A TreeBreedex seminar open beyond the consortium

What do large genetic field experimental networks across Europe bring to the scientific community?

Sękocin Stary (Poland), June 22 – 24, 2010

Minutes

By: Jan Kowalczyk, Władysław Chałupka, Gerry Douglas, Berthold Heinze, Darius Danusevicius, Mirko Liesebach and Heino Wolf

Seminar attenders

Sękocin Stary (Poland), June 22, 2010

Program

Monday, June 21, 2010
Arrival of participants

Tuesday, June 22, 2010

8.00	Leave hotels by minibus or by foot (a twenty minute walk)
8:30 – 9.15	Registration and coffee
9.15 – 9.30	Welcome address of Prof. dr hab. Tomasz Zawiła-Niedźwiecki, Director of Forestry Research Institute in Sękocin Stary.
9.30 – 9.45	Introduction by Luc. E. Paque, TREEBREEDEX Coordinator Technical announcements by Jan Kowalczyk
9.45 – 10.15	1st invited presentation: *Usefulness of the genetic field experiments for biological sciences* - Jacek Oleksyn
10.15 – 10.50	Voluntary papers
10.15 – 10.35	*The role of common garden studies in adapting forests to climate change in the Northwestern U.S.* - Daniel Chmura
10.35 – 10.50	*Population variability of Fagus sylvatica leaves: a preliminary study* - Marzenna Guzicka
10.50 – 11.00	Discussion
11.00 – 11.30	Coffee and group photograph
11.30 – 13.00	Visit to the experimental plot of Scots pine (IUFRO 1982)
13.00 – 14.00	Lunch
14.00 – 14.30	2nd invited presentation: *What do genetic field trials tell about the future use of forest reproductive material?* - Csaba Matyas
14.30 – 15.30	Voluntary papers
14.30 – 14.50	*Genetic reactivity of Norway spruce to climate change based on experimental results from IPTNS-IUFRO 1964/68 test in Poland* - Janusz Sabor
14.50 – 15.10	*Short review of the tree improvement work with birch and alder in Ireland* – Ellen O'Connor
15.10 – 15.30	*International trials concerning forest species in Italy* – Anna De Rogatis
15.30 – 15.45	Discussion
15.45 – 16.00	Coffee
16.00 – 16.30	3rd invited presentation: *Provenance experiment networks as a tool for biochemical and molecular genetics of forest trees* - Berthold Heinze
16.30 – 17.10	Voluntary papers
16.30 – 16.50	*Characteristics of genetic diversity and differentiation of progeny and mother stands of European Beech in Poland* - Małgorzata Sułkowska
16.50 – 17.10	*Microsatellites and genetic diversity in seed orchard and provenance test* - Magdalena Trojankiewicz
17.10 – 17.25	Discussion
17.25 – 18.30	TREEBREEDEX Consortium meeting *Efficiency of tree breeding strategies in Europe. Report from the Questionnaire "Testing strategies in tree breeding"* - Darius Danusevicius
18.30	Free evening

Wednesday, June 23, 2010

9:00 – 9.30	4th invited presentation: *Impact of the results of large genetic field experimental networks to practical forestry supporting industry* - Dag Lindgren
9.30 – 11.00	Voluntary papers
9.30 – 9.55	*Climate-growth-relations of Fagus sylvatica provenances of the International Beech Provenances Experiment of 1993/95 growing in Central Europe* - Mirko Liesebach
9.55 – 10.20	*Euro-Asiatic transcontinental provenance experiment on Scots pine (Pinus sylvestris L.)* – Władysław Chałupka
10.20 – 10.40	*Larix decidua polonica in Western Europe. First results from a joined European network of progeny trials* – Luc Pacues
10.40 – 10.55	*Last Evaluation of the Provenace Plot Podbanské, Slovakia (IUFRO I. Larch Series 1944)* – Elena Foffová
10.55 – 11.10	*Eurasian provenance experiment trial of Scots Pine at Sambor in Ukraine* – Jan Kowalczyk
11.10 – 11.30	Coffee
11.30 – 12.10	Voluntary papers
11.30 – 11.50	*Adaptability of oak (Quercus robur L.) ecotypes in conditions of climate change* - Igor Neyko
11.50 – 12.10	*PLANTACOMP: Genetic experimental network of French National Institut for Agricultural Research* - Anger Christel
12.10 – 12.30	Discussion
12.30 – 13.30	Lunch
13.30 – 14.00	5th invited presentation: *Large forest tree provenance experimental networks: their advantages, limitations and importance for future experiments* - Mirko Liesebach and Heino Wolf
14.00 – 14.30	Poster session and common discussion
14.30 – 14.45	Final Discussion and conclusions
15.00 – 15.30	Coffee
15.30	Leave for Warsaw to visit the Royal Castle and the Old Town
19.00	Social dinner in the “Kompania Piwna” restaurant at the Old Town
22.00	Arrive hotels

