Genetic considerations at establishing “Dag Lindgren” seed orchard

To get “optimal” seed orchards the genetic data management must aim at utilizing all available information in an optimal way for clone selection and deployment. The techniques were developed during the establishment of this seed orchard and the establishment of this seed orchard is at the frontier of this art. But there is still room for further fine-tuning of the art to set up seed orchards.

Design of clones and grafts

The design is a mixture of selection of founders and their offspring. The list of clones selected and propagated for the seed orchard includes 86 clones, but only 84 were planted. There were 2459 grafts planted. The actual lists are found below. The number of grafts planned for each clone was optimised, but there are some losses and other limitations. Before setting up the actual orchard the optimizing program was run once more. Of the clones in the orchard, 11 are “selection backwards” (“founders”). Thus genotypes selected as phenotypes in a forest once upon a time. Four of these are “old plus trees” selected before 1978 as mature trees in natural forest. Three of these grow at Västerhus. Seven are plus trees selected after 1980 in some decade old plantations. Their progenies were tested in field-experiments and based on that, genotypes found to be genetically superior were selected. One third (33%) of the grafts in the seed orchard are such first generation plus trees. All 73 selection in offspring have known father and mother, which were selected and tested plus trees. Some of these parents grow at Västerhus.

Figure 1 Grafts for the seed orchard cultivated at Sävar midsummer 2012

Dedication of clones to Västerhus and how these dedications roll on to “Dag Lindgren”

Two clones in the planned New Brån are offspring of a clone in Västerhus (Y4508) dedicated to Nebi Bilir: 11-067 (Y4508xY4500, where the dedicated clone is mother) and 86-398 (Y4501xY4508, where the dedicated clone is father). Here Nebi’s son, Yusuf Bilir, keeps grafts of these two clones, which have the clone dedicated to his father as one of their parents. (Photo midsummer 2012) The Figure demonstrates that trees are like humans, generations follow each other.

There are more who will get their dedicated genes transmitted to “Dag Lindgren”.

Runpeng Wei	AC1006
Katarina Lindgren	AC2047
Seppo Ruotsalainen	AC2064

Shen Xi-Huan	AC4221
Urban Eriksson	Y4103
Gösta Eriksson	Y4507
Nebi Bilir	Y4508
Anders Fries	Z3007
Xiao-Ru Wang	Z3009
Yoshinari Morugushi	Z3029

Three clones in Västerhus grow also in "Dag Lindgren" and will thus get their life as clones prolonged some decades and contribute more to future forests. Those lucky are: Run Peng Wei, Katarina Lindgren and Gösta Eriksson. Their dedicated clones were also used in a seed orchard established 2012 by Holmen, "Öden". Those who will get offspring from their dedicated clones in "Dag Lindgren" and thus get grandchildren of their dedicated clones in the seed crop are: Seppo Ruotsalainen, Shen Xi-Huan, Urban Eriksson, Nebi Bilir, Anders Fries, Xiao Ru Wang and Yoshinari Morugushi.

Modern deployment of genotypes to seed orchards

This seed orchard will be the one using the technically most advanced selection and design tools available at its establishment. That includes unequal deployment of clones, which are partly related. This is discussed in: "Lindgren D, Danusevičius D & Rosvall O 2009. Unequal deployment of clones to seed orchards by considering genetic gain, relatedness and gene diversity. Forestry 82:17-28. Forestry (2009) 82 (1): 17-28. doi: 10.1093/forestry/cpn033 " where difference is made between self-coancestry and cross-coancestry. As far as I understand the article is possible to download free of charge: http://forestry.oxfordjournals.org/content/82/1/17.full Later the matter was discussed without emphasis on relatives by Lindgren D, Danusevičius D, Högberg K-A, Weng Y & Hallingbäck HR. 2010. Relatives in seed orchards and clone mixtures**.** International Forestry Review 12(5) page 322. Abstract Slideshow. Rosvall, O. & Lindgren, D. 2012. Inbreeding depression in seedling seed orchards. Arbetsrapport nr 761, Skogforsk, 13 pp. Relatives in seed orchards has always existed in seedling seed orchards, but an early suggestion to use it in clonal seed orchards is: Lindgren D & Werner M 1986. Helsyskonplantage – ett sätt att få bättre granfrö. Årsbok skogsförbättring 155-186.

