

Progress Report on Research: November 1933.Nursery Investigations.

The climatic feature of the year has been the prolonged drought and high temperatures experienced during the summer. Germination was however good generally in Scotland. At Kennington March sowings germinated well but seed beds sown in April and May have mostly made a poor showing.

Three of the experimental projects have given results of considerable interest.

1. Weed Control. Experiments were carried out in 4 nurseries in Scotland and in 6 nurseries in England and Wales using different strengths of Sulphuric acid. The effect of the acid on germination varied with the species of seed sown and the nature of the soil; in general there have been no ill effects in the better soil nurseries, but germination was seriously affected in some of the sandy nurseries notably Clipstone (Corsican pine), Haldon (European larch), Altonside and Auchterawe (European larch, Scots pine and Sitka spruce). In almost all cases weeding costs have been drastically reduced. The most striking results have been obtained at Benmore where the controls took 240 minutes per 100 sq.ft. to weed, while the acid treatment reduced the time to only 38 minutes, i.e. a saving of nearly $3\frac{1}{2}$ hours work per 100 sq.ft. of seed bed. The best results having regard to germination as well as weed control were obtained with a strength of 1 in 110 Sulphuric acid applied at the rate of 2 gallons per square yard 7 days after sowing. It should be observed that the abnormally dry summer provided the severest possible test for the acid treatment. The conclusion is that the method is generally applicable except on very sandy nursery soil.

A preliminary weed control experiment, using dilute Sodium chlorate solution applied to a seedbed of Sitka spruce, gave very promising results at Kemington Nursery. One half per cent and one per cent solutions were sprayed over the surface of the bed 12 days after sowing, at the rate of 1 pint per square yard. The soil was very dry at the time of application. The first two weedings in the control took 85 minutes of work per 100 sq.ft. as against only 17 minutes for the $\frac{1}{2}\%$ and $2\frac{1}{2}$ minutes for the 1% sodium chlorate treatments. The chlorate evidently disappeared quickly from the soil for the third weeding took about the same length of time (50 minutes per 100 sq.ft.) in the treated as in the untreated plots. The germination was appreciably higher in those plots to which sodium chlorate had been applied. These results are considered to be of some importance because there are possible objections to the use of sulphuric acid in nursery soils, also relatively large quantities of water are required which runs up the cost. The chlorate treatment, if this year's results can be confirmed, will be cheaper to apply and there should be less risk of harm being done to the soil.

2. Stratification of Seed.

Last year's experiment on stratification was repeated with certain modifications. Douglas fir gave virtually the same result as before, i.e. a poor germination from normal sowing in the spring, but excellent germination from autumn sowing or from stratification in sand at the end of January. Other methods of stratification were either harmful or only slightly beneficial.

See Table.

<u>Treatment.</u>	<u>Germination per cent.</u>
Normal spring sowing.	15
Autumn sowing	68
Stratification in sand in January	67
" " " in Autumn	8
" " " peat " "	32
" " " " January	0 ^x

^x Failure probably due to fungi attacking the seed.

Birch stratified in sand or peat in February showed a twenty-fold increase in germination as compared with dry sown seed. On the other hand stratification was definitely harmful to seed of Sitka spruce and Corsican pine and without apparent effect on Japanese larch.

3. Methods of covering seed.

Three grades of sand were used in four nurseries in Scotland and tested in each case against nursery soil. The source of the sand and grit used for covering was the same at Altonside and Newton, but different at Auchterawe and Inverleith.

<u>Species.</u>	<u>Nursery.</u>	<u>Yield of Seedlings per lb (1000 s)</u>			
		<u>Nursery Soil.</u>	<u>Fine Sand.</u>	<u>Medium Sand.</u>	<u>Coarse grit.</u>
European larch	Altonside	4	8	8	8
	Auchterawe	45	51	47	43
	Newton	4	8	4	6
	Inverleith	12	13	12	10
Sitka spruce	Altonside	6	78	18	36
	Auchterawe	92	101	83	101
	Newton	20	39	28	32
	Inverleith	37	70	63	40

Fine sand has given the best results and at Altonside has made an astonishing difference to the yield of Sitka spruce seedlings (from 6,000 to 78,000 seedlings per lb of seed sown.) By covering with fine sand the yield has been doubled or more in 5 out of the 8 experiments. It should be observed that in all cases the beds were rolled after covering.

