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# EXPERIENCES WITH NORWAY SPRUCE PROVENANCES IN FINLAND

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#### SELOSTE:

KOKEMUKSIA KUUSEN PROVENIENSSEISTÄ SUOMESSA

## **INTRODUCTION**

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

When we consider Norway spruce as a 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 originatinto South Poland and the central alpine ing from Sweden, Germany and the Baltic area. It is probable that material of the Finland. Unfortunately, the records of 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

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 Saxonv.

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	D	Exp. N	o. 143	Exp. N	o. 146	Exp.	No. 90
No.	Provenance	%	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
<b>55</b> – 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

(see table 1) is one of the oldest of these new exeriments, and here Fichtelgebirge, Istebna and Harz have performed well, although hardly superior to the local provenance.

Experiments No. 143 Vihti, No. 146 Pornainen and No. 193 Finström contain material from Austria, Slovakia and Poland (see table 1 and 2). Some experiments with second generation provenances collected from some of the trees in the earliest Finnish experiments have also given quite good results.

In experiments No. 217 Punkaharju, No. 219 Geta, No. 221 Närpes and No. 233 Vilppula (see table 3) we were able to plant progenies from selected spruces from Saxony and it is interesting to note the great variation between the single tree progenies even from within such a limited area.

# The Romanian Expedition

One of the areas of which very little was known was Romania. The international experiment indicated that spruces from that country could be very valuable in Scandinavian forestry and it was clear that more information was needed about the natural variation within Romania. It was therefore agreed upon among the Scandinavian forest geneticists that an expedition should be sent to Romania to select sample plots and later to obtain seed. This expedition was made in 1962 and 20 stands were selected in different parts of Romania. The

seeds were obtained in 1963 and the experiments (Nos. 237/1-7) planted out in 1967-1968, again mainly in Southern Finland, but one trial as far north as Muhos near the city of Oulu. These experiments have revealed a great deal of variation and not all of the provenances are, perhaps, so promising as the old ones from the 1930's. However, some of the sources are obviously promising, especially in the mildest parts of Finland. It is also clear that Romanian spruce should not be transferred too far inland in our coutry.

# The concentration on northeastern sources

During the course of the experimentation going on in all the Scandinavian countries from 1950-1970, it was becoming more and more evident, that for the more northern parts of Finland and Sweden in contrast to Norway and Denmark, the best material was to be obtained from Northeastern Europe (Poland, the Baltic states and perhaps White Russia).

This is therefore the region upon which the latest efforts have been concentrated. In particular, it was of interest to compare the spruces from N. Poland with those still further north. Experiment No. 270/1-6 has proven very informative. As can be seen from table 4a and 4b, the 1974 measurements indicate good survival and better growth of the foreign provenances

Table 2. Survival and growth in the experiment No. 193, Finström, Åland. The experiment was planted in 1961 and assessed in 1978.

Seed lot No.	Provenance	Survival %	Mean height m
35			İ
54 - 130	Finland, Urjala, plusstand No. 9.	88,9	3,05
56 - 043	ČSSR, Sp. Podhradie	85,0	3,85
56-045	ČSSR, Muran	92,5	3,74
56-044	ČSSR, Lipt. Hradok	88,5	3,78
55 - 095	Poland, Istebna-Wisla, 7-800 m	87,5	4,50
56 - 046	ČSSR, Cadča	72,7	4,24
56 - 047	ČSSR, Košice	79,8	3,85
55 - 075	Finland, Tuusula, sample plot 12	90,4	3,96
55 - 096	Poland, Bialystok, Lešna	87,9	4,09

and Romania. for ČSSR an sed 1974 Finland, and assess sources compared from . 233 sources frank and No. of so No. Table 3. Survival and growth 217 Punkaharju, N. 219 Geta, 217 which was measured 1976.