Optimization of a seed orchard at a given status number (=group coancestry)

A paper appeared in Tree Genetics & Genomes at exactly the same time as the inauguration of the seed orchard: Ahlinder, J., Mullin, T.J., and Yamashita, M. 2014. Mathematical programming for optimising balance of genetic gain and relatedness in forest tree breeding. I. Using semi-definite programming to optimise unequal deployment to a clonal seed orchard. Tree Genet. Genom. 10:27-34 In press..(its clickable). It describes the methodology that has been applied by Skogforsk to optimize the clone mix to be deployed in this orchard; methodology that was very much inspired by Dag Lindgren! Its role is acknowledged in the paper. It was hoped to integrate a general approach to both optimisation of seed orchards and breeding population within POPSIM. The optimizing of selection with a constraint on group coancestry was done with semidefinite programming. The operational tool, OPSEL, is already being used by Skogforsk breeders (including this orchard). OPSEL is a very user-friendly and flexible tool to do orchard selection. OPSEL can re-optimize the survivors, and even fill planting after establishment. OPSEL is available free to anyone, and the solvers it uses are open-source. It is available on request from 'Tim Mullin' <tim.mullin@biosylve.com>. But hopefully it will soon be available from a Skogforsk-hosted page. The optimisation leads to different number of grafts for different clones and the ones

with higher breeding values tends to get higher numbers, but that is counteracted if there are relatives to the clone. The optimisation allows for relatives and leads to a high number of clones and many selections which are offspring from controlled crosses among "founders".

Further genetic management of the orchard

Many selections are rather young trees with plus-tree parents, where the estimation of their breeding values will grow more accurate by time. Some of them belong to the "breeding population", thus parents to the breeding stock. Some of them are selected from young trials where more measurements will be done.

This added information can be used for selective harvest and genetic thinning. Genetic thinning is possible as the trees are arranged in rows and a "hole" in the row will be filled up by neighbours.

The thought to use control crosses for seed production has existed for long, maybe emphasized by vegetative propagation. As this seed orchard is not so far from Umeå and rather easily accessible it is suitable for this type of operations.

Historic strong research environment for initiating New Brån

The idea of making New Brån a spear head seed orchard arose around eight years ago. At that time there was a research school in forest genetics. Jon Hallander (now Ahlinder) and Johan Kroon were doctorands at the research school. Finnvid Prescher was "industrial supervisor" to Jon and Johan. The students at the research school were paid for five years, one year for industrial praxis with the industrial supervisor. The Research School contact motivated Finnvid Prescher to take up his doctorand studies, which he had abandoned two decades earlier. This was extremely successful and Finnvid got IUFROs "Outstanding Doctoral Research Award" for the best thesis work worldwide in forest genetics and plant physiology during five years. Dag Lindgren was supervisor to Finnvid Prescher and Johan Kroon. Through Dag Lindgren contact with Tim Mullin became established. Both Jon Hallander and Johan Kroon spent some time at the breeding station at Sävar. Skogforsk/Sävar pushed the TreO seed orchard program and a breeding review. It can be said to be a very strong environment for seed orchard research, (which was reflected by Finnvids IUFRO award). It was when very natural to assign the task of constructing a spearhead seed orchard to Jon and Johan as a sort of master work. The seed orchard was planned for field grafting on seedlings. However the seedlings did not stand the competition and the seed orchard establishment was much delayed and established after Jon Hallander and Johan Kroon left the research school. Johan Kroon became a lodgepole pine breeder and designs seed orchards for that species and contribute to the general seed orchard competence at Sävar. But after a long time Jon Hallander played a key role in making the seed orchard the spear-head it was intended to be.

That led to that this seed orchard became a spearhead seed orchard at the frontier!

Jon Hallander (nowadays Ahlinder) cooperated in developing algorithms and programs for seed orchards and long term breeding (see below). He is main author of a program was used for this seed orchard. The idea is to optimize the use of relatives in seed orchards, and it is the by far most if not only useable program for that purpose. It uses the actual optimization of this seed orchard as a training example. Thus the project once initiated many years ago for a spear head seed orchard finally concluded in a success – a seed orchard using the most advanced and recent technology. The paper is Ahlinder, J., Mullin, T.J., and Yamashita, M. 2013. Mathematical programming for optimising balance of genetic gain and relatedness in forest tree breeding. I. Using semi-definite programming to optimise unequal deployment to a clonal seed orchard. Tree Genet. Genom. In press. The paper, besides publishing the actual calculations for the composition of this seed orchard, actually mention the orchard in acknowledgements: "The establishment of a seed orchard in northern Sweden, honouring the

pioneering work of Professor Dag Lindgren (SLU, Umeå, Sweden) provided the motivation for the Scots pine case study." Mainly the same calculations as in the scientific paper are presented in a powerpoint-presentation.