II Plantation Experiments.

(1) Peat Soils. *Alnus oregona* continues to make good growth at Inchnacardoch. The slagged Japanese larch in Achnashellach 9 P.28 are now in canopy and presumably the crop can be regarded as successfully established, the unslagged controls continue to make slow progress.

There is increasing evidence to show that a single dose of basic slag applied to Sitka spruce at the time of planting is not going to keep the plants growing vigorously on *Scirpus-Calluna* peat, after 4 or 5 years growth falls off again badly. The

effect of Semsol appears to be more lasting than that of basic slag. Sitka spruce are doing very well in slagged groups on partly flushed ground at Glenrigh. The Beddgelert peat areas are generally promising, Sitka spruce is checking only on relatively small areas of bad Scirpus and here basic slag is giving good results.

An experiment on the lifting of checked spruces at Inchnacardoch (lifted in P.32) again gave indifferent results, losses ranged from 20 to 30% and the survivors show little signs of improvement.

(2) Upland Calluna Soils. The P.31 and 32 experiments on deeply ploughed ground at Allerston are looking extremely well. Two year seedling Sitka spruce planted in 2-furrow ploughing in 12 P.31 have put on shoots up to 30 inches in length. The broom hedges are now 5 feet high and provide excellent shelter, Sitka spruce was introduced between the broom rows in P.33. In general P.33 planting has been successful.

The results at Harwooddale are encouraging, Pinus contorta, alder and Scots pine are the most promising species at present.

At Teindland both Sitka spruce and Pinus contorta, planted in P.27 and P.28 on ploughed and slagged ground have grown well. The spruce are from 2 to 5 feet in height but on the whole the shoots are shorter than last year and the colour not so good. Heather has strongly invaded the soil and the grasses which appeared at first as a result of the slagging are dying out. There is a distinct possibility that the plants may go back again into check but equally the fall-off in growth may be only temporary. So far Pinus contorta is the most promising species.

(3) Dorset Heaths. P.33 planting and sowing on ploughed ground at Wareham has done well in spite of the drought. It was found that by running the caterpillar tractor up and down the furrows after full ploughing level strips were formed which could be satisfactorily sown with a Planet Junior seed drill. The cost of

preparing the seedbed and sowing worked out under 10/- per acre; a fair germination of Corsican pine was obtained. One-year seedlings of Japanese larch slaggd when planted have done well for the second year in succession. *Pinus radiata* is outstanding among the direct sown pines as regards growth in the second year.

(4) Thetford Chase. ~~Beech~~ planted in P.33 under Scots pine of 6 to 8 feet in height suffered only 4" of casualties while those planted among Scots pine of 3 to 4 feet in height lost 50% from frost and sun scorch. Much the same result was obtained in previous years and it seems clear that the pine does not function successfully as a nurse for tender species until it is about 6 feet high, with the crowns just beginning to meet.

(5) Chalk Soils. The beech plants introduced in P.33 among plots of grey alder at Buriton have taken fairly well and are putting on shoots of 2 to 4 inches. The ash planted in one of the alder plots have started well, there have been no failures and the plants have put on shoots of 1½ to 8 inches. The alders are continuing to grow strongly. At Priston the beech are making excellent progress without nurses, while the alders and other species planted as nurses are still very backward and poor.

(6) Loam and Clay Soils (Hardwoods). In the Forest of Dean area the most interesting result is the response of ash to hoeing. There are two experiments, in one of these improved growth showed itself in the hoed plots in the third year after planting and in the other in the second year. In the latter experiment the plants put on shoots of up to six feet in length in 1933. It should be added that the unhoed plots have mostly done quite well though growth has not been so spectacular. All the oak plots in the Dean and at Dymock are making satisfactory growth. Experiments at Drayton in Northamptonshire on choice of species for planting on heavy clay soils are beginning to show interesting results, *Thuja* and *Muga* have done badly especially the latter. *Pinus contorta* has made the best growth and shows the fewest

losses. Other good species are Scots pine, Norway Spruce, *Alnus oregona* and *Alnus incana*.

Rooted cuttings of poplar planted in P.32 on mounds at Yardley are beginning to show signs of growth.

Field Work in hand during P.34. Planting Season.
England and Wales.

Allerston. Repetition of trial of broom seed. Trial of various species, Horse chestnut etc. Repeat comparison of seedlings and transplants of J.L. and S.S.