Thursday, 24 June, 2010 - Field trip

7.30	Leave Sękocin
8.45 – 9.30	Visit to the European larch reserve “Modrzewina”
11.30	Arrive Bliżyn, EVOLTREE Intensive Study Site (ISS) Bliżyn, Świnia Góra larch stand Open air lunch
19.00	Arrive hotels

Friday, 25 June, 2010

Departures

Summary reports on papers and posters presented at the Seminar:

What do large genetic field experimental networks across Europe bring to the scientific community?

held at the Forest Research Institute, Sekocin Stary, Poland, 22-24 June 2010.

For publication / distribution by Treebreedex:

Seminar background

Compared to other plant species, forest trees are specific in many aspects. They are long living plants with late sexual maturity, still undomesticated with high variability and heterozygosity levels. All this implies that research and tree improvement requires a specific approach. Forest tree breeders have developed over a long time a vast and original know-how. Most are interested in traits exploitable through selection, they have developed extended and unique experimental field networks covering contrasting ecological conditions where expression of genetic variability is studied. Unfortunately, this knowledge is not always disseminated and infrastructures are not exploited to their full extent. Thus we organize this seminar to discuss practical aspects connected with genetic field experiments not only between forest tree breeders but also with a wider audience.

The main objectives of the seminar were:

- To review the existing international field experiments
- To inform (advertise) the scientific community about the existing international networks.
- To review studies in different fields of biological sciences already done (such as biochemical/molecular genetics, environmental changes, soil microbiology, ecophysiology etc.) using forest tree provenance experimental networks.
- To evaluate limitations and constraints as well as new possibilities for using old provenance trials.
- To discuss the need for new networks for forest tree studies.

Summaries

Session 1 - *Gerry Douglas,* Chair and rapporteur

Invited presentation:

Usefulness of genetic field experiments for biological sciences

Jacek Oleksyn

Field experiments to test the adaption of new and different origins of genetic material (provenances) began when explorers bought new species to Europe from diverse parts of the world in the 16th and 17th century. 'Riga Pine' from the Baltic was the source of pine trees suitable for ship masts in the 18th and 19th centuries and these Baltic seed sources were collected and tested in 18 sites in France by Philip de Vilmorin at around 1810. The first concerted international trials decided on the parameters to record to compare sources, such as DBH and tree height. Scots Pine was the first international scientifically based trial established in 1938-39 by IUFRO and thereafter a series of trials used a broad range of provenances.

The first trials with Scots pine showed that 'local' sources were best however modest increases in height and survival rates can be obtained using different sources to local. Recent experiments have shown that Northern provenances have more root production biomass per year and that the populations from North or high elevation had a higher proportion of live roots. Clear differences in the start and end of the growth cycle were detected with an earlier flushing (by 10 days), a longer period of needle growth (by 45 days) and a larger growing season (+60 days) was found for Polish provenances compared to Swedish Provenances. Ecophysiological studies have shown that Northern Provenances of Norway spruce and those from higher altitudes have a higher concentration of nitrogen in their leaves and dark respirations and photosynthesis was also higher.

