

EXPERIENCES WITH NORWAY SPRUCE PROVENANCES IN FINLAND

MAX. HAGMAN

The Finnish Forest Research Institute

SELOSTE:

KOKEMUKSIA KUUSEN PROVENIENSSEISTÄ SUOMESSA

INTRODUCTION

When we consider Norway spruce as a native tree species in Finland, we have to remember that on an evolutionary time scale *Picea abies* is a comparatively new species in our country. When the trees were recolonising Finland as land appeared from the sea after the last glaciation, the Norway spruce was a relative newcomer. Thus geological investigations have shown that the spruce reached Western Finland about 1500-1000 years B.C. and did not reach the Åland islands before around the year 0. If we examine Scandinavia from the same point of view, it might be noted that the Norway spruce has not yet reached Western Norway in a natural way, neither is there any native spruce in Denmark.

It is also well known from geobotanical and palynological research that the spruce reached our country from the east and northeast, having survived the glaciation somewhere in the central parts of the Asian continent. On the other hand, in Central Europe the recolonisation took place from several directions. Into North Poland and probably also the Baltic states, the spruce entered from the east but into South Poland and the central alpine

countries it entered from refuges in the south and southeast. Even today there is a gap in Central Poland where no natural spruce is to be found.

Since different climatic conditions promote the development of races of plants adapted to the particular conditions where they grow, one could *a priori* think that very different geographic races of Norway spruce might have developed during the course of the evolution of this species. This has, indeed, proven to be the case, and the existence of such geographical variation has provided the forest researcher with much interesting study material and the practical forester with provenances of better growth and higher economic yield.

Norway spruce provenances in Finland

The earliest approach

The interest in spruce provenances goes back a long way in Finland. By as early as 1881 at the Forestry Exhibition in Helsinki, spruce plants were displayed originating from Sweden, Germany and the Baltic

area. It is probable that material of the same kind was used for forest plantations as well, but the planting localities are, unfortunately, not known.

Soon after the turn of the century, Professor Olli Heikinheimo started his first provenance experiments and these were further enlarged at the Forest Research Institute Experimental Forests in the 1930's. (See e.g. KALELA 1937, HEIKINHEIMO 1949.)

The results from these experiments, in addition to findings from abroad, as shown e.g. in the international spruce experiment of 1938, indicated clearly that spruce from Central Europe, particularly from Eastern Europe, was superior to Finnish spruce. In the Solböle and also in the Ruotsinkylä experimental forests, the provenances from Poland, ČSSR, Romania and the Baltic states were promising and the injuries incurred, even after the severe winters of 1939-1944, were not too extensive.

The seed imports in the 1930's

On the basis of accumulated knowledge, and with the stimulus of the large plantation programme for spruce in the 1930's, seed of foreign origin was imported on a fairly large scale. This seed came from Estonia, Latvia and Lithuania and was widely distributed to forest owners in Southern

Finland. Unfortunately, the records of these plantations are very scanty, and only a few cultivations have been identified with certainty. Those found, are, however, growing very well and will form a valuable source for further selections.

The new approach

When forest genetics research was started anew at the Forest Research Institute in 1949, it was therefore natural that provenance research with Norway spruce should be continued. Since certain areas had not been represented in the earlier programme, we decided to start experiments with spruces from Austria, Eastern Germany, Romania, Southern Poland and the Slovakian parts of the Tatra and Carpathian mountains. The seed imported for these experiments was mainly of commercial origin, representing bulk collections, but a few, more precisely defined samples were also obtained, notably single tree samples from Saxony.

The experiments were planted out in various parts of Southern Finland, including the Åland islands, but a few plots were also planted further north in order to investigate the northern limits for the transfer of these provenances.

Experiment No. 90 at Tenala, Lindö

Table 1. Survival and growth of provenances from Austria, Finland, Germany and Poland in the experiments No. 143 Vihti, No. 146 Pornainen and No. 90 Tenala. The experiments were planted 1959 and assessed 1975 (Exp. No. 90 & 143) and 1976 (Exp. No. 146.).

