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International Family Test of Eurasian Larch Species

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Abstract

Larch (*Larix sp.* Mill.) is a natural element of the boreal forest. Different species of Larix dominates the boreal forests of Eurasia. Larch also had a natural distribution in Scandinavia nine thousand years ago but disappeared for unknown reasons in prehistoric time. It was reintroduced by man in the 18th century and has for a long time attracted interest from forestry in Scandinavia. One major obstacle for reintroduction of Siberian larch in Scandinavia has been availability of seed sources for establishing test plantations. A co-operation between three Russian research institutes on one side and two organisations in Scandinavia on the other started in 1996. Seed was collected from 1005 individual trees distributed over 17 regions and 45 larch stands from Kamchatka in the east to Onega in the west. Seedlings were produced in 2002 and family field tests of 1005 families were established in Sweden and Norway in 2003. In addition to 7 family test plantation areas in Scandinavia similar test plantations are being established in northwest Russia (Komi and Archangelsk), China, Japan, Alaska, Saskatchewan, Minnesota, Quebec, Iceland and Finland. The results of this seed collection in Russia and establishment of international test plantations will be of big importance for the optimal selection of seed source, ecologic adaptation and economic use of Siberian larch species in the northern hemisphere.

Key words: International family test, Larch (*Larix sp.* Mill,), survivability, growth rate, adaptation

Introduction

Larch (*Larix sp.* Mill.) is a natural element of the boreal forest. Different species of *Larix* dominates the boreal forests of Eurasia (Milyutin & Vishnevetskaya 1995, Putenikhin & Martinsson 1995, Abaimov *et al.*1998). Larch also had a natural distribution in Scandinavia nine thousand years ago but disappeared for unknown reasons in prehistoric time (Kullman 1998). It was reintroduced by man in the 18th century and has for a long time attracted interest from forestry in Scandinavia (Martinsson 1992). One major obstacle has been availability of seed sources for establishing test plantations. A co-operation between four Russian research institutes on one side and two organisations in Scandinavia one in Japan and one in the USA on the other started in 1996 (Table 1).

The objectives of this study were to report the details of the three test plantations established in Sweden and to evaluate survivability and growth performance after two growing seasons. This paper is a sequel of the previous report (Abaimov *et al.* 2002).

Materials and Methods

In phase 1 of the project seed was collected in 17 regions and 1005 individual trees from Kamchatka in the east to Onega in the west (Figure 1). Although there are several different definitions of scientific name for larch species in Siberia (Schmidt 1995), we obeyed the definition described by Abaimov *et al.* (1998). Materials for the Swedish and Norwegian field experiments were brought up in 2002 in Alstahaug nursery in central Norway. In addition to this, seed of the same material was distributed to 9 more participants resulting in a circumpolar participation of this progeny series of Eurasian larch species (Table 2).

In the spring of 2003, one-year-old container-seedlings were planted on three main sites and ten small sites in Sweden. The three main sites for field experiments in Sweden are located in Österbymo, Särna and Järvträsk. The properties of the three sites are explained in Table 3.

Each experimental sites were established as 60 sub-plots of 30x40 m on each site. 300 seedlings, representing one region, were planted in each subplot with spacing 2x2 m (Figures 2, 3 and 4). One family (progeny of one selected tree) was represented by 3 or 4 seedlings. All regions were replicated three times in three sub-plots. Three commercial Swedish and Finnish seed sources and two Russian collections (No 18-22) were included as standards in the experiments. All seed sources and their origins are explained in Table 4.

Results and Discussion

In October 2004 the survival rate was recorded (Table 5). In Österbymo also the tree height was assessed. However the period is still too short for this estimation, only two growing seasons after plantation.

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Survival

The average survival rate two growing seasons after plantation was between 70 and 90 %. The highest average survival rate was recorded in Österbymo and the lowest in Särna. The lower survival in Särna and Järvträsk was mainly due to attack by *Hylobius abietis*. The material planted on these two sites were not treated with *Hylobius* repellents, while the material of Österbymo was treated in the nursery and two times in the summers of 2003 and 2004. Another reason, especially in Särna, was care of plantation. In several cases the seedling was planted outside the site prepared spot in Särna.

