

PROVENANCE TESTS OF COMMON EXOTICS IN THE NORTHEAST

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Introduction.--The exotic trees most commonly planted in the Northeast have been Scotch pine (Pinus silvestris), Norway spruce (Picea excelsa) and European larch (Larix europaea). The reason these species found favor early in the last century is not far to seek. Local planting stock was not available and seedlings (largely from the great commercial nurseries near Halstenbek, Germany and possibly also from Holland) could be imported more cheaply than they could be grown here. Norway spruce trees were commonly sold in southern New England as much as a century ago. It is said that when a newly married couple moved into a house, two Norway spruce trees were planted on either side of the doorway. Many such trees can be seen today. Larger numbers of these trees were planted around estates, cemeteries and in parks. It would be interesting to know the source of the seed from which these plantations grew.

Later, true forest plantations were established with imported stock and it was thus that white pine blister rust is reported to have been introduced on imported white pine seedlings. The exotic conifers appeared to offer many advantages. Scotch pine grows well on the driest and most sterile sites. Norway spruce exceeds native spruces in growth and yield on good soils and European larch appears to be the only conifer that can keep ahead of the competition of hardwood sprouts when planted on cutover land.

The almost invariable poor form of Scotch pine, susceptibility of Norway spruce to white pine weevil and bud gall, and the preference of porcupines for larch has still not ruled out these species for commercial planting. Scotch pine has been in demand for Christmas trees in some areas and weevil damage to Norway spruce has not proved a lasting detriment since the trees readily outgrow the injury and most of the crook is lost by middle age.

Following the 1907-1910 provenance tests in Europe undertaken by the International Union of Forest Experiment Stations and the widespread interest in provenance trials that resulted from them, it became the pious hope of American foresters that perhaps all that was wrong with these species in their adopted land was that seed of the wrong source had been used, and that a source of seed could be found for each climatic and soil province in America that would produce Scotch pine of Baltic straightness and Norway spruce the equal of any in central Europe along with resistance to local pests.

Scope.-- This discussion of provenance tests covers a very limited field. (1) Only New England plantations are considered, (2) exotic trees, (3) plantations must be specifically designed to test different seed sources or at least more than one known source must be represented. There are, of course, thousands of plantations of exotics in New England, mostly of unknown seed source or lacking a representation of more than one source.

It has not been possible to make an exhaustive search for plantations that meet the requirements for provenance tests. There may be some superior to those mentioned in this paper but their existence is unknown to the writer.

One of the purposes of this paper is to report on the known provenance tests in New England in the hope that other undiscovered tests would be uncovered.

Early provenance tests in New England.--The Mathew's or Black Brook plantations at Hamilton, Massachusetts are owned by Harvard University and administered by the Harvard Forest. They include small plantings of several western American, Asiatic and European conifers. Records of origin are not complete but some of the stock is reported to have come from Dr. C. S. Sargent at the Arnold Arboretum and thus some record of origin may be traced,

After working in the provenance trials in Sweden in 1923-24 the writer became interested in the subject and brought a few sample lots of seed to the New York Conservation Department in 1924. In 1927 additional seed was collected by the writer in Sweden. Finland and Germany and the plants were raised in the Brown Company Nurseries at Berlin, New Hampshire and Cupsuptic Lake, Maine. Some of this stock was planted at the Fox State Forest in Hillsboro, New Hampshire in 1934. Later other lots of seed were received from abroad and set out. The results of these New Hampshire plantings have not yet been thoroughly analyzed. None of the Scotch pine sources produced trees of both wholly desirable form and rapid growth. The Norway spruce has grown splendidly but without significant differences between sources except those from the far north.

The International Union tests.--Nothing daunted, when the post World War . I rejuvenated International Union of Forest Research Organizations (IUFRO) proposed a new source of seed test with Scotch pine and Norway spruce at the 1936 Congress in Hungary, the writer agreed to accept the responsibility for the establishment of some tests in the United States. The seeds were collected in the fall of 1937, extracted at Eberswalde, Germany and received in the early spring of 1938. The original seed packets were processed at the Fox Forest and divided into smaller samples for distribution to other agencies that had expressed a willingness to participate in the tests. Copies of the geographical origin data and instructions for sowing and outplanting were sent each agency. Seed samples were distributed as follows:

<u>SEED DISTRIBUTION 1938</u>	<u>NUMBER OF SOURCES</u>	
	<u>Scotch pine</u>	<u>Norway spruce</u>
Fox Forest	62	27
Harvard Forest	41	14
Mass. Department of Conservation	11	17
Vermont Forest Service	31	24
N. Y. Conservation Department	55	27
Conn. Forest and Park Commission	13	9
Lake States Forest Experiment Station	10	12
Northeastern Forest Experiment Station	--	12