The Australian connection
This seed orchard has been established using genotypes selected using the largest integrated analysis of tree breeding programs in the world.

Through the work of Öje Danell, Sweden led the world in use of quantitative genetics in the analysis of forest progeny trial data. Through the initial inspiration of Tore Ericsson and the support of Ola Rosvall, Skogforsk has been working with PlantPlan Genetics of Australia and the Southern Tree Breeding Association (Mainly Tony McRae and Greg Dutkowski) to extend those same quantitative principles to integrated analysis of the whole Swedish tree breeding programs using the DATAPLAN on-line database and the TREEPLAN analytical software.

Integrated analysis allows maximum gain from the investment in progeny testing, by making sure that all of the data that has been collected is used in the analysis. The more data, the higher the reliability of the results, and the more gain that can be made from selection.

Integrated analysis revolves around a massively multivariate prediction of genetic effects (provenance, additive and non-additive) accounting for different traits, measured at different ages, and on different site types. All data that can fit into this framework can be used. The reliability of estimates is boosted by the use of lots of data, through exploiting estimates of the correlations between traits (and ages and sites) and the similarities in performance of relatives.

This innovation has not been without challenges, but has kept Swedish breeding at the forefront internationally.

This method has been used for this orchard and analysis of the populations for this orchard, with the integrated analysis of 72 trials from latitudes 60 to 66, encompassing 332 variable measurements grouped into 86 traits on 292,000 genotypes from 3590 families originating from latitudes 61 to 67 in Sweden, and some Norwegian material. Selections were based on an index that gave most weight to growth on latitudes 63 and 64 mild sites, but also took into account a variety of form traits. The breeding values from these runs have been the input into the OpSel program used to finalise selections for this orchard, taking into account the relatedness between the best genotypes.

The data and analyses continue to expand with the latest runs for *Pinus sylvestris* using 1.3 million measurements from 76 trials from 61 to 67 degrees north and lab freezing tests, with 100 traits of around 378,000 genotypes from 4600 families originating from latitude 61 to 68 in Sweden, as well as material from Finland and Norway.

"Treeplan" is nowadays routinely used in Swedish Tree Breeding, and part of that includes procedures and programs for optimal seed orchard set up

Genetic gain
The breeders have estimated the genetic gain to 27% assuming 100 % seed orchard genes in the resulting plantations. Assuming 40% background pollination this is reduced to 22%, the

reduction will be higher in early crops. The local pollen cloud has a similar origin to the orchard and will reduce gain but not adaptation. The seed can support planting of up to 40000 ha during the life time of the orchard and the genetic gain creates an extra yield of 3.5 million cubic meters. However, I regard these estimates as optimistic. One reason is that I believe in shorter productive life-time of seed orchards than used in most past estimates and would like to see that full scale harvest for plant production in the seed orchard stops 2043 when a genetically more modern seed orchard will take over most of the seed supply.

Application to "Dag Lindgren"

The close to the ground genetics

Torgny Persson made most of the actual work with compiling candidate trees evaluating breeding value of candidates. Seed orchards is creaming the long term breeding population, thoughts about long term breeding in Sweden is presented here. The link to Skogforsk does not work. The main function of long term breeding in the foreseeable future is to support seed orchards.

The program has access to many plus-tree founders (F0 generation) that have been progeny tested by open-pollination, polycross or crosses in different designs. It exist progeny of many pair crosses between the F0 parents that have been established in F1 family field tests. Comparable BLUP EBVs for the target orchard deployment region were available from the TREEPLAN® system (McRae et al. 2004), using all available field-test data. The specification for the orchard is that the grafts deployed should get a Status Number N_S=18. Torgny has been running the optimisation program OPSEL (Ahlinder et al 2014), constructing pack lists to the seed orchard and rerunning OPSEL when available plantation spots in the orchard map became known. Curt Almqvist cooperated with getting seed orchard plan in order.