Height growth

Estimated mean heights for provenances in Österbymo were between 20 and 100 cm, two growing seasons after plantation. Shortest mean height had Yakutiya and the five tallest mean heights were provenances 14. Chabarovsk, 1. Nishnij Novgorod, 21. Maglehem, 6. Perm and 15. Sachalin. The tallest individual tree, 175 cm, was found in provenance 14. Chabarovsk.

Conclusion

Only two growing seasons is a too short period for estimation of survival, growth rate and adaptation to the three sites. The survival rate is so far very good in the most southern site Österbymo and acceptable in the two sites Särna and Järvträsk. The seedlings from provenances 17. Evenkia and 5. Salechard were already at nursery smaller than average and this my have influenced the survival. The local hybrid larch 21. Maglehem does not fit in the northern locations and has therefore a low survival. Larch from 12. Yakutiya and 17. Evenkia are adapted to a more continental climate than anywhere in Sweden. The very fast growth and vitality of 14. Chabarovsk, 16. Kamchatkta and 15. Sachalin are interesting. The long term vitality and fast growth of these provenances should be followed up carefully before any assessment can be done.

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Table 1. Participating organisations of phase 1 of the Russian-Scandinavian Larch Project – Seed Collection 1996-2001.

Organisations	Countries
Swedish University of Agricultural Sciences, Umeå	Sweden
Helegland Forest Society	Norway
V N Sukachev Institute of Forest, Krasnoyarsk	Russia
Arkhangelsk State Enginering Society	Russia
Institute of Northern Biological Problems, Magadan	Russia
Bashkirian Botanical Garden Institute, Ufa	Russia
Kyushu University, Fukuoka	Japan
The University of Minnesota, Minneapolis	USA

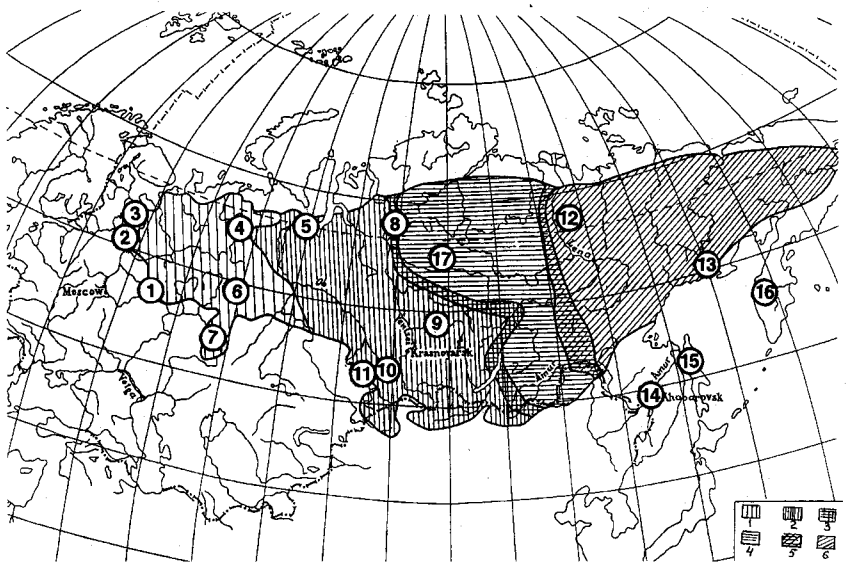

Fig. 1. 17 seed collection regions in Russia. The six different patterns are indicating larch species and their hybridisation zones 1= *Larix sukaczewii* Dyl., 2=*Larix sibirica* Ledeb., 3=*Larix czekanowskii*, 4= *Larix gmelinii* Rupr., 5=*Larix gmelinii x Larix cajanderii*, 6= *Larix cajanderii* Mayr.

Table 2. Participants of the International Progeny test of Eurasian Larch Species.