The samples retained at Fox Forest were sown in May, 1938, in the experimental nursery, transplanted two years later and set out in the field as 4-year stock in the spring of 1942. The planting site was prepared in the fall of 1941 by ploughing furrows at the required spacing (plots carefully staked out in blocks) on the Vincent State Forest in Deering, New Hampshire, the only available area of open fields with uniform soil and moisture condi-

tions. The soil consists of Hermon fine sandy loam. As recommended in IUFRO instructions, a "standard" source was planted as a border along the sides of each block. Each plot measured 16.9 x 19.5 meters (53 x 64 feet) and was designed to contain 200 plants spaced 1.3 x 1.3 meters (4 1/3 feet). The instructions called for five replicates of each lot but this was not always possible due to limitations of space and supply of plants. Trials on a variety of soils and at different elevations were desirable but only one other site was available at the time. A small number of Scotch pine sources were planted on light Merrimack sand at the State Forest Nursery in Gerrish, New Hampshire. Sample rows of each origin of Scotch pine were also planted at the Fox Forest. A number of seed origin plots of the same species had been established on the Vincent State Forest in 1939 and 1940.

Early in 1940 the Harvard Forest reported that the seedlings raised from the seed distributed in 1938 could not be used, and 37,148 2-0 Scotch pine seedlings including 41 sources were returned to Fox Forest and thereupon distributed to other cooperators who agreed to make use of the plants and keep the origins separate. In addition some surplus Norway spruce was also sent out. A total of about 50,000 trees were distributed at this time.

<u>1940 DISTRIBUTION OF SEEDLINGS</u>	<u>NUMBER OF SOURCES</u>	
	<u>Scotch pine</u>	<u>Norway spruce</u>
Keene Water Works, Keene, N. H.	32	--
Arthur E. Bent, Exeter, N. H.	37	10
Connecticut Forest Service	35	--
Western Maine Forest Nursery	36	--
Manchester Water Works	9	--
Society for Protection of N. H. Forests	--	7

European larch provenance tests. --The rapid growth of European larch in New England had been noted for many years and been the subject of several reports. It attained the height of 30 to 35 feet on the Fox Forest 10 years after planting as 2-0 seedlings. A considerable number of sources were represented in plots set out there from 1938 to 1941.

During World War II the IUFRO decided to include European larch in its provenance program. The set of seed samples destined for Fox Forest was kept in storage in Sweden until after the war and was received in the spring of 1946. Again, as in the case of the earlier tests, the seed samples were subdivided in order to share the material with other stations. This time the New York Conservation Department was the only agency that was able to cooperate. Fifty-five origins were represented and Mr. E. J. Eliason at the Saratoga Nursery kindly agreed to carry out germination tests and determinations of the weight of 1,000 seeds of each lot. The germinative energy was very low even for larch, resulting in an inventory of plants in the seedbeds of 2,220 at Saratoga the first fall after sowing, and 10,057 at Fox Forest after 2 years. The trees were planted at the Fox Forest in the spring of 1948 according to IUFRO instructions and some of the surplus stock was set out in irregular plots on the Vincent State Forest. A few lots of surplus seedlings were also shipped to Mr. John B. Woods for planting on his farm in Vermont.

The larch planted on the Fox Forest has grown exceptionally well with some trees 8 to 12 feet high after 4 growing seasons.

Results of provenance tests in New England.--No data have been compiled on test plantings made before 1938. There is doubtless much valuable material but it is either unknown to the writer or it has not been examined, measured or analyzed.

Inquiries have been made of the results of the IUFRO tests, both seed and plants, distributed from Fox Forest 1938-40. The seeds sent to New York and to the Lake States and the Northeastern Forest Experiment Stations, were fully utilized and records have been made of the results of the plantations. These will be reported elsewhere. The Massachusetts Conservation Department had the misfortune to have the seedbeds washed away in the 1938 hurricane flood.

The Norway spruce seeds sent to the Harvard Forest were sown in the Doe Valley Nursery and seedlings grown two years. In the spring of 1941 it was decided to discontinue the experiment and most of the stock was shipped to the Pack Forest in Warrensburg, New York. Its subsequent history will be covered in the New York paper. However, 200 plants of each seed source were transplanted to a nursery back of the old Nichewaug Inn in Petersham in May 1941. On this occasion at least 20 plants of each seed source were measured for root length, height of shoot and frost damage. (The same measurements were made on stock sent to the Pack Forest). The plants remained in this nursery for 3 years, until May 1944, when they were lifted, measured as before and planted in Compartment III of the Prospect Hill Block on the Harvard Forest. There was a severe drought and the foliage of the larger plants was cut back the day after planting, watered, and again watered two weeks later. A survival count was made August 29, 1944. The trees were heavily defoliated by gypsy moth in July 1945. Later measurements were made July 9, 1946 and June 26, 1947. Students made descriptions and reports on the plantations on the latter date. In August 1953, Dr. Raup examined the plantation and found it growing rapidly with some of the trees 10 feet high and only a little weevil damage. A weeding is now necessary.