Seed lot No.	Provenance	Exp. No. 143		Exp. No. 146		Exp. No. 90	
		%	m	%	m	%	m
54-129	Finland, Pornainen, plusstand No.8	82,8	3,82	53,2	5,79		
55-036	BRD, Niedersachsen, Osterode 2-400 m	29,7	2,00	46,3	5,38	89,8	4,08
55-038	BRD, Bayern, Fichtelgebirge 51	60,6	3,04			85,0	4,29
55-091	Austria, VI Mühl-u. Waldviertel, Altenburg	47,2	2,86			78,4	3,75
55-016	Finland, Tuusula, sample plot No. 12	89,7	4,59	52,6	5,17		
55-095	Poland, Istebna-Wisla, 7-800 m	52,2	2,71	59,6	4,64	85,0	4,05
55-096	Poland, Bialystok, Lešna	60,0	3,98			82,2	3,81
55-037	BRD, Westfalen, Arnsberg 6-900 m			60,9	5,15		
55-074	DDR, »in der nähe von Carlsfeld«			74,1	5,50		
55-092	Austria, Semmering, Alpenrand 5-900 m			52,4	4,76		
55-093	Austria, III NO-Alpenrand, Weyer a.d. Enns					79,4	3,31
55-108	Finland, Tenala					91,0	4,35

compared with the local ones. Almost no Finnish sources are to be found among the ten best provenances in these experiments. Particularly, the more southern provenances have proven resistant to spring frost. This could be very clearly seen during the summer of 1978 when a very hard frost occurred as late as June 17th, when temperature dropped to $-7^{\circ}-9^{\circ}\text{C}$. The Polish and Baltic provenances emerged from that frost much less damaged than many of the Finnish ones (table 5).

It is hoped that the new international experiment of 1972, initiated by Professor St. Tyszkiewicz of Warsaw, and which is now planted out also in Finland (Exp. No. 535) in three different locations, will confirm the earlier results.

The unknown provenances of White Russia

During all these years of experimenting there remained one area of which very limited information has been available, namely the further extension to the east of the Baltic-North Poland spruce forest. Few provenances from this part of the Soviet Union have so far reached our experimental plots, although in all likelihood many good provenances, especially for Finland, could be found in these areas.

In 1978 we sowed the first experiment (No. 655) with 26 provenances from Vitebsk—Minsk—Grodno. But these sources are commercial, obtained through Sweden, and very little is known about the stands and

conditions from where these seeds originated. Since this area is of the utmost importance for Finnish provenance research it is sincerely hoped that the cooperative approach, now so successfully begun between provenance researchers of the Soviet Union and Finland, will make it possible to enlarge this research on Norway spruce. It might be necessary, in addition, to proceed further east along the same latitudes, as samples from the Ural seem to indicate.

The all-Scandinavian approach

Provenance research is international, and by comparing results from different countries and in various climatic conditions, we can

generally obtain a better picture of the characters of the provenances and their reactions to different environments. With this in mind the Scandinavian countries decided in 1975 to make a common assessment of all the provenance experiments with Norway spruce in their countries.

This synthesis has been carried out by Dr. Jon Dietrichson of the Norwegian Forest Research Institute and will be published soon. Preliminary data from this material, which consist of 293 field experiments with 1218 provenance samples, have recently been published (DIETRICHSON 1978). These results confirm the earlier view that provenances from the most northeastern parts of Central Europe are of the greatest value for Finland. Never-

Table 4 a. Norway spruce provenance experiment No. 270/1—6 planted autumn 1969 and spring 1970, assessed 1974. Survival of all plants, percent.

Seed lot No.	Provenance	270/1 Loppi %	270/2 Imatra %	270/3 Pargas %	270/4 Pernå %	270/5 Geta %	270/6 Eurajoki %	Mean %
65-025	Sund, St. No. 14	66,9	62,5	82,8	94,6	69,5		73,5
T8-64-116	Vehkalahti	76,2	68,4		97,3	53,9	82,0	75,6
65-010	Bromarv	75,4	81,1	71,0	96,3	60,2		76,8
64-241	Jokioinen	63,3	86,0	84,4	99,3	49,4	69,0	75,2
T3-64-170	Mellilä	80,4	79,5		95,8	43,7		74,9
55-075	Tuusula	74,6	76,3	80,3	98,6	50,8	74,7	75,9
61-370	Bialowiesa	76,2	76,1	85,0	97,8	73,9		81,8
61-364	Zwierzyniec	79,0	69,9	71,3	98,3	54,7		74,6
61-369	Ptaska	62,2	73,6	91,8	97,3	73,0		79,6
61-365	Augustow	66,8	73,5	82,3	98,3	45,3	85,7	75,3
61-371	Borki	61,5	72,7	88,4	97,3	67,4	89,8	79,5
61-372	Przerwanki	69,7	80,6	92,5	95,9	67,3	86,9	82,2
61-366	Gorowo	63,6	56,6	83,7	96,6	77,1	91,4	78,2
61-367	Mestwinowo	64,9	64,8	85,7	97,3	70,7		76,7
59-048	Tatr. Lomnica	72,9	75,5	86,4	98,3	48,6		76,3
T3-63-103	Vöry, Simerpalu	83,4	62,0	83,0	99,6	52,1		76,0
T3-63-108	Veriora, Ilumetsä	78,3	86,0	76,2	94,2	50,8		77,1
T3-63-101	Tallinna, Trigi	65,7	56,7	87,8	97,6	49,4		71,4
T3-63-106	Kohila, Järvakandi	76,8	75,5	88,3	97,6	65,1		80,7
T3-63-112	Tartu, Alatskivi	84,4	73,2	87,1	98,0	61,5		80,8
T3-65-116	Rakvere, Porku	82,4	77,3	73,0	97,6	63,3	79,2	78,8
T3-65-113	Killingi-Nõmme	80,9	71,7	79,6	96,0	73,4	85,7	81,2
T3-65-118	Elva, Kambja	76,8	78,6	74,2	99,0	61,2	83,3	78,9
T3-65-115	Tartu, Kärknä	85,2	69,1	78,9	99,0	62,1		78,9
Mean of alla provenances		73,6	72,8	82,4	97,4	60,2	82,8	77,6