Country, province	Organisations, city	Contact persons
Norway	Helgeland Forest Society, Mosjöen	Jaap Buitink Gisle Skaaret
Sweden	SLU; Umeå	Owe Martinsson
Arkhangelsk	NFRI, Arkhangelsk	Natalia Demidova Vladimir Barzut
Komi	Komi Science Centre, Syktyvkar	Aleksey Fedorkov
Japan	Akita Prefectural University,	Katsuhiko Takata
China	Beijing University, Beijing	Shen Xi Huan
Alaska	U S Forest Service, Alaska, Fairbanks	John Alden
Saskachewan	Agriculture and Agri-Food Canada, Indian Head, Saskatchewan	Bill Schroeder
Minnesota	University of Minnesota	Andrew David
Quebec	Ministry of Forest, Quebec	Gaston Lapointe
Iceland	Iceland Forest Service	Thröstur

Table 3. Localities and site properties of the three main test sites in Sweden.

Locality	Latitude, N	Longitude, E	Altitude, m	Topography	Soil
Österbymo	57°47'	15°37'	250	Slight southern slope	Gravelly morain
Särna	61°31'	13°00'	540	Slight western slope	Stony morain
Järvträsk	65°11'	19°31'	410	Steep eastern slope	Sandy morain

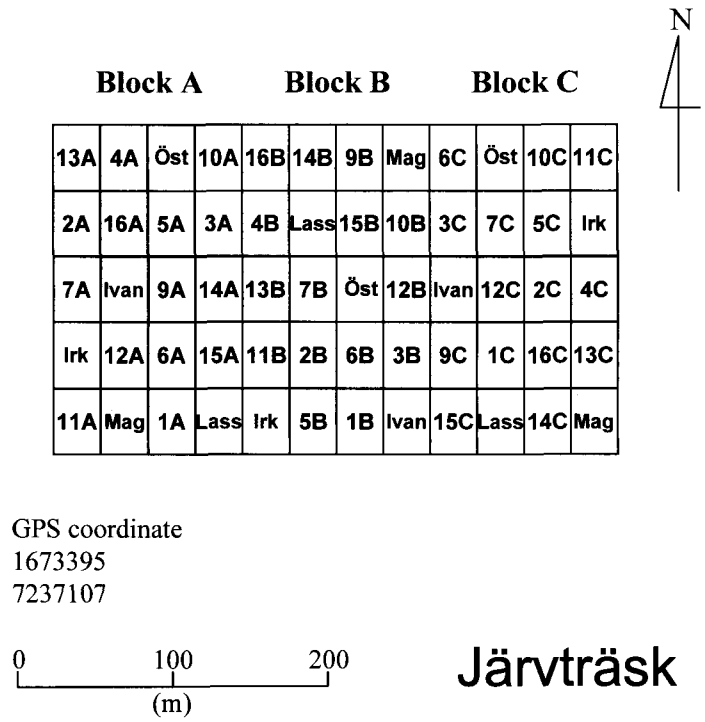

Fig. 2. Design of experimental plot in Järvträsk

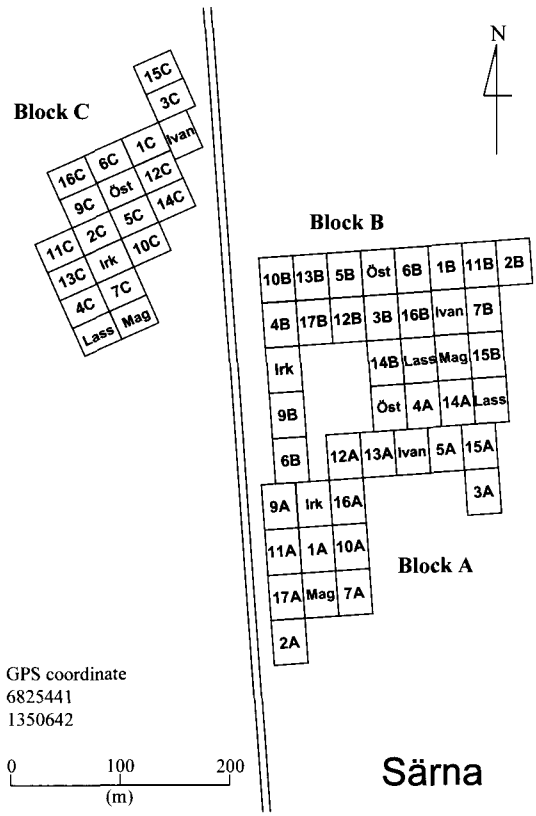

Fig. 3. Design of experimental plot in Särna.