No reports have been received on the other seed distributions.

The seedlings sent out in 1940 also have a varied history. Norway spruce planted by L. W. Rathbun in Harrisville, New Hampshire are growing well, but different lots were not separated.

Scotch pine sent to Western Maine Forest Nursery were planted on rented land directly across Route 302 from Nursery No. 3 between Conway, New Hampshire and Fryeburg, Maine. The nursery owner, Mr. T. C. Eastman, was killed in action in World War II and the trees were allowed to revert to the land owner when the lease expired. The different lots are not now marked but the trees are growing.

The trees sent Mr. Bent were planted in Brentwood, New Hampshire and were reported doing well in September 1940. A letter received August 24, 1953 states that he had lined the stock out in a small nursery but had to move suddenly to war work and was not able to care for the trees later. The trees are now crowded but "20 feet high" according to his report.

The stock sent to the Manchester Water Works was planted and an attempt was made to keep the sources separate. There was considerable (50 percent) loss due to the stock being dried out. (These were the trees received from Harvard Forest). According to A. J. Christie: "Most of the trees have now reached a height of about 12 to 15 feet ranging from poor to good in form.

Some of this poor form, no doubt, is due to competition from sprout growth on the different areas which I have been unable to keep out."

No word has been received regarding the fate of the other lots of seed and seedlings distributed at no little trouble and expense. These reports point up, however, the difficulties attending record keeping and care of experimental plantations.

The Fox Forest IUFRO plantations are intact. These trees have been examined annually, and the Vincent State Forest trees were weeded on several occasions, the last in 1951. They are all growing well. White pine weevil damage to Norway spruce has been light until 1953 when considerable attack was noticed. One Scotch pine plot was badly eaten by porcupines in 1951. All the individual rows on the Fox Forest were pruned to 5 feet in 1951-52. The Scotch pine plots established at the State Forest Nursery in Gerrish, New Hampshire grew rapidly on the light Merrimack sand and outstripped the red pine separation rows by 4 to 5 times in height. All these trees were cut in 1952 to make room for more nursery seedbeds.

Measurements of provenance tests of exotics in New England.--Information is not available on other existing tests of exotics in New England so this progress report will be confined to the IUFRO tests mentioned above. Some data have been obtained on the following:

- a. Tests of seeds before sowing.
- b. Measurements and dry weight determinations of nursery seedlings.
- c. Measurements and descriptive notes of trees in plantations.

The Scotch pine and Norway spruce seeds used in the 1938 tests were tested for germination at the Saratoga Nursery and weights of 1,000 seeds were determined at Harvard Forest. European larch seeds were similarly tested at the Saratoga Nursery.

Harvard Forest tests included dry weight of one-year seedlings expressed in percent of dry matter, and mean dry weight of shoot and root separately. At the Saratoga Nursery the color of needles was classified and the percent of trees with fascicle leaves and those with fully developed bud, and the average height of one-year seedlings were determined. At Fox Forest 4-year transplants were measured in the Nursery in November 1941 for total height, current seasons growth and mean needle length. Determinations were also made of dry weight in percent of fresh weight. Seedling height was measured in European larch.

Norway spruce was measured for total height in the fall of 1948 at the Vincent State Forest and European larch was measured at the Fox Forest in the fall of 1952. Special observations were also made of Scotch pine winter coloration and the form of a few sources.

Preliminary conclusions. --The measurements and inspections of these plantations to date have not been thorough enough to permit any definite conclusions. Not only have the data so far collected not been completely analyzed but more careful examination and measurement are required. As time goes on, it is probable that some differences in growth, form, and resistance to enemies will be accentuated but other differences may become even less pronounced.

1. Variation in seed and seedling characteristics has been confirmed.
2. Northern sources have shown much slower height growth.
3. Scotch pine from far northern sources exhibited a marked golden foliage in winter and early spring.
- 4.. Central European sources produced the best height growth.
5. These characteristics were true of all species tested.
6. Scotch pine from Eastern Germany and Poland has made about the best development considering rate of growth and form combined.
7. Individual trees from the same source showed great variation in height growth in the case of Norway spruce and European larch. Scotch pine was much more uniform.