The role of common garden studies in adapting forests to climate change in the Northwestern U.S.
Daniel Chmura G. T. Howe, J. Brad St. Clair, P. D. Anderson

This paper reported on the value of long term provenance tests and short term nursery tests as information sources to develop models which can suggest the optimal provenance sources for a particular range of sites or those sites which are suitable for specified provenances. Trees are adapted to their original climate conditions, however populations may occupy suboptimal sites and the management unit in relation to climate change should be considered as the population rather than the species. In NW USA several climate changes are expected which will impact on the adaptability and productivity of the forests such as drought, fires, insects and diseases. Active management and assisted migration of genetic resources at the level of population may be required. It is known that temperature increase will significantly reduce productivity in Lodgepole pine but populations have been identified which can cope with such changes to maintain productivity. In climate change scenarios it was reported that a 4◦c increase in temperature would give a 9% reduction in yield but by using the best adapted germ plasm gains of 14% could be possible from studies on lodepole pine. The response to climate change is to a) use genetic options of better suited populations to expected climate change conditions b) Produced improved genotypes with greater stress resistance c) Manage populations by assisted migrations d) Conserved genetic diversity of populations *in situ* and *ex situ* e) develop better climate change models for local/regional levels of application f) Promote decision support tools which helps the forester to identify the optimal populations for his geographic site or the identify the optimal sites for the population genotypes which are available. A centre for provenance data including all provenance trial results is available in the USA, similar to the date base of Treebreedex, but more detailed information on soil and site conditions would help to make models more accurate and results from common garden experiments have a big role in developing the decision support tools.

Population variability of Fagus sylvatica leaves: a preliminary study
M. Guzicka and R. Rozkowski.

This was a report examining genetic diversity of 12 beech provenances tested in Poland, using leaf morphological characters such as area, perimeter length and width, number of holes per leaf, LSA and leaf mass. Statistical analysis was performed on all data and an analysis of variance showed no effect of blocking on all characters except blade length. Significant provenance effects were found for all of the characters which were measured.

Session 2 - *Luc Paques,* Chair and rapporteur

Invited presentation:
What do genetic field trials tell about the future use of forest reproductive material material?
Csaba Matyas

This paper reported methods of adjusting the policy of forest reproductive material use to the challenges of climate change. Possible actions requires genetic information on the tolerance and adaptability of tree species. In practice, the only possibility to study adaptive responses under experimental conditions is the analysis of common-garden tests (i.e. provenance trials). The transfer analysis of forest reproductive material, i.e. modelling and forecasting responses based on field trials, is a useful tool to investigate the effects of environmental changes on growth and health. As part of this analysis, the phenotypic response of a provenance across test sites is interpreted as norm of response to changing climatic conditions. The response functions can be used to validate models describing adaptive reactions to changed climate. Results of field trials show a remarkable range of adaptability even to dramatic changes in thermal and moisture conditions. The effects of environmental changes on tree populations in different parts of the distribution range are, however, divergent, as different climatic factors exert their selection pressure. A fundamental question is how much the natural genetic processes such as migration, gene flow and natural selection, can compensate the effects of climate change. It seems that the simultaneous action of these processes creates an adaptive genetic disequilibrium, instead of adaptive optimisation, a preconception implicitly regarded as basis of forest reproductive material use in the past. Author recommend human interference to ensure adaptability of forests and reduce environmental and social pressures on sustainability and pointed out the need a common plan of action.

Genetic reactivity of Norway spruce to climate change based on experimental results from IPTNS-IUFRO 1964/68 test in Poland
Janusz Sabor

This was a report presenting result of Norway spruce trial from series IUFRO 1964/69. Genetic diversity of spruce provenances tested in Krynica (Poland)n was presented. The trial has a full set of 1096 provenances. It is the most elevated planting site (750 m) for the whole experiment. The experiment covers provenances from the natural range of the species and from the area where spruce was introduced by man. Poland is represented by 92 provenances. Among all the provenances considered, 528 have a strictly defined (accurate to a stand) location, so they can be reproduced and used in practice. The material is thus representative of the whole Picea abies species to the degree that has no parallel in any previous research. Statistical analysis was performed on all data and an analysis of variance showed no effect of blocking on all characters except blade length. Significant provenance effects were found for all of the characters which were measured. As suggested by the height of trees aged 25 years and the frost resistance (late flushing) of spruces, the provenances from regions 67 East Pomeranian Lakeland, Masuria Poland, 69 Augostów, Lakeland Poland, 50 Slovenskie Rudohorje , 75 Belarus, 96 Canada (Hudson, Ontario) and 58 Bihor Mts., Transylwania, Romania have the greatest genetic and breeding value.