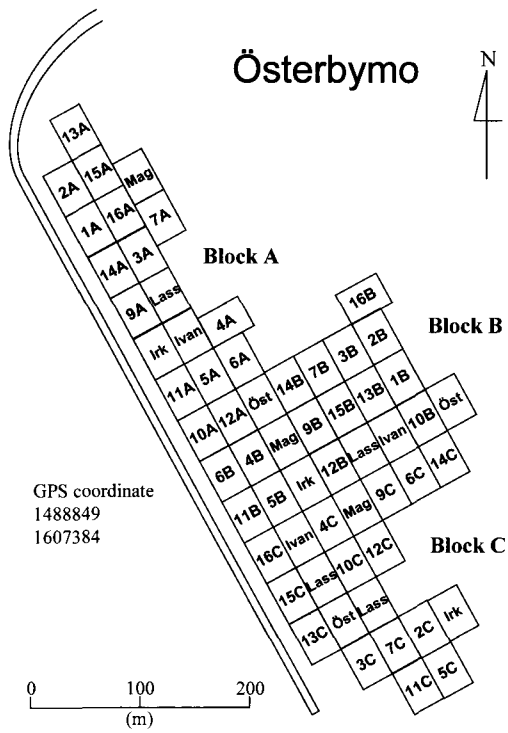

Fig. 4. Design of experimental plot in Österbymo.

Table 4. Seed sources and their origins in the three Swedish main test sites, Österbymo, Särna and Järvträsk.

Number of region	Name of region	Site	Nearest village	Latitude N	Longitude E	Elevation, m	Number of selected seed trees	Species of larch
1	Nizhnij Novgorod	A	Vetluga	57° 30'	45° 10'	-	7	*Larix sukaczewii*
		B	"	57° 30'	45° 10'		29	*Larix sukaczewii*
		C	"	57° 30'	45° 10'		17	*Larix sukaczewii*
		D	"	57° 30'	45° 10'		13	*Larix sukaczewii*
2	Plesetsk	A	Emtsa	63° 05'	40° 21'	100	20	*Larix sukaczewii*
		B	Korasi	63° 00'	40° 25'	120	25	*Larix sukaczewii*
		C	Sheleksa	62° 09'	40° 19'	120	18	*Larix sukaczewii*
3	Onega	A	Leskhoz Onezhskii	64° 01'	38° 15'	110	7	*Larix sukaczewii*
4	Petchora	A	Usinsk	66° 00'	57° 48'		64	*Larix sukaczewii*
5	Salechard	A	Beloyarsk	63° 41'	66° 44'	60	20	*Larix sukaczewii*
		B	Kharp	66° 56'	65° 45'	130	20	*Larix sukaczewii*
		C	Labytnangi	66° 28'	66° 39'	40	20	*Larix sukaczewii*
6	Perm'	A	Okhansk, Yugo-Kamsky	57° 19'	55° 27'	160	20	*Larix sukaczewii*
		B	Nyazepetrovsk, Uzaim	56° 09'	59° 32'	460	20	*Larix sukaczewii*
		C	Kyshtym	55° 43'	60° 27'	480	20	*Larix sukaczewii*
		D	Nizhnij Tagil	57° 30'	59° 48'	350	12	*Larix sukaczewii*
		E	Sotrino	59° 27'	60° 59'	110	Mix of 30 trees	*Larix sukaczewii*
7	Ufa	A	Maginsk	55° 45'	56° 58'	370	20 + mix of 10	*Larix sukaczewii*
		B	Miass	54° 58'	60° 07'	380	20 + mix of 10	*Larix sukaczewii*
		C	Zlatoust	55° 07'	59° 30'	600	20	*Larix sukaczewii*
		D	Ziliar	52° 13'	57° 25'	550	Mix of 10 trees	*Larix sukaczewii*
		E	Bolshoy Iremel	54° 33'	58° 57'	1200	10	*Larix sukaczewii*