Table 4 b. Norway spruce provenance experiment No. 270/1—6 planted autumn 1969 and spring 1970, assessed 1974. Mean height of all plants cm.

Seed lot No.	Provenance	270/1 Loppi cm	270/2 Imatra cm	270/3 Pargas cm	270/4 Pernå cm	270/5 Geta cm	270/6 Eurajoki cm	Mean cm
65-025	Sund, St. No. 14	45,6	66,8	90,1	85,9	54,4		68,6
T8-64-116	Vehkalahti	52,5	69,8		97,7	61,3	77,7	71,8
65-010	Bromarv	49,2	73,6	85,9	85,0	53,5		69,4
64-241	Jokioinen							
T3-64-170	Mellilä	54,3	70,3		84,0	56,4		66,3
55-075	Tuusula	54,0	71,7	91,1	84,3	59,5	77,4	73,0
61-370	Bialowiesa	53,8	79,0	89,3	97,3	69,6		77,8
61-364	Zwierzyniec	56,9	76,4	86,5	91,0	63,8		74,9
61-369	Ptaska	53,8	84,9	101,7	93,5	70,5		80,9
61-365	Augustow	54,1	84,0	89,3	96,2	70,6	83,1	79,6
61-371	Borki	57,5	84,4	91,8	95,3	67,1	87,6	80,6
61-372	Przerwanki	55,1	77,4	103,9	97,5	67,0	94,2	82,5
61-366	Gorowo	55,3	76,3	92,4	85,5	62,9	90,3	77,1
61-367	Mestwinowo	51,2	79,9	97,2	97,0	67,6		78,8
59-048	Tatr. Lomnica	54,2	79,1	88,8	98,5	62,8		76,7
T3-63-103	Vöry, Simerpalu	59,8	80,8	84,4	99,0	69,6		78,7
T3-63-108	Veriora, Ilumetsä	54,4	83,5	81,6	85,0	65,2		73,9
T3-63-101	Tallinna, Trigi	53,6	73,4	97,2	89,2	61,9		75,1
T3-63-106	Kohila, Järvakandi	57,0	83,6	94,8	91,8	66,0		78,6
T3-63-112	Tartu, Alatskivi	54,7	83,4	79,9	84,7	55,6		71,7
T3-65-116	Rakvere, Porku	56,1	73,6	79,6	91,7	56,0	81,1	73,0
T3-65-113	Killingi-Nõmme	53,8	80,3	94,0	94,1	61,8	88,6	78,8
T3-65-118	Elva, Kambja	56,3	82,5	80,0	102,6	64,8	87,4	78,9
T3-65-115	Tartu, Kärknä	59,8	79,9	88,2	98,3	62,5		77,7
Mean of all provenances		54,3	77,9	89,7	92,6	62,9	83,9	75,7

Table 5. Frost damages in June 1978 in the provenance experiments No. 270/1-6. Assessment scale 0 = no damage - 6 = plant dead.