Seed lot No.	Provenance	Exp. No. 217 % m	Exp. No. 219 % m	o. 219 m	Exp. No. 221	fo. 221 m	Exp. N	Exp. No. 233   % m
59-304	DDR, Bärenfels, Rehefeld 1, Abt. 146, ZN 48	2,51	88,7	1,59	79,3	2,20		
59-305	DDR, Bärenfels, Rehefeld 5, Abt. 146, ZN 52	2,64	76,7	1,51	93,3	1,96		
59-306	DDR, Bärenfels, Hermsdorf 16, Abt. 164, ZN 122	2,14	82,7	1,59				
59-307	DDR, Bärenfels, Hermsdort 17, Abt. 164, ZN 123	2,18	84,7	1,73	78,7	1,66		
59-308	DDR, Annaberg, Tellerhäuser 5, Abt. 44, ZN 130	2,43	82,0	1,67	88,7	2,32	71,3	2,38
59-309	DDR, Annaberg, Tellerhäuser 32, Abt. 44, ZN 131	2,35	81,3	1,60				
59-310	DDR, Annaberg, Tellerhäuser 3, Abt. 44, ZN 132	2,66	72,0	1,37	85,3	2,12	65,3	1,80
59 - 311	DDR, Annaberg, Tellerhäuser 33, Abt. 44, ZN 133	1,99	83,3	1,56				
59-312	DDR, Aue, Carlsfeld 43, Abt. 275, ZN 467	2,40	85,3	1,64				
59-313	DDR, Aue, Carlsfeld 44, Abt. 275, ZN 468	2,77	73,3	1,81				
55-075	Finland, Tuusula, sample plot No. 12	2,05	83,3	1,78	88,0	2,54		
55-090	Finland, Mikkelin maalaiskunta	2,24	77,3	1,29	79,3	1,78	70,7	2,27
55 - 110	Finland, Etelä-Karjala	2,68	85,3	1,59	88,7	2,16		
55 - 113	Finland, Satakunta	2,91	74,7	1,37	0'06	2,03	78,0	2,15
59-048	CSSR, Tatra Mt., Tatr. Lomnica	2,15	84,0	1,69	0'08	1,93	78,0	2,48
59-050	ČSSR, Kláštor	2,54	89,3	1,55				
59-051	CSSR, Ruzomberok	2,81	84,7	1,59				
59-052	ČSSR, Podolinec	2,99	87,3	1,85	79,3	1,85		
59-295	DDR, Aue, Wilschmühle, Abt. 233 ZN 423	2,96	0,06	1,89				
59-296	DDR, Aue, Carlsfeld, Abt. 275 ZN 424	2,90	87,3	1,79	89,3	2,16	80,0	2,37
59-297	DDR, Annaberg, Tellerhäuser, Abt. 44, ZN 425	2,52	75,3	1,61		-	82,0	2,63
59-298		2,24	87,3	1,69	73,3	2,05	72,7	2,53
59-299	DDR, Marienberg, Rungstock, Abt. 46 A, ZN 415	2,47	84,0	1,92	92,0	1,98		
59-300	DDR, Tharandt, Hermsdorf, Abt. 164, ZN 428	1,70	92,7	1,86	81,3	1,66	84,7	2,35
59 - 301	DDR, Zella-Mehlis, Oberhof, Schlossbergkopf, ZN 416	2,30	85,3	1,65	87,3	1,90	67,3	2,29
59-303	Romania, Suceava, Vatra Dornei, Cosna, Cucureasa 436	1,91	70,7	1,65	0'06	2,25	2'09	2,73
59-053	ČSSR, Žilina		89,3	1,81				
59 - 294	DDR, Aue, Wilschmühle, ZN 422		95,6	1,61				
59-302	DDR, Sonnenberg, Steinheid, Kieferleskopf, ZN 429		82,0	1,68				
59-049	ČSSR, Murán		0'98	1,66	80,0	2,29	0,08	2,51
57-025	USSR, BSSR, Mogiljevsk obl. Bichovsk raion		76,7	1,57	92,0	1,87	0,99	2,29

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  $-7^{\circ}-9^{\circ}$  C. The Polish and Baltic provenances emerged from that frost much less damaged than many of the Finnish ones (table 5).

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 It is hoped that the new international 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

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	Provenance	270/1 Loppi	270/2 Imatra	270/3 Pargas	270/4 Pernå	270/5 Geta	270/6 Eurajoki	Mean
No.	Tiovenance	%	%	%	%	%	%	%
		İ	Ì			1	İ	
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-Nömme	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 I	provenances	73,6	72,8	82,4	97,4	60,2	82,8	77,6

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

		270/1	270/2	270/3	.270/4	270/5	27016	
Seed lot	Provenance	Loppi	Imatra	Pargas	Pernå	Geta	270/6 Eurajoki	Mean
No.		cm	cm	cm	cm	cm	cm	cm
						1	l om	CIII
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					,-		05,1
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-Nömme	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 pr	ovenances	54,3	77,9	89,7	92,6	62,9	83,9	75,7

Seed lot No.	Provenance	Exp. 270/1 Loppi	Exp. 270/2 Imatra	Exp. 270/3 Pargas	Exp. 270/4 Pernå	Exp. 270/6 Eurajoki	Mean
	M Charles Of the 1	4 03	3 14	0.13	2.02		2.56
65-025	Finland Sund, Standard No. 14	50,1	3,00		1 06	1 66	200
T8-64-126	Finland, Vehkalahti	4,82	3,08	,	1,90	1,00	7,00
65-010	Finland, Bromarv, Solböle	4,98	3,41	0,10	2,43		2,13
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		3,27
55_075	Finland Tuusula, sample plot No. 12	5,00	3,45	0,07	2,31	2,24	2,61
61-370	Poland. Bialowiesa	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	68'0	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
50-048	CSSR Tatra Mt. Tatr. Lonnica	4,53	2,26	0,39	1,82		2,25
T3 63_103	1155R Estonia Vörv Simerpalu	4,41	2,09	0,15	1,68		2,08
T3_63_108		4,88	2,68	0,22	2,43		2,55
T3-63-101		4,43	3,27	0,10	1,99		2,45
T3-66-106		4,52	2,40	0,22	2,17		2,33
T3-63-112		4,55	2,03	0,15	2,15		2,22
T2 65 116		4,77	2,85	0,38	1,95	0,82	2,15
T2 65 113		4,80	2,59	0,16	1,65	1,06	2,05
T2 65 118		4,45	2,98	0,47	1,37	09'0	1,97
T3-65-115	USSR, Estonia, Tartu Kärknä	4,59	2,68	0,25	1,88		2,32
		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 erilaistuneita maantieteellisiä rotuja. Tämän olettamuksen tueksi on provenienssitutkimus tuonut runsaasti kokeellista tulosaineistoa. Kokeiden tulokset viittaavat myös siihen että paikallisesti syntynyt rotu ei metsätalousmielessä 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 pohjoisempana viljeltäväksi.

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

paikallinen kuusi. Rannikolta sisämaahan siirryttäessä on tarpeen hankkia alkuperät jonkun verran pohjoisempaa, Pohjois-Puolasta ja Balttian maista. Lisätutkimuksilla on vielä selvitettävä mihin saakka pohjoiseen maamme rajojen ulkopuolelta tuotuja kuusialkuperiä voidaan siirtää, samoiten 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.