Each tree get a chip for identification in the root, thus current and future mapping will not depend on manual updating of tags in the field or require consulting old papers. The grafting and propagation of grafts (and rootstocks) to the New Brån seed orchard were propagated at Sävar.

Genetic values and seed orchard implications have been calculated twice, first for selection and multiplication of graft twigs. But as routinely some extra grafts are produced to compensate for possible failures, a final analysis was done before planting allocation, leading to the elimination of a few clones selected for inclusion.

The grafts were allocated spots on the plan of the seed orchard using the program SEEDPLAN. SEEDPLAN is a part in what is available from PLANTPLAN Genetics. SEEDPLAN considers pedigree, and available grafts of each clone. Grafts were packed clonewise and each graft was planted on a spot chosen for the clone by SEEDPLAN. Using any type of assignment map requires a map of the planting spots, which was done rather late in this case. Currently SEEDPLAN was the only program available to Skogforsk. SEEDPLAN spreads the clones over the whole seed orchard which means that collections in part of the seed orchard will be more similar and more representative. There are ideas to isolate some of the grafts in plastic tents and when it is good if selfing is kept down. SEEDPLAN considers pedigree, thus relatives are not planted close, which reduces inbreeding. SEEDPLAN is new and "high-tech" and the ambition is that this seed orchard should be good.

In the seed orchard map where were 84 clones with 2459 ramets (grafts)

The list follows:

Genotype_name	Ramets	V-hus	Öden	Sysknr	Korsnr	Mor	Far	Lat	Long	Alt
11-2	12			S23H6313142	S23KP631024	S01Y4501	S01Y4507			
11-4	32			S23H6212086	S23KP621023	S01AC3032	S01AC3035			
11-5	32			S23H6212121	S23KP621023	S01AC4212	S01AC3035			
11-6	35			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
11-7	28			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
11-8	10			S23H6412203	S23KP621023	S01AC2064	S01AC1007			
11-9	9			S23H6412203	S23KP621023	S01AC2064	S01AC1007			
11-10	8			S23H6412205	S23KP621023	S01AC2064	S01AC4226			
11-11	39			S23H6212079	S23KP621023	S01AC3006	S01AC3035			
11-12	21			S23H6212079	S23KP621023	S01AC3006	S01AC3035			
11-13	22			S23H6212121	S23KP621023	S01AC4212	S01AC3035			
11-14	17			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
11-15	9			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
11-16	7			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
11-17	35			S23H6212142	S23KP621023	S01AC4221	S01AC3008			
11-18	33			S23H6212167	S23KP621023	S01Z3009	S01AC1007			
11-19	10			S23H6212181	S23KP621023	S01Z3007	S01AC1007			
11-20	12			S23H6312123	S23KP621023	S01AC4212	S01AC4204			
11-22	36			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-23	28			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-24	18			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-25	16			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-26	5			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-27	2			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-28	30			S23H7110061	S23KP711031	S01AC1025	S01AC1043			
11-29	39			S23H7110068	S23KP711031	S01AC1025	S01AC2011			
11-30	21			S23H7110071	S23KP711031	S01AC3023	S01AC2011			
11-31	15			S23H7018105	S23KP701029	S01AC3043	S01AC3013			
11-33	31			S23H8510001		S01AC1006	S01Z3007			
11-34	19			S23H8510001		S01AC1006	S01Z3007			
11-35	31			S23H8510013		S01AC4221	S01AC1006			
11-36	16			S23H8510023		S01Y4507	S01Y4103			
11-38	53			S23H8510025		S01Z3009	S01AC2064			
11-39	21			S23H8510013		S01AC4221	S01AC1006			
11-41	33			S23H8510023		S01Y4507	S01Y4103			
11-42	38			S23H8510023		S01Y4507	S01Y4103			
11-43	12			S23H8510023		S01Y4507	S01Y4103			
11-45	29			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
11-46	6			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
11-47	18			S23H6212128	S23KP621023	S01AC4212	S01AC3008			
11-48	36			S23H6212182	S23KP621023	S01Z3007	S01AC1062			
11-49	11			S23H6312123	S23KP621023	S01AC4212	S01AC4204			
11-50	30			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-51	26			S23H6412199	S23KP621023	S01AC1006	S01AC1007			

