Forestry in the Netherlands

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IN the course of a recent study tour in the Netherlands, I collected some data on forestry and forestry fertilizer research in that country which may be of some interest to our members.

Out of a total land area of some 8,900,000 acres (roughly half the size of the 26 counties), there is a woodland area of 642,000 acres. Thus 7.2% of the Netherlands is under forest compared with about 2.2% here at home.

The area of State forest is 126,000 acres, which represents 19.5% of the total wooded area. Private forestry predominates in the Netherlands and accounts for 58% of the total area classed as forest. The private woods are mainly small plots of less than 10 acres in size, but there is a number of large private forest properties. The average size of forest unit held in private lands is a little over 20 acres, while the average state forest unit is around 1,000 acres. Municipality forests account for 15% of forest area and about 7% of 42,000 acres are held by societies for nature conservation.

The State Forestry Service, which is a branch of the Ministry for Agriculture and Fisheries, has its headquarters at Utrecht. Under the Director of State Forests, who is assisted by a Deputy Director, there are in addition to the Secretariat and Administration Section, four main sections, each under a Forestry Inspector, as follows :—

(1) Forest Management, which administers some 110,000 acres of State forest and 75,000 acres of waste land.

(2) Forestry Advisory Section, which deals with statistics, publicity and propaganda, nurseries, seed control and direct advisory work on 50,000 acres of private or other woods and 12,000 acres of waste land.

(3) Nature Conservancy Section. This section deals with recreation facilities in the forest and runs the Institute for Nature Conservation Research.

(4) Landscape Planning Section. Landscape gardening is an important feature in the Netherlands and the general planting of the countryside, for protection, amenity, together with the planting of public roads, is part of the responsibility of this section.

In all, about 35% of the nation's woodlands are managed or are directly advised by the State Forestry Service, which has 58 Forest Officers, nearly all graduates of the Agricultural University of Wageningen. There are 184 foresters in the Service. The foresters are recruited from the Netherlands Heath Company, School for Foresters, Arnhem.

There are many openings for forestry graduates and foresters outside the state service—in the municipal, company and crown forests, on private estates and as forestry consultants. The various research

institutes also employ forestry graduates, as at the Forestry Institute at the Faculty of Agriculture, Wageningen, The Forest Research Institute, Wageningen, Division for Forest Soil Survey, Bennekoin, The Polders' Development Authority, and so on. Graduates in forestry have gone into the nursery, landscaping or timber utilization fields and others find openings abroad, in the East Indies with bodies like F.A.O. There seems to be no shortage of employment opportunities for Netherlands trained professional foresters, which fact speaks well for the excellence of their training.

As is to be expected in a country so thickly populated and where agriculture of the most intensive kind is practised, forestry is concentrated on the poorer quality lands. While woodlands are scattered fairly widely over the whole country, the central region of the country—east of a line from Amsterdam to Utrecht and west of a line from Zwolle to Apeldoorn and Arnhem and north of the Rhine river—holds the greatest concentration of forest proper, as distinct from the small woodlot which is a universal feature. The east and south-east are generally heavily wooded, particularly the regions bordering Germany on the east and south-east and also along the Belgian frontier.

These forest concentrations coincide closely with the poorer heath land regions, with soils variously classed as humus podsols, humus iron podsols, inland dunes or blown sands. On this hungry light type of soil, as one would expect, there has been a concentration on afforestation with Scots pine in the past. The significance of Scots pine in Netherlands forestry can be seen from the following tables of statistics.

Classification of Woodland.

Type	*Area*	*% of Woodland Area*
Conifers	395,000 Acres	62%
Broadleaved	71,700 ,,	11%
Mixed	39,500 ,,	6%
Non-Productive	54,400 ,,	9%
Coppice	54,400 ,,	9%
Willow beds	9,900 ,,	1%
Felling Area	12,400 ,,	2%

In addition there are 31,000 miles of line plantation—mainly poplar and oak—which are rated as equivalent to nearly 100,000 acres of woodland in productivity.

Classification of Coniferous Plantations.

