0.317
Exchangeable Cations.						
Calcium m.e.% & %	3.8 68	4.6 65	3.5 61	8.0 75	2.6 60	4.5 50
Magnesium m.e.% & %	1.2 21	1.9 26	1.2 21	1.5 16	1.0 22	3.6 39
Potassium m.e.% & %	0.36 7	0.37 5	0.70 12	0.54 6	0.59 14	0.54 9
Sodium m.e.% & %	0.20 4	0.28 4	0.33 6	0.26 3	0.15 4	0.22 2
Hydrogen m.e.%	28.7	27.7	36.1	27.3	37.7	35.7
Cation Exchange Capacity m.e.%	34.3	34.8	41.9	37.6	42.3	44.8
Saturation %	16	20	14	27	10	21

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