11-52	1			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
11-56	45			S23H7018094	S23KP701029	S01AC3043	S01AC3046			
11-57	10			S23H7110061	S23KP711031	S01AC1025	S01AC1043			
11-58	23			S23H7110064	S23KP711031	S01AC3023	S01AC1043			
11-59	30			S23H7110068	S23KP711031	S01AC1025	S01AC2011			
11-60	12			S23H7110071	S23KP711031	S01AC3023	S01AC2011			
11-61	21			S23H7018105	S23KP701029	S01AC3043	S01AC3013			
11-62	46			S23H8510001		S01AC1006	S01Z3007			
11-63	37			S23H8510013		S01AC4221	S01AC1006			
11-64	13			S23H8510013		S01AC4221	S01AC1006			
11-66	17			S23H8510025		S01Z3009	S01AC2064			
11-67	22			S23H9110085	S23KP911043	S01Y4508	S01Y4500			
11-68	21			S23H8510001		S01AC1006	S01Z3007			
11-69	30			S23H8510023		S01Y4507	S01Y4103			
81-420	66		X					64,2	17,65	410
82-33	36		X					63,88	20,47	35
83-40	51		X					63,48	16,70	195
84-248	34							64,37	20,48	230
84-250	65		X					64,37	19,67	230
84-334	83							64,02	19,8	205
85-44	147		X					64,02	20,8	110
86-317	5			S23H6313142	S23KP631024	S01Y4501	S01Y4507			
86-398	18			S23H6313138	S23KP631024	S01Y4501	S01Y4508			
89-529	15			S23H6212079	S23KP621023	S01AC3006	S01AC3035			
89-535	15			S23H6412203	S23KP621023	S01AC2064	S01AC1007			
89-577	38			S23H6412194	S23KP621023	S01AC3001	S01AC1007			
89-650	26			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
89-658	13			S23H6212080	S23KP621023	S01AC3006	S01AC4208			
89-666	29			S23H6312126	S23KP621023	S01AC4212	S01AC2047			
89-668	4			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
89-670	37			S23H6212177	S23KP621023	S01Z3007	S01AC3008			
89-671	6			S23H6212167	S23KP621023	S01Z3029	S01AC1007			
89-685	29			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
89-687	25			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
89-694	36			S23H6212121	S23KP621023	S01AC4212	S01AC3035			
89-826	26			S23H7110061	S23KP711031	S01AC1025	S01AC1043			
AC1006	106	X	X					64,88	18,86	300
AC1066	44							64,13	17,41	350
AC2064	49	X	X					64,25	17,52	350
Y4507	137	X	X					63,62	16,84	250
	84	2459	3	8						

Gulmarkerad klon ingår i T10 Västerhus X samma Öden

Clone list. The list of the clones cultivated for the new seed orchard at Sävar follows:

Clone ID	V-hus	Öden	SibIDr	CrossID	MotherID	FatherID	Lat	Long	Alt
S01AC1006	X	X					64,88	18,86	300
S01AC1066							64,13	17,41	350
S01AC2064	X	X					64,25	17,52	350
S01Y4507	X	X					63,62	16,84	250
S23K1110002			S23H6313142	S23KP631024	S01Y4501	S01Y4507			
S23K1110004			S23H6212086	S23KP621023	S01AC3032	S01AC3035			
S23K1110005			S23H6212121	S23KP621023	S01AC4212	S01AC3035			
S23K1110006			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
S23K1110007			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
S23K1110008			S23H6412203	S23KP621023	S01AC2064	S01AC1007			
S23K1110009			S23H6412203	S23KP621023	S01AC2064	S01AC1007			
S23K1110010			S23H6412205	S23KP621023	S01AC2064	S01AC4226			
S23K1110011			S23H6212079	S23KP621023	S01AC3006	S01AC3035			
S23K1110012			S23H6212079	S23KP621023	S01AC3006	S01AC3035			
S23K1110013			S23H6212121	S23KP621023	S01AC4212	S01AC3035			
S23K1110014			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
S23K1110015			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
S23K1110016			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
S23K1110017			S23H6212142	S23KP621023	S01AC4221	S01AC3008			
S23K1110018			S23H6212167	S23KP621023	S01Z3009	S01AC1007			
S23K1110019			S23H6212181	S23KP621023	S01Z3007	S01AC1007			
S23K1110020			S23H6312123	S23KP621023	S01AC4212	S01AC4204			
S23K1110022			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110023			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110024			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110025			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110026			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110027			S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110028			S23H7110061	S23KP711031	S01AC1025	S01AC1043			
S23K1110029			S23H7110068	S23KP711031	S01AC1025	S01AC2011			
S23K1110030			S23H7110071	S23KP711031	S01AC3023	S01AC2011			
S23K1110031			S23H7018105	S23KP701029	S01AC3043	S01AC3013			
S23K1110033			S23H8510001		S01AC1006	S01Z3007			
S23K1110034			S23H8510001		S01AC1006	S01Z3007			
S23K1110035			S23H8510013		S01AC4221	S01AC1006			
S23K1110036			S23H8510023		S01Y4507	S01Y4103			
S23K1110038			S23H8510025		S01Z3009	S01AC2064			
S23K1110039			S23H8510013		S01AC4221	S01AC1006			
S23K1110041			S23H8510023		S01Y4507	S01Y4103			
S23K1110042			S23H8510023		S01Y4507	S01Y4103			
S23K1110043			S23H8510023		S01Y4507	S01Y4103			
S23K1110045			S23H6212122	S23KP621023	S01AC4212	S01AC4208			
S23K1110046			S23H6212124	S23KP621023	S01AC4212	S01Z3006			
S23K1110047			S23H6212128	S23KP621023	S01AC4212	S01AC3008			

