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COST

EUROPEAN SCIENCE FOUNDATION

COST E52 "Evaluation of Beech Genetic Resources for Sustainable Forestry" Final Meeting

Genetic Resources of European Beech (*Fagus sylvatica* L.) for Sustainable Forestry

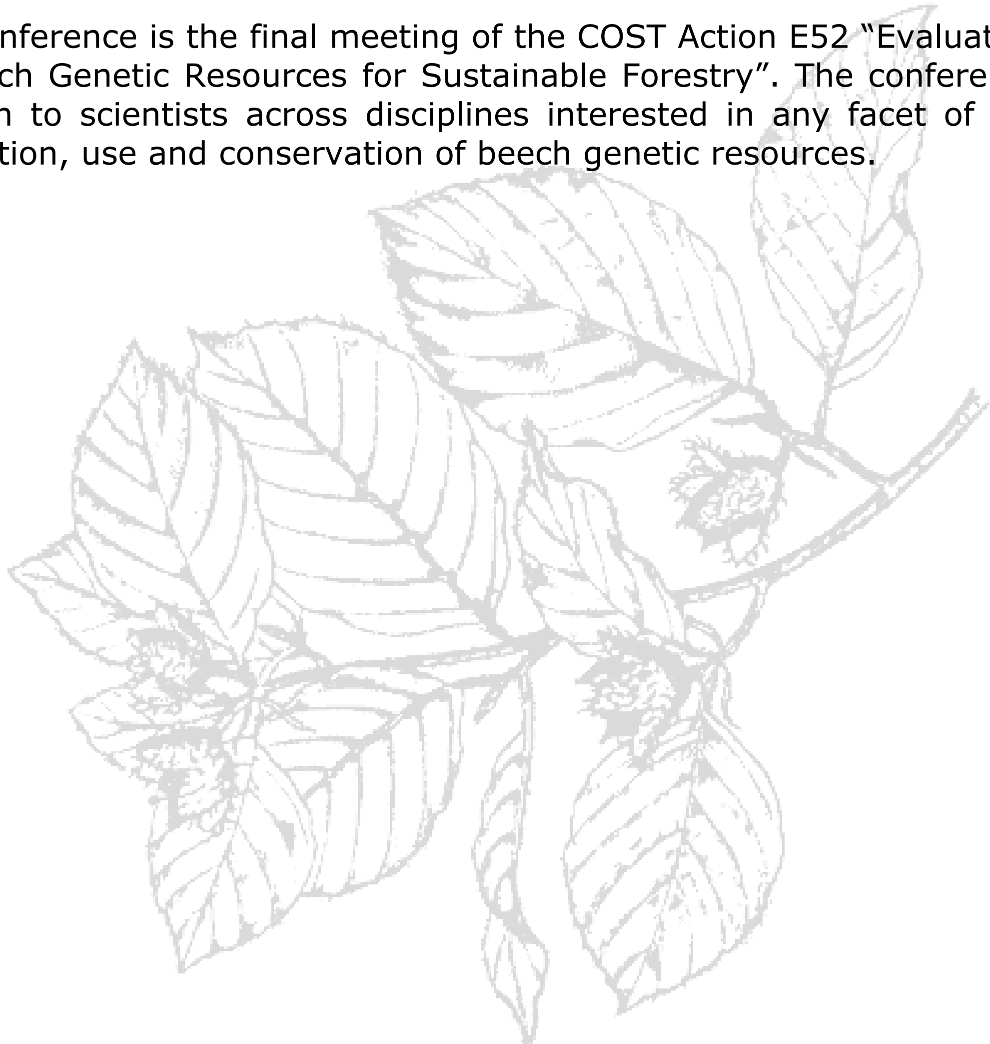
4-6 May 2010, Burgos, Spain

BOOK OF ABSTRACTS

Presentation

This meeting aims to determine the importance of genetic resources to European beech, through their characterization, use and conservation, to provide sustainable forestry in the context of climate change. To this end, the role of adaptation, phenotypic plasticity, prediction of future changes, the use of forest reproductive material, and the genetic conservation will be analysed.

The conference is the final meeting of the COST Action E52 "Evaluation of Beech Genetic Resources for Sustainable Forestry". The conference is open to scientists across disciplines interested in any facet of the evaluation, use and conservation of beech genetic resources.