8	Norilsk							*Larix sibirica*
9	Boguchany	A	Boguchany	58° 39'	97° 30'	158	27	*Larix sibirica*
		B	Karabula	"	"	96	25	*Larix sibirica*
		C		"	"	--	23	*Larix sibirica*
10	Novokuznetsk	A		53° 48'	88° 00'	mountain	20	*Larix sibirica*
		B		54° 12'	88° 42'	"	20	*Larix sibirica*
		C		52° 48'	87° 24'		20	*Larix sibirica*
11	Altai	A	Kosh-Agash	50° 16'	87° 54'	1630	26	*Larix sibirica*
		B	Kosh-Agash Karnagalu	50° 12'	87° 47'	1580	26	*Larix sibirica*
		C	Kosh-Agash, Turgune	50° 14,5'	87° 3'	1630	26	*Larix sibirica*
12	Yakutiya	A	Zhigansk	66° 45,5'	123° 22'	70	20	*Larix cajanderi*
		B	Zhigansk	66° 51'	123° 21'	80	20	*Larix cajanderi*
		C	Zhigansk	66° 45'	123° 22'	90	20	*Larix cajanderi*
13	Magadan	A		59° 30'	150° 15'	60	25	*Larix cajanderi*
		B		59° 20'	152° 30'	100	25	*Larix cajanderi*
		C		59° 30'	148° 30'	80	25	*Larix cajanderi*
14	Khabarovsk	A	Vaninskyi	49° 08'	149° 00'	90	20	*Larix gmelinii* var *olgensis*
		B	Vaninskyi	49° 09'	149° 00'	100	20	*Larix gmelinii* var *olgensis*
		C	Vaninskyi	49° 12'	149° 00'	125	20	*Larix gmelinii* var *olgensis*
15	Sachalin (missing data)						60	*Larix gmelinii* var *japonica*
16	Kamchatka (missing data)						60	*Larix gmelinii* var *kamchatica*
17	Evenkiya	A	Tura	64° 19'	100° 13'	285	25	*Larix gmelinii*
		B	Tura	64° 19'	100° 14'	310	25	*Larix gmelinii*
		C	Tura	64° 17'	100° 16'	270	25	*Larix gmelinii*
18 Lassinmaa		Seed orchard (Fi)						*Larix sukaczewii*
19 Ivanov		Seed stand (Ru)						*Larix sukaczewii*
20 Irkutsk		Seed stand (Ru)						*Larix sibirica*
21 Maglehem		Seed orchard (S)		55° 46'	14° 10'	20		*Larix eurolepis*
22 Östteg		Seed orchard (S)		63° 48'	20° 16'	10		*Larix sukaczewii*

Table 5. Rate of survival on three experimental sites two growing seasons after plantation.

Number	Region/Provenance	Österbymo		Järvträsk		Särna	
		Survival %	N of planted seedlings	Survival %	N of planted seedlings	Survival %	N of planted seedlings
18	Lassinmaa	93.6	900	86.9	885	87.4	900
3	Onega	95.6	524	88.4	524	81.5	524
19	Ivanov	97.3	823	88	900	76.4	900
10	Novokuznetsk	97.4	900	90	900	72.7	900
9	Boguchany	96	900	87.3	900	75.7	900
2	Plesetsk	98.7	900	84.8	900	75.2	900
16	Kamchatcka	97	900	82	900	78.7	900
7	Ufa	96.4	900	87.8	900	72.6	900
11	Altai	91.8	900	90.2	900	74.6	900
13	Magadan	94.8	900	87.3	900	70.4	900
4	Petchora	86.8	900	81.7	900	80.9	900
6	Perm	96.6	900	82.7	900	68.8	900
5	Salechard	79	900	89,2	900	79.6	900
15	Sachalin	96.6	900	80.3	900	68.3	900
1	Nishnij Novgorod	94.7	900	85.2	900	62.3	900
20	Irkutsk	93.7	900	87.7	448	56.2	450
22	Östteg	90.9	900	84.1	900	62.3	900
14	Chabarovsk	97.8	900	80.1	900	42	900
21	Maglehem	87.1	900	70.1	448	26	450
12	Yakutiya	38.3	900	79.4	900	63.4	900
17	Evenkia					26.8	235
	Total	**90.9**	**17547**	**84.9**	**16705**	**69.4**	**16959**