Type	*Area*	*% of Coniferous Area*
Pine	303,800 Acres	77%
Spruce	24,700 ,,	6%
Larch	34,600 ,,	9%
Douglas Fir	32,100 ,,	8%

ESTIMATED YEARLY PRODUCTION
(under bark) Hoppus Measure

	Woodlands		Line Plantations		Total	
	Conifer	Broad-leaved	Conifer	Broad-leaved	Conifer	Broad-leaved
Commercial Timber	11,000,000	3,000,000		4,000,000	11,000,000	7,000,000
Firewood ...		1,500,000				1,500,000
TOTAL	11,000,000	4,500,000		4,000,000	11,000,000	8,500,000
GROSS TOTAL ...	15,500,000 (H.ft.)		4,000,000 (H.ft.)		19,500,000 (H.ft.)	

Growing Stock of the Woodlands (*Hoppus feet over Bark*).

Conifers	416,000,000
Broadleaved	55,500,000

Current Annual Increment of the Woodlands (*Hoppus feet over Bark*).

Conifers	23,580,000
Broadleaved	6,930,000

The Annual Increment appears to be practically double the yearly felling—which is probably due to the fact that a large proportion of the Coniferous area is still immature and growth under those circumstances normally greatly exceeds cut.

From these figures of coniferous acreage and annual growth, it is possible to deduce a figure for production per acre per annum.

On 395,000 acres, annual production is 23,580,000 Hoppus or 60 Hoppus feet per acre per annum.

This rather low yield may be attributed to the predominance of Scots pine in the plantations, to the poor quality of the soil and to the low rainfall.

The forest soils have been mapped and are broadly classed as follows :—

Dry podzolics	35%
Wet podzolics	25%
Brown podzolics	10%
Dunes and blown sands	25%
Clay, loess and peat	5%

The average rainfall is from 24″ to 32″ per annum.

These low yields from their coniferous plantations have presented the Netherlands' foresters with a challenge which they are meeting in a typical fashion. It is recognised that the low yields are associated with poor physical conditions of the soil—low rainfall, unsuitable tree species or strains and to a very great extent the low nutrient status of the afforested sites. They are attacking the problem of increased output mainly along the lines of improved selection of species (including greater concentration on Douglas fir and less on Scots pine), tree breeding, better thinning and silviculture (based on tree physiology studies) and most of all by studying the use of fertilizers in forestry.

Experiments in the use of fertilizers in forestry in the Netherlands go back to the beginning of the century. In this first period trials were mainly in Scots pine stands but the statistical analysis of these earlier trials failed to reveal any significant or reliable results. Research was taken up again in 1954 but on a more fundamental basis, with the main emphasis on tree physiology and its bearing on the relationship between growth and mineral nutrition of conifers. The new research tools, pot cultures, soil mapping, soil and foliage analysis, promise rapid and reliable information on this vital field of forest production. This type of research has been fruitful in the Netherlands in other fields and in forestry valuable studies have been made.

In approaching this question of fertilizers in forestry, it has been found that the following problems have to be tackled separately:

(a) The relationship between soil chemical factors within certain soil type units and the growth of different tree species.

(b) The nutrient economy of the plant and the effects of nutrients on growth.

(c) The influence of fertilizer applications on the nutrition and growth of plants.

(d) The interaction of the site and the fertilizer on the growth and nutrition of the trees.

These four main problems must be solved before any exact basis for quantitative fertilizer recommendations can be established.

Summary of Results of Fertilizer Trials and Research.

From the hundreds of trials with fertilizers in forestry—in the Netherlands—the following can be deduced: soil phosphate is of major significance, particularly with spruce, larch and Douglas fir. Due to the mycorrhizal equipment of forest tree roots and the long growing season enjoyed by conifers, the insoluble and poorly soluble phosphates are largely available to forest trees. Therefore, extraction with strong acids have given the best indicator values for phosphate availabilities. The Netherlands' workers measure the ratio of total phosphate in mg./100 grams of soil in the main rooting zone. There is a very good correlation between total P_2O_5 content and Quality Class of site for larch and Douglas fir. The minimum level for these species is around 20 mg./100 grams of soil in the case of humus podsols; P_2O_5 in excess of 60 mg. brings no further improvement. On humus iron podsols, figures in excess of 40 mg. of P_2O_5 show no further improvement in site quality. It has been found impossible to get correlations with Scots pine as the whole problem is so confounded with questions of provenance.