Harwooddale. Repeat experiment on methods of planting.

Clocaenog. Repeat work on intensity of drainage. Comparison of basic slag and semsol. Extend the nursery experiment on the spacing of spruce seedlings in bedding out work.

Wareham. Repeat experiment on direct sowing. Trial of alder in mixture with spruces. Repeat comparison of seedlings and transplants of J.L., S.S., and S.P.

Buriton. Interplant alder plots with beech. Trial of *Pyrus intermedia*.

Thetford. Continue underplanting of Scots pine with beech. Repair species plots at Lynford and Olby.

Drayton. Repeat species experiment.
Repeat stump planting of oak and alder.

Forest of Dean. Repair Walnut experiment.

General. Continue Beating-up Investigation. Races experiments.

Scotland.

Teindland. Trial of Henderson Plough and draining machines. Sowing of broom on ploughed ground with slag and semsol.

Inchnacardoch. Small scale experiments with basic slag and

other phosphatic manures.

General. Continue Beating-up investigation. Study of root development of pine and birch on leached mineral soils, especially with regard to the supposed soil improving properties of birch.
Preparation of publication on the Crown Plantations of Hafod Fawr and the Isle of Man.

III. Sample Plot Work.

From January to October 1933 39 sample plots were remeasured; of these 33 were in England and Wales and 6 in Scotland. In addition new plots were established, namely four Japanese larch and one Sitka spruce at Hafod Fawr; one Japanese larch at Llandinam, and two Corsican at Sherwood. One Norway spruce at Douglas, Lanarkshire, had to be abandoned owing to windblow.

The Japanese larch plots at Hafod Fawr form an interesting series as regards elevation above sea level. The respective elevations are 750 ft., 1100 ft., 1250 ft., and 1480 ft. In the highest of these plots the trees are 28 years old, average 27 ft. in height and carry a volume of 1200 cubic feet per acre. The plot at 1100 feet elevation is 44 feet in height at 26 years with a volume per acre of 1750 cubic feet. All the plots have suffered from lack of thinning.

V. Research Work at Aberdeen. Dr E.V. Laing and Mr G.K. Fraser.

Dr Laing is starting a new investigation on the root and shoot development of European larch with special reference to planting and the avoidance of losses consequent upon spring drought. In this work periodicity of root growth will be studied, also the question of storage of food materials, as well as the effect of various methods of treatment such as wrenching, autumn lifting etc., upon root growth.

Mr G.K. Fraser, working in collaboration with one of the students of the Macaulay Soil Research Institute at Aberdeen has

carried out during the summer a fairly detailed soil and vegetation survey of Durris Forest in Lower Deeside. The intention is to use this intensive survey as a basis for more general forest soil investigation and to help to determine the deficiencies of poor quality planting ground. In studying the soil samples collected Mr Fraser will concentrate on the properties of the humus layer.

V. Mycorrhiza Research.

Dr M.C. Rayner.

The pot culture work with Wareham soil, carried out by Dr Rayner at Bedford College is giving interesting results. The trouble at Wareham, probably also in other poor Calluna soils, seems to be due not so much to a lack of the necessary mycorrhiza-forming fungi, as to the presence of certain conditions which prevent these fungi from functioning normally. In pot cultures these inhibiting conditions can be almost entirely removed by mixing the soil with about one quarter of its bulk of a compost prepared from dried straw or from sawdust. The nature of the changes brought about by the compost is under investigation.

VI. Research on Vole Disease.

Dr C. Elton.

Dr G.M. Findlay of the Wellcome Research Institution has succeeded in transmitting a disease obtained from field voles to laboratory voles. This disease has been found to be due to a protozoan parasite infecting the brains of the voles and the organism has been named Toxoplasma microti. It is believed that the disease is spread in the case of field voles by contaminated food.

Much work remains to be done before this discovery can have any practical applications.

VII. Advisory Committee on Forest Research.

Professor J.H. Priestley, D.S.O., Professor of Botany at Leeds University has been appointed to the Committee. The research programme was discussed at a meeting held in London on May 5th, 1933. A field meeting was also held in the Forest

of Dean in the latter part of September when experimental work in progress was inspected.

VIII. Mycology. Mr W.R. Day and Mr T.R. Peace.

(1) Meria laricis. This year the control obtained by the use of the sulphur spray was again satisfactory. Work on the disease is now virtually completed.