S23K1110048		S23H6212182	S23KP621023	S01Z3007	S01AC1062			
S23K1110049		S23H6312123	S23KP621023	S01AC4212	S01AC4204			
S23K1110050		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110051		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110052		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110053		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K1110056		S23H7018094	S23KP701029	S01AC3043	S01AC3046			
S23K1110057		S23H7110061	S23KP711031	S01AC1025	S01AC1043			
S23K1110058		S23H7110064	S23KP711031	S01AC3023	S01AC1043			
S23K1110059		S23H7110068	S23KP711031	S01AC1025	S01AC2011			
S23K1110060		S23H7110071	S23KP711031	S01AC3023	S01AC2011			
S23K1110061		S23H7018105	S23KP701029	S01AC3043	S01AC3013			
S23K1110062		S23H8510001		S01AC1006	S01Z3007			
S23K1110063		S23H8510013		S01AC4221	S01AC1006			
S23K1110064		S23H8510013		S01AC4221	S01AC1006			
S23K1110066		S23H8510025		S01Z3009	S01AC2064			
S23K1110067		S23H9110085	S23KP911043	S01Y4508	S01Y4500			
S23K1110068		S23H8510001		S01AC1006	S01Z3007			
S23K1110069		S23H8510023		S01Y4507	S01Y4103			
S23K8110420	X					64,2	17,65	410
S23K8210033	X					63,88	20,47	35
S23K8310040	X					63,48	16,70	195
S23K8410248						64,37	20,48	230
S23K8410250	X					64,37	19,67	230
S23K8410334						64,02	19,8	205
S23K8510044	X					64,02	20,8	110
S23K8610017			S23KP701029	S01AC3043	S01AC3013			
S23K8610317		S23H6313142	S23KP631024	S01Y4501	S01Y4507			
S23K8610398		S23H6313138	S23KP631024	S01Y4501	S01Y4508			
S23K8910529		S23H6212079	S23KP621023	S01AC3006	S01AC3035			
S23K8910535		S23H6412203	S23KP621023	S01AC2064	S01AC1007			
S23K8910577		S23H6412194	S23KP621023	S01AC3001	S01AC1007			
S23K8910650		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K8910658		S23H6212080	S23KP621023	S01AC3006	S01AC4208			
S23K8910666		S23H6312126	S23KP621023	S01AC4212	S01AC2047			
S23K8910668		S23H6212122	S23KP621023	S01AC4212	S01AC4208			
S23K8910670		S23H6212177	S23KP621023	S01Z3007	S01AC3008			
S23K8910671		S23H6212167	S23KP621023	S01Z3029	S01AC1007			
S23K8910685		S23H6412199	S23KP621023	S01AC1006	S01AC1007			
S23K8910687		S23H6212122	S23KP621023	S01AC4212	S01AC4208			
S23K8910694		S23H6212121	S23KP621023	S01AC4212	S01AC3035			
S23K8910826		S23H7110061	S23KP711031	S01AC1025	S01AC1043			
86	3	8						