A Review of the Irish Birch and Alder Improvement Programmes
Ellen O'Connor, Niamh O' Dowd, Martin Steer, Michael Bulfin, Nuala Ni Fhlatharta and Barbara Doyle

This was a brief review of the Irish birch and alder improvement programmes. The improvement of birch has progressed with 10 year-old progeny trials and an indoor seed orchard established at this stage. Alder, is on the recommended list for afforestation and has been in such demand in recent years that the development of an improved sustainable, healthy native seed source was warranted. Poor stem quality of naturally regenerated birch has prevented the listing of birch as a recommended species for afforestation programmes. Previous field tests of seed obtained from Sweden and Finland in the 1960's and 1980's have resulted in low survival and slow growth rates in the imported material. This poor performance was attributed to mal-adaptation to environmental cues, especially photoperiod, in these species. Based on this experience, a programme of birch improvement founded on native plus-tree selection was started in 1998; supported and funded by COFORD, the council for forestry research and development. The improvement of alder was initiated in 2005. Grafts of eighty-five plus-trees have been collected for use in an untested seed orchard.

International trials concerning forest species in Italy
Anna De Rogatis, Fulvio Ducci & Lorenzo Vietto

This paper reported Italian and specially CRA SEL efforts for establishing international experiments on forest species. Only large and completive experiments can allow the understanding of productive potential and adaptation traits of species. Most of international tests were initially focused on conifers, mostly exotics but also hardwood species. Presentation concerns trials with Pseudotsuga menziesii, Pinus helepensis, others Mediterranean pines (Haleppo pines section), Prunus avium, Juglans sp. Mediterranean firs, Populus sp., Pinus sylvestris and Larix. During the seminar authors pointed out that old trials still existing and maintained. Nowadays, in view of the global change effects, they are open air laboratories for studying deeply adaptation and genetics of adaptation and supply information on FGR reactions strategic for mitigation activities and preserving resources in situ and ex situ. During the managements of the trials some problems exist, for maintenance, continuity of the measurements and observation in the time, problems due to changes in people, but now also to the increased frequencies of extreme events (for example drought).

Session 3 - *Mirko Liesebach,* Chair and rapporteur

Invited presentation:
Provenance experiment networks as a tool for biochemical and molecular genetics of forest trees Berthold Heinze

The 3rd session was opened with the presentation on "Provenance experiment networks as a tool for biochemical and molecular genetics of forest trees" (Berthold Heinze). Two case studies on "*Characteristics of genetic diversity and differentiation of progeny and mother stands of European Beech in Poland*" (Małgorzata Sułkowska) and "*Microsatellites and genetic diversity in seed orchard and provenance test*" (Magdalena Trojankiewicz) rounded the session off.
The presentation showed that the genetic diversity is equal in investigated seed orchards and their progenies. That was also observed regarding stands and their progenies (provenances). Yet the question is: What does genetic diversity mean?
It was stated that genetic diversity is necessary for a save production process. A restriction to one or only a limited number of clones comprises higher risks of

damage. To keep inbreeding on a low and maintainable level, 20 clones seems to be enough.
An example of Scots pine stand, which has been destroyed in wide parts by a storm, has shown that the diversity of the remaining stand and within the natural regeneration is lower than in the progenies coming from a seed orchard. There is no doubt, using reproductive material from seed orchards seldom alleles which might be present in a stand and its natural regeneration can get lost.
Correlations between gene markers and phenotypic traits are detected in a few cases for various species e.g. Poplar and Norway spruce. Therefore, basic research into gene function is necessary. Further traits and tree species should be taken into prospective consideration.