(2) Elm Disease. A survey was carried out in September. The result shows that the disease is making little progress either westwards or northwards. In general the attack this year has been more severe than in 1932 but the position remains better than it was in 1931.

(3) Damping-off. Interesting results have been obtained from the pretreatment of seed with sterilising agents such as formaldehyde and cresylic acid.

(4) Frost Investigation. A good deal of work has been done but the data have still to be worked up.

(5) Heart Rot in Conifer. A beginning has been made with this work. So far Fomes annosus has been the organism isolated in most cases from the material sent in.

(6) Ink Disease of Chestnut. Mr Day takes rather a serious view of this disease. A tour of the areas where the disease was known to exist was made this summer and in each case it was found to be apparently spreading. It has now been found in Devon, Somerset, Herefordshire, Hampshire and Buckinghamshire, and is no doubt present elsewhere. This is believed to be one of the most important of the diseases affecting the roots of broadleaved trees.

IX. Entomology. Dr R.N. Chrystal and Mr J.M.B. Brown.

(1) Pine Beetle. Mr H.S. Hanson of the Farnham House Laboratory has spent a large part of the summer in the New Forest investigating this insect together with its predators and parasites. Experiments with billet - traps have shown that rough barked

billets attracted six times as many beetles per square foot as smooth barked billets. It is proposed to make a sample census of the insect population this winter.

Mr Hanson also visited pine woodlands on the Seafeld Estate round Grantown-on-Spey. He found evidence of a fairly strong resident population of pine beetle (Myelophilus) but no appreciable damage in any of the woods. While the system of leaving the woods unthinned provides an ample supply of material in which Myelophilus can breed freely, the conditions also favour the maintenance of a large population of predators and parasites and the result would appear to be a state of more or less stable equilibrium between Myelophilus and its predators etc. On the other hand the bark beetle, Hylastes ater was found to be doing a considerable amount of harm, the insects boring into the base of the stem, and the roots, weakening or killing large trees. This is considered to be related to the lack of thinning, the almost complete lack of breeding material on the surface forcing the Hylastes to breed in the roots of the standing trees, where they are relatively inaccessible to the predators.

It is hoped that the investigation in the New Forest will indicate the best method of treating pine woods so as to prevent serious insect damage.

(2) Pine Shoot Moth. Further work has been done on the disbudding of pines in autumn. There is now conclusive evidence that this method of control is ineffective and should be abandoned. The alternative method of disbudding in spring is still under investigation.

The collection of information as to the status of the pest in East Anglia has yielded interesting results. Over 200 Compartments in Thetford, Swaffham and Rendlesham Forests were visited and 160,000 trees classified. The results may be briefly summarised as follows :-

- (1) None of the plantations P.22 to P.29 is free from attack.
- (II) The existing Scots pine belts and hedges are considered to be the chief source of infection of young plantations.
- (iii) The attack is below average intensity in areas where the pines are growing strongly and also in mixed plantations of Scots pine and Corsican pine. It is worst when the growth is poor.
- (iv) The older plantations show in most cases a surprising recovery from the effects of attack.
- (v) Corsican pine is relatively immune from injury. The percentage of infection is about the same as that of Scots pine but a large proportion (80% in a batch of trees kept under observation) of the caterpillars die without appreciably injuring the buds.

(3) Oak leaf Caterpillar. The attack of oak tortrix was considerably worse this year in the Forest of Dean than it was in 1932 but was still chiefly restricted to certain inclosures. The Highmeadow Woods were virtually untouched. Winter Moth, which was so prevalent a few years ago, has almost disappeared, but on the other hand the Mottled Umber Moth has increased in abundance and is doing a considerable amount of defoliation, there is some evidence however to show that parasites are beginning to gain the upper hand of this pest. With regard to 1934, another serious outbreak of oak tortrix is threatened but whether it will develop seems to depend largely on the time relation between the flushing of the buds and the hatching out of the caterpillars.

(4) Chafer Larvae. During the summer observations have been made at Lynford Nursery on the flight periods of the different chafer beetles, where they lay their eggs, the population of larvae in the soil, and the relative amounts of damage done.

From the point of view of actual damage Rhizotrogus was found to be the most important species at Lynford this year, but as a whole the losses were not serious. It is believed that a close study of the egg laying habits of the beetles may suggest cultural measures for minimising the attack. Other nurseries will be visited in the spring of 1934.