When taken within the framework of soil type and P_2O_5 status units, pH values have some influence, however weak, and indicate, if anything, that conifers are acid lovers.

It has also been established by workers in the Netherlands and elsewhere that there is a definite correlation between the N content of needles and growth; at least where there is no phosphorus deficiency present. The limiting values are given lying between 0.9% and 1.7%. If phosphorus is deficient there is a correlation between growth and N/P, with a definite optimum for Douglas fir of 10 and for larch 6. A deficiency of K in the needles, has so far not been found to influence the correlation established between the N content and growth. The K content of needles depends largely on the K content of the soil, unless a disturbing factor like too high pH is present. An improved K supply results in a more effective photosynthesis.

It seems that P influences the absorption capacity of the root system of the tree and, therefore, the uptake of both K and N. With improved P availabilities up to a given limit, there will be an increasing uptake of other plant nutrients, such as K and N.

On the other hand, the P content of the needles does not rise with increasing levels of P in the soil or only when there is a P deficiency. There is, in fact, a tendency for the P content of needles to fall due perhaps to what is called volume antagonism. The P content of needles is, therefore, no criterion of P requirements.

While the nitrogen and potash requirements of the trees are determined by their presence in the soil, phosphate has a decisive influence on the optimal uptake of these plant foods.

To sum up—

(a) Of all the plant foods in the soil, P plays the key role in the nutrition and growth of trees.

(b) There is a close correlation between growth and N content of tree needles, *if there is no P deficiency.*

(c) There is a positive correlation between the K content and the N content of tree needles, if N has not been applied as a fertilizer.

The results of the fertilizer researches in the Netherlands have shown to date that *Pinus* species have lower P requirements than Douglas, larch or spruce. Pines and larches require less nitrogen than Douglas and spruce. Douglas and pine seem to require more potash than spruce and larch.

The influence of fertilizer application on the nutrition of forest crops is particularly interesting.

On the one side, the phosphate content of the soil, which can be permanently improved by manuring, is vital for the adequate uptake of other nutrients; on the other, improved potash availability makes for an improved nitrogen economy in the plant in the long run. Nitrogenous fertilizers, on their own are only useful as boosters as in the nursery but, in combination with potash, they can have more lasting

effects. It appears then that phosphatic and potash manures have important roles in forest fertilization.

Finally, what about the prospects for soil asalysis as a simple key to forest tree nutrition. They do not appear to be promising. With close attention to soil classification or site mapping, some results of manurial trials can be forecasted when combined with chemical analysis of soils. A very great deal of work still remains to be done on the many and variable sites that come up for tree planting. The Netherlands research workers are now tackling this problem by laying down factorial N,P,K trials on the various site types. It will require hundreds of plots and many years must elapse before the results are to hand.

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The material on forestry manuring in the Netherlands is my own translation of a paper entitled "Forstliche Düngung in den Nederlanden" by I.R.C.P. van Goor, Wageningen.

Footnote.

The Netherlands is indeed well worth a visit from a forestry point of view. There is scarcely any forest area anywhere in the world so well surveyed, mapped and recorded, as are the forests of this very progressive country. The research in thinning, tree breeding, manuring, is of direct interest and application here, the mechanisation of nursery work, draining, planting and grass cleaning, particularly in the Polder areas, is in advance of anything I have seen this side of the Atlantic. It is a most stimulating country for a forester to visit; here "A living nation builds for its future" in agriculture, in forestry, in education, in industry, in good neighbourliness. It is a country small in size but great in achievements. It is also a country where, if my experience is typical, there is a brand of hospitality, kindness and welcome that one would like to commend as the equal of our own, but in these fields, as in many others, we have to give first place to the Dutch.