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Sponsors and Organisms involved in the Organization

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Organization

Organizing committee	Scientific Committee
Ricardo Alía- *INIA, Spain*	Georg von Wühlisch, *vTI*, *Germany*
Diana Barba – *INIA, Spain*	Gregor Bozic, *SFI*, Slovenia
Jose A. Reque - *UVA, Spain*	Hans Muhs, Germany
Salustiano Iglesias – *MMARM, Spain*	Sven de Vries, *Alterra*, *The Netherlands*
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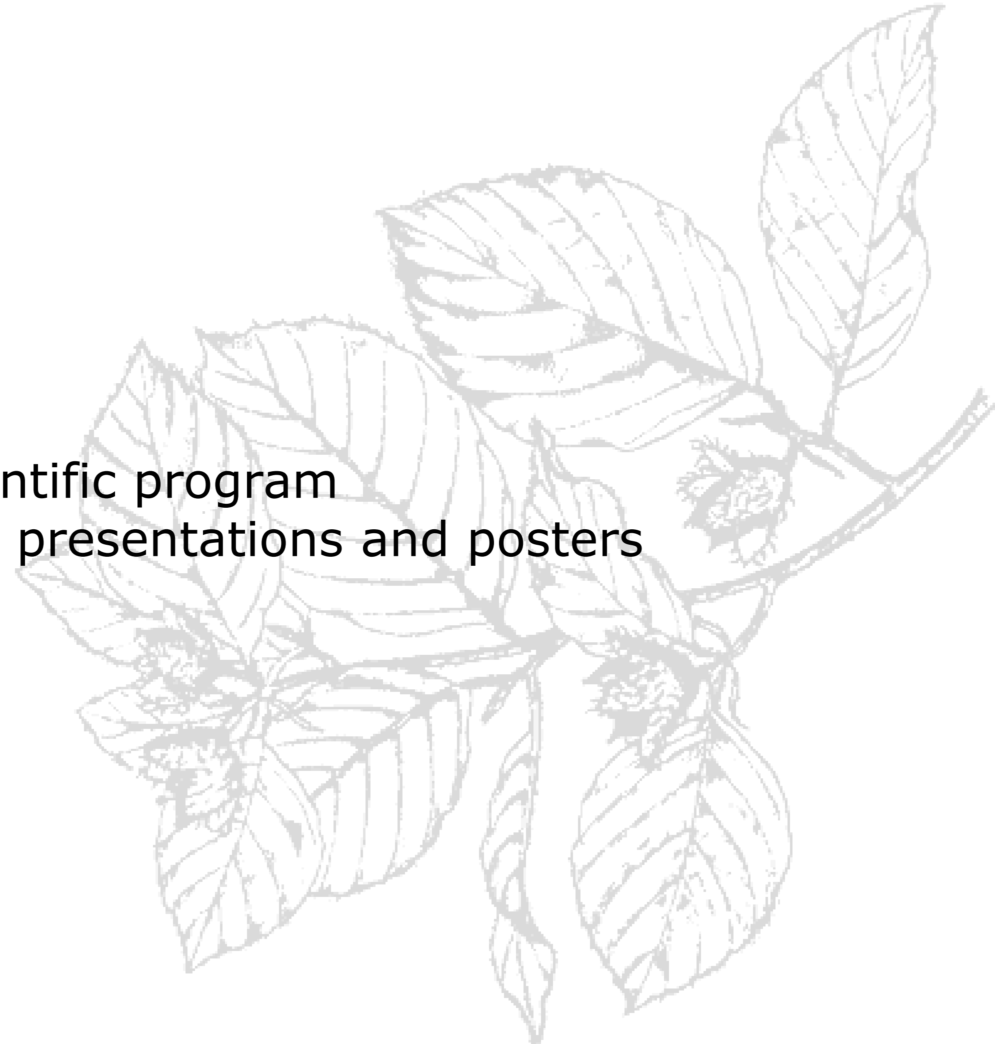
	Cristina Vettori, *IGV-CNR*, *Italy*
	Ladislav Paule, *Univ Zvolen*, *Slovakia*

Secretary of the Meeting

Diana Barba,INIA,Spain (dbarba@inia.es)