Seed lot No.	Provenance	Exp. 270/1 Loppi	Exp. 270/2 Imatra	Exp. 270/3 Pargas	Exp. 270/4 Pernä	Exp. 270/6 Eurajoki	Mean
65-025	Finland Sund, Standard No. 14	4,93	3,14	0,13	2,02		2,56
T8-64-126	Finland, Vehkalahti	4,82	3,08		1,96	1,66	2,88
65-010	Finland, Bromarv, Solböle	4,98	3,41	0,10	2,43		2,73
64-241	Finland, Jokioinen, plusstand No. 241	5,05	2,74	0,14	1,73	2,13	2,36
T3-64-170	Finland, Mellilä	4,72	2,94		2,15	2,24	3,27
55-075	Finland, Tuusula, sample plot No. 12	5,00	3,45	0,07	2,31		2,61
61-370	Poland, Bialowiesza	4,48	3,31	0,15	1,66		2,40
61-364	Poland, Zwierzyniec	4,49	2,47	0,46	1,45		2,22
61-369	Poland, Ptaska	4,53	2,34	0,29	1,89		2,26
61-365	Poland, Augustow	4,63	1,93	0,44	1,68	1,50	2,04
61-371	Poland, Borki	4,37	2,02	0,45	1,41	0,83	1,82
61-372	Poland, Przerwanki	4,71	2,63	0,21	1,55	0,89	2,00
61-366	Poland, Gorowo	4,63	2,71	0,36	2,00	0,92	2,12
61-367	Poland, Mestwinowo	4,66	2,45	0,40	1,45		2,24
59-048	ČSSR, Tatra Mt. Tatr. Lomnica	4,53	2,26	0,39	1,82		2,25
T3-63-103	USSR, Estonia, Võry Simerpalu	4,41	2,09	0,15	1,68		2,08
T3-63-108	USSR, Estonia, Veriora Ilumetsä	4,88	2,68	0,22	2,43		2,55
T3-63-101	USSR, Estonia, Tallinna, Trigi	4,43	3,27	0,10	1,99		2,45
T3-66-106	USSR, Estonia, Kohila Järvakandi	4,52	2,40	0,22	2,17		2,33
T3-63-112	USSR, Estonia, Tartu Alatskivi	4,55	2,03	0,15	2,15	0,82	2,22
T3-65-116	USSR, Estonia, Rakvere Porku	4,77	2,85	0,38	1,95		2,15
T3-65-113	USSR, Estonia, Killingi-Nõmme, Pärnu	4,80	2,59	0,16	1,65	1,06	2,05
T3-65-118	USSR, Estonia, Elva Kambja	4,45	2,98	0,47	1,37	0,60	1,97
T3-65-115	USSR, Estonia, Tartu Kärknä	4,59	2,68	0,25	1,88		2,32
	Mean of all provenances	4,66	2,68	0,25	1,88	1,25	2,19

theless, a great variation is observable between the provenances and good material might be obtainable also from certain southern sources. The influence of the variation in the local climate can be clearly seen from these results, and thus in the selection of a provenance for a certain

cultivation area, each case must be judged on its own merits. The large experimental material available, and further results yet to be obtained might, however, help the local practical forester in his efforts to reach the best solution as to the choice of provenance.

LITERATURE

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SELOSTE:

KOKEMUKSIA KUUSEN PROVENIENSSEISTÄ SUOMESSA

Kuusimetsien jääkauden jälkeinen kehitys Euroopassa antaa aiheen olettaa että evoluution mukana eri alueille on syntynyt hyvinkin erilaisuneita maantieteellisiä rotuja. Tämän oletuksen tueksi on provenienssitutkimus tuonut runsaasti kokeellista tulosaineistoa. Kokeiden tulokset viittaavat myös siihen että paikallisesti syntynyt rotu ei metsätaloustaloudessa aina tarvitse olla paras.

Suomessa suoritettu aikaisempi provenienssitutkimus on kuitenkin ollut kuusen osalta vaillinaista ja nyt esitetään tuloksia eräistä täydentävistä kokeista. Nämä tulokset tukevat aikaisempaa käsitystä siitä että kasvunlisäystä voidaan saavuttaa siirtämällä kuusialkuperiä pohjoisempaan viljeltäväksi.

Etelä-Suomen ilmastollisesti edullisimmilla alueilla Itä-Euroopan keskiosista - Romaniasta, Tsekkoslovakiasta ja Puolasta - siirretyt alkuperät voivat ilmeisesti tuottaa enemmän kuin

paikallinen kuusi. Rannikolta sisämaahan siirryttäessä on tarpeen hankkia alkuperät jonkun verran pohjoisempaa, Pohjois-Puolasta ja Baltian maista. Lisätutkimuksilla on vielä selvitettävä mihin saakka pohjoiseen maamme rajojen ulkopuolelta tuotuja kuusialkuperiä voidaan siirtää, samoin kuin missä määrin kotimaiset siirrot ovat edullisia.

Koetulokset ovat tuoneet esille huomattavan vaihtelun samankin maantieteellisen alkuperäalueen sisällä. Tämän huomioiminen mahdollistaa ilmeisesti tulevaisuudessa provenienssijalostusta. Jokseenkin kokonaan tutkimatta ovat Valko-Venäjän alueelta saatavat kuusen alkuperät jotka kaikesta päättäen ovat Suomenkin kannalta merkityksellisiä. Yhteistyö Neuvostoliiton kanssa tekee toivottavasti lähitulevaisuudessa mahdolliseksi tällaisen tutkimuksen aloittamisen.