Yellow clones in) T10 Västerhus Clone list FromUlfstandGraftingSavar1206

This list comprises 86 clones, two of them were not planted

Lists with seed orchards

Market name on "the official list"
The name "Dag Lindgren" or "T10 Dag Lindgren" may be the official (market) name of the seed orchard, but that remains to be seen. Approval for commercial use and "official" registration of name need to be done first when the seeds become available to the market. When it appears in the official list (called "rikslängden"; ett "handelsregister"; "National list of basic material") managed by the forest authority (Skogsstyrelsen). You may note Brån (FP-18) on the current list. This inclusion of the new seed orchard in this official list may occur around year 2021 (it costs, so why register early, but the first crop may be harvested 2021 (eight years after establishment). The current list has names and nr in different columns, if "Dag Lindgren" remains as a name it seems better to differ between name and nr. It remains to be seen if the name survives so long, but till that I assume it will continue to be used as a work name.

Tall
Pinus sylvestris

Namn	Rikslängdsnr.	Kategori	Plantagens: latitud (N)	altitud	areal (ha)	Klonernas: antal	latitud (N)	altitud
Albjershus	FP-59	Individutvalt	56°00'	105	23	37	57°24'	180
Almnäs	FP-601	Individutvalt	58°15'	125	19	60	59°19'	166
Alnön	FP-402	Individutvalt	62°30'	20	10	40	64°18'	340
Alvik T1	FP-626	Testat	63°47'	5	39	82		
Alvik T1, Frak A, 10 kl	FP-626A	Testat	63°47'	5	39	10		
Alvik T1, Frak B, 129 kl	FP-626B	Testat	63°47'	5	39	129		
Alvik T2	FP-627	Testat	63°47'	5	23	139		
Alvik T2, Frak A, 10 kl	FP-627A	Testat	63°47'	5	23	10		
Alvik T2, Frak B, 72 kl	FP-627B	Testat	63°47'	5	23	72		
Asarum	FP-611	Individutvalt	56°13'	50	12	23	56°48'	151
Askerud	FP-493	Individutvalt	59°48'	80	14	43	61°06'	460
Bogrundet	FP-406	Individutvalt	62°30'	10	10	44	65°54'	440
Borgvik	FP-494	Individutvalt	59°18'	95	10	40	61°00'	430
Brån	FP-18	Individutvalt	63°54'	75	8	34	64°24'	190

A coordinated program for establishment of seed orchards

Skogforsk coordinates a seed orchard establishment program "TreO programmet". This has a home page
www.skogforsk.se/sv/Om-oss/Samverkan/Nya-froplantager-TreO/Aktuellt-utbyggnadslage/ The link to Skogforsk does not work. where you may read (

Tallplantager (=new pine seed orchards; zone, establishment year, area, link)

Zon	Anläggnings år	Ha	Ansvarig	Länk
T10	anläggs 2012	18,3	Holmen	Öden, Grundsunda
T10	**anläggs 2013**	**5,0**	Sv.skogspl. egen	Dag Lindgrens plantage

The Swedish genetic database and Skogforsk´s share in it.

The Seed Orchard is registered in FRITID-database. That is the Skogforsk genetic data base and the only national register of forest genetic units including seed orchards. It is difficult to believe someone authorized to operate this database should dare to remove “Dag Lindgren” from that data base as long as the seed orchard exists without a specific instruction from the owner, but who knows? The current identification of the orchard in the database is S23FP1T10 -2. An extract from the data base is shown below. S23 is a common Swedish code identifying the organisation assigning the number. Thus the first three places is a national (Nordic) standard, which now gets into international problems claiming that Sweden is SE.

Query5														
Lokalnr	**Namn**	**Trsl**	**Lan**	**Zon**	**Kartnr**	**Ns_kord**	**Ov_kord**	**Lat**	**Long**	**Hoh**	**Agare**	**Agar_andel**	**t**	**Ovrigt**
S23FP1T10 -2	Dag Lindgren	10	24		20J	7095300	1698200	63.92	19.85	80	994	SSP 100%		Seed orchard dedicated to professor Dag Lindgren

”Lokalnr” (seed orchard identification) S23FP1T10 var redan upptaget av Västerhusplantagen. Denna plantage skall försörja vad som här kallas för tallzon T10, dvs. samma geografiska area som Västerhus.

This document was last edited 15-08-26, links except most to SkogForsk worked.