Scientific program
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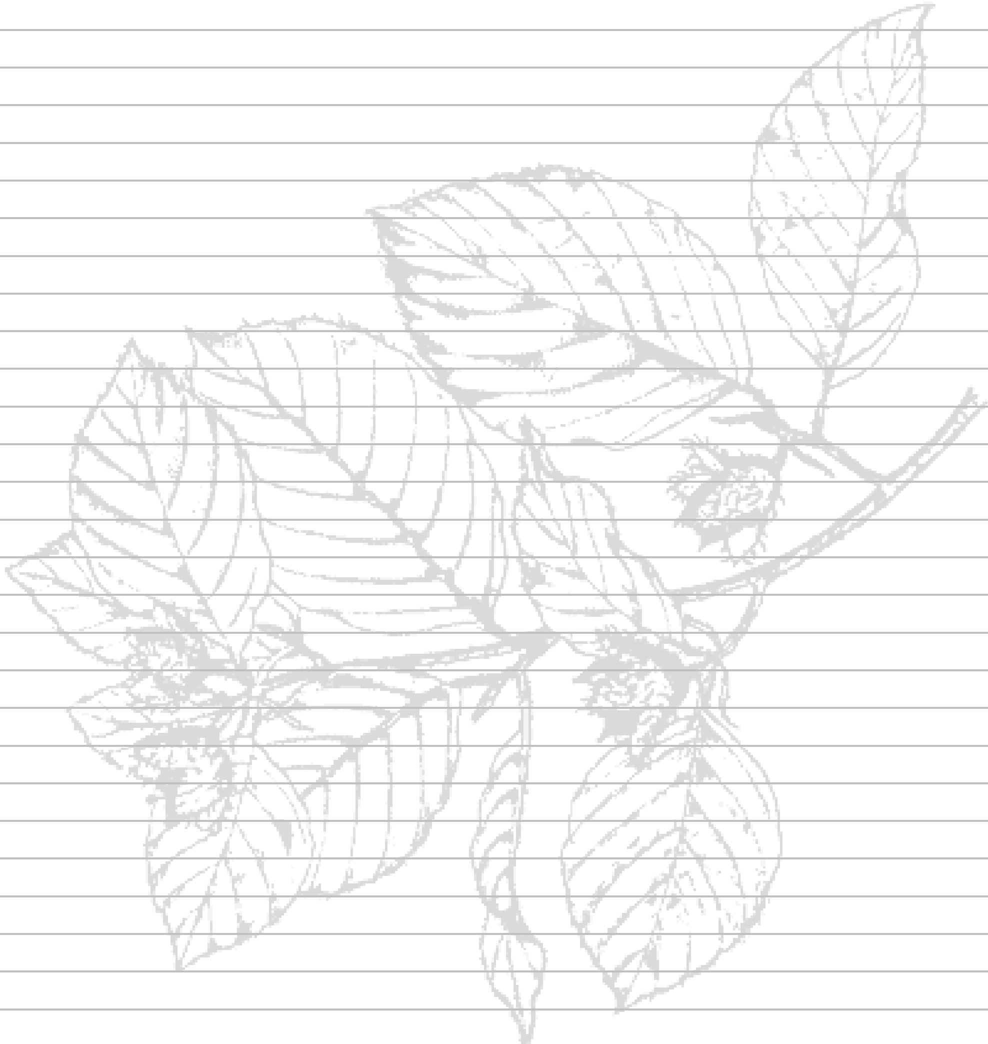

Session 1: Ecology of European Beech and Introduction to International European Beech Provenance Trial Networks.
Chair: H. J. Muhs

OP1. Ecology of European beech, its sociological characteristics and adaptation strategy

A. Alexandrov, C. Mátyás, R. Giannini, G. Parnuta, K. Spanos, S. Orlovic

Summary.- The ecological characteristic of *Fagus sylvatica* L. as a species is stuck to the moderate climate, shadow-resistant and sensitive to deficit of soil and air humidity, to peat, heavily sandy and clay soils. It is resistant to low winter temperatures but sensitive to late spring frosts. Its generative and vegetative ability for regeneration depends significantly on the ecological conditions and in their optimum its natural regeneration is very good.

Beech occurs mainly in pure but also in mixed stands. In the upper part of the vertical range it is frequently associated with *Picea abies* (L.) Karst., *Abies alba* Mill., *Pinus sylvestris* L., *Ulmus glabra* Huds., *Betula pendula* Roth., *Acer pseudoplatanus* L., *Populus tremula* L., *Sorbus aucuparia* L. In the lower part it is mixed with *Quercus petraea* Liebl., *Carpinus betulus* L., *Tilia tomentosa* Moench and *Prunus avium* L. The most productive are the mixed stands of beech and fir, beech and spruce, and in particular - beech, fir and spruce in maximum of 1600 m^3 /ha at 1400 m a.s.l. in Parangalitsa Reserve - Rila Mt. Mixed stands of European beech with Scots pine and Macedonian pine are comparatively rare.

The vulnerability of beech ecosystems towards 2050 and especially in 2100 is expected to be more strongly expressed at the current tendency of climate changes. The European beech adaptation strategy includes the following main priorities:

- improvement of the stability and health status of beech forests;
- conservation of beech genetic resources;
- establishment and maintenance of vital beech ecosystems.

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