Session 4 - *Darius Danusevicius,* Chair and rapporteur

Invited presentation:
Impact of the results of large genetic field experimental networks to practical forestry supporting industry
Dag Lindgren

The morning session started with an invited presentation by Dag Lindgren (Swedish University of Agricultural Sciences, Sweden) “Impact of the results of large genetic field experimental networks to practical forestry supporting industry”. Professor pointed out that the experimental networks supported by several interested organizations at national or international level is a very beneficial initiative, which now is more or less abandoned at least an the international level. Environments are changing, thus individual organizations may change preferred materials on their land to other genetic materials tested in other environments than foreseen and this choice is helped by large genetic field experimental networks. Predictions for the sites where material is not tested could be possible. The session continued with voluntary presentations. Mirko Liesebach (vTI, Germany) reported results on “Climate-growth-relationships of Fagus sylvatica provenances of the international beech provenance experiment of 1993/95 growing in central Europe”: provenances were transferred to a warmer and more dry climates which could allow modeling the response to climatic change; the material grew better on agricultural land than on forest land; the transfer had no significant effect on height growth of the provenances form center of the species distribution, however, it did markedly affected the performance of the eastern provenances. The next speaker W. Chalupka (Institute of Dendrology, Poland) presented the series of testes of Eurasian Scots pine provenances (so called Prokazin series) where the testes were established, numbers of provenances and references to the reports of the results by noting the importance of this series as it contains the eastern material not well studied as the corresponding IUFRO series. Luc Paques (INTRA, France) presented the first results from the jointed European network of larch progeny trials including provenances of Larix deciduas var. Polonica. The performance of the Polish larch and the transfer effect were discussed. Jan Kowalczyk (IBL, Poland) presented results for an Ukrainian site of the Prokazin series of Scot spine provenance tests. Slight transfer southwards (form Belarus Gomel) had a positive effect on the performance of the provenances sat the Ukrainian test site. Elena Foffova (NCL, Slovakia) presented the results from an inventory on a recent storm damage in an adult European larch provenance test in Tatra mountains. Most of th trees in the test were broken and dead; this shows the need of an ex-situ back up of the moist valuable tests as the genetic resource populations. Igor Neyko (URIFFM, Ukraine)

presented results on adaptability of oak ecotypes in conditions of climatic change in Ukraine.

Session 4 - *Berthold Heinze,* Chair and rapporteur

Invited presentation:
Large forest tree provenance experimental networks: their advantages, limitations and importance for future experiments
Heino Wolf (presented by Mirko Liesebach)

Session early afternoon starts Mirko Liesebach (in a presentation prepared with Heino Wolf) reviewed the history of provenance research and important developments since the 18th century up to the recent *Fagus sylvatica* 1993/95 example. In summary, the main conifer and broadleaf species are covered by such networks. Assessment of growth, quality and resistance was done and published. More or less, knowledge for current climate conditions is available. Knowledge gaps include rare and minor species, which are under-represented; additionally, there are regional gaps. Assessments of morphology, anatomy etc. are often done by chance only; material tested regionally can be traded Europe-wide without restriction. Advantages are that this forms the scientific base for delineation of regions of provenances, and practical recommendations for deployment. Limitations are the representativeness of the seed collections (unequal flowering years), inconsistent sets of standard provenances, gaps in participating countries, and that the distribution of trial plots can be uneven. Continuity of experiments place high demand on local infrastructure; ownership, institutional continuity, and other factors. Analyses depend on reliable data, its storage for long term, accessibility and low level of missing values. More systematic testing and breeding would be desirable.

Poster session - *Berthold Heinze*, Chair and rapporteur

Posters presented at the seminar where intensively discussed in personal meetings with the authors. During a general discussion that followed, the following topics where touched:

- examples for other disciplines using trial networks (growing interest among physiologists because of the wider range they cover; entomologists)
- which networks are the ones most valuable for preserving (a request was made by Luc Paques to send a list of 3 most important ones to him)
- emphasis on provenance trials - what about seed orchards and other material?
- IUFRO Working Parties are not stable over time - they depend much on persons. EFI and COST are possible alternatives
- for any new species, are new networks necessary? (e.g. the RAP field trials did not cover the range of *Fraxinus* well).
- such networks should remain open; launching of networks should be more widely announced
- is more systematic testing of seed orchards necessary? (e.g. sycamore, Acer pseudoplatanus)
- there is a timing problem for seed orchard tests (as in some cases, the seed orchards will not be used long enough in order to wait for trial results); better

test individual clones first; include neighbouring material in any tests, share bred material, also for references

- however, lifetime of seed orchards varies a lot, often they stay in place longer

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Field trip summary

Jan Kowalczyk

Field trip was split for two parts. First one was short visit on demonstration plots IUFRO 1982 Scots pine experiment in Sękocin during first day of seminar. The discussion was concentrated on usefulness of demonstration trials and theirs managements.
Te second part was devoted to visit ISS Bliżyn site selected within Evoltree project as close to untouched ecosystem. ISS are large scale ecosystem plots (a few thousands of hectares) where trees and selected associated species will be mapped, genotyped and phenotyped. The sites will contain entire portions of landscapes where trees are present in different configurations. The trip was concentrated on demonstration some research plots. The focus was put on larch stands which was served as seed sources to the France – Polish common experiment. Because during the trip was heavy rain there was opportunity for a dipper discussion participants and also local foresters. The decisions was focused on present management of such diversified forest. The special and interested review including historical background was given by the director Piotr Kacprzak.

Conclusions

There were present 37 participants from 14 countries representing. All presentations were followed by detailed questions/answers and discussions. A total of 20 minutes was the allotted time for each speaker for presentation including 5 minutes for discussions. After the seminar e-mail exchange was performed imitated by Dag Lindgeren “how to utilise for the breeding practical purpose big international experimental series”. The conclusion is still open. .....

More information and seminar material are available on IBL website:

http://genetyka-lesna.ibles.pl/dla-wszystkich/treebreedex

List of Attendees:

Treebreedex IBL Sachsenforst

What do large genetic field experimental networks across Europe

Forest Research Institute, Sękocin Stary, Poland 22.06. 2010(Tuesday)

No	Name	Institution	signature
1	Berthold Heinze	BFW	
2	Josef Frydl	VULHM	
3	Christel Anger	INRA, Orleans	
4	Luc E. Paques	INRA	
5	Mirko Liesebach	vTI	
6	Csaba Matyas	UWH	
7	Gerry Douglas	TEAGASC	
8	Ellen O'Connor	UCC	
9	Anna De Rogatis	CRA - SEL	
10	Jurata Buchowska	LFRI	
11	Darius Danusevicius	LFRI	
12	Jacek Banach	UR	
13	Władysław Chałupka	ID PAN	

14	Daniel Chmura	ID PAN	
15	Marzenna Guzicka	ID PAN	
16	Anna Hebda	UR	
17	Anna Jagielska	IBL	
18	Marta Kempf	UR	
19	Janusz Sabor	UR	
20	Jan Kowalczyk	IBL	
21	Piotr Markiewicz	IBL	
22	Katarzyna Masernak	UR	
23	Jan Matras	IBL	
24	Jacek Oleksyn	ID PAN	
25	Krystyna Szczygieł	IBL	
26	Roman Rożkowski	ID PAN	
27	Marek Rzońca	SGGW	
28	Małgorzata Sułkowska	IBL	
29	Iwona Szyp-Borowska	IBL	
30	Magdalena Trojankiewicz	UKW	

31	Tomasz Wojda	IBL	T. Wojda
32	Carla Faria	UTE ISA	Carla Faria
33	Elena Foffova	NLC	
34	Eduardo Notivol	CITA	
35	Dag Lindgren	SLU	
36	Roman Gout		
37	Yuriy Hayda		
38	Valentina Kovaleva		
39	Ihor Neyko		
40	Andrzej Misiorny	ID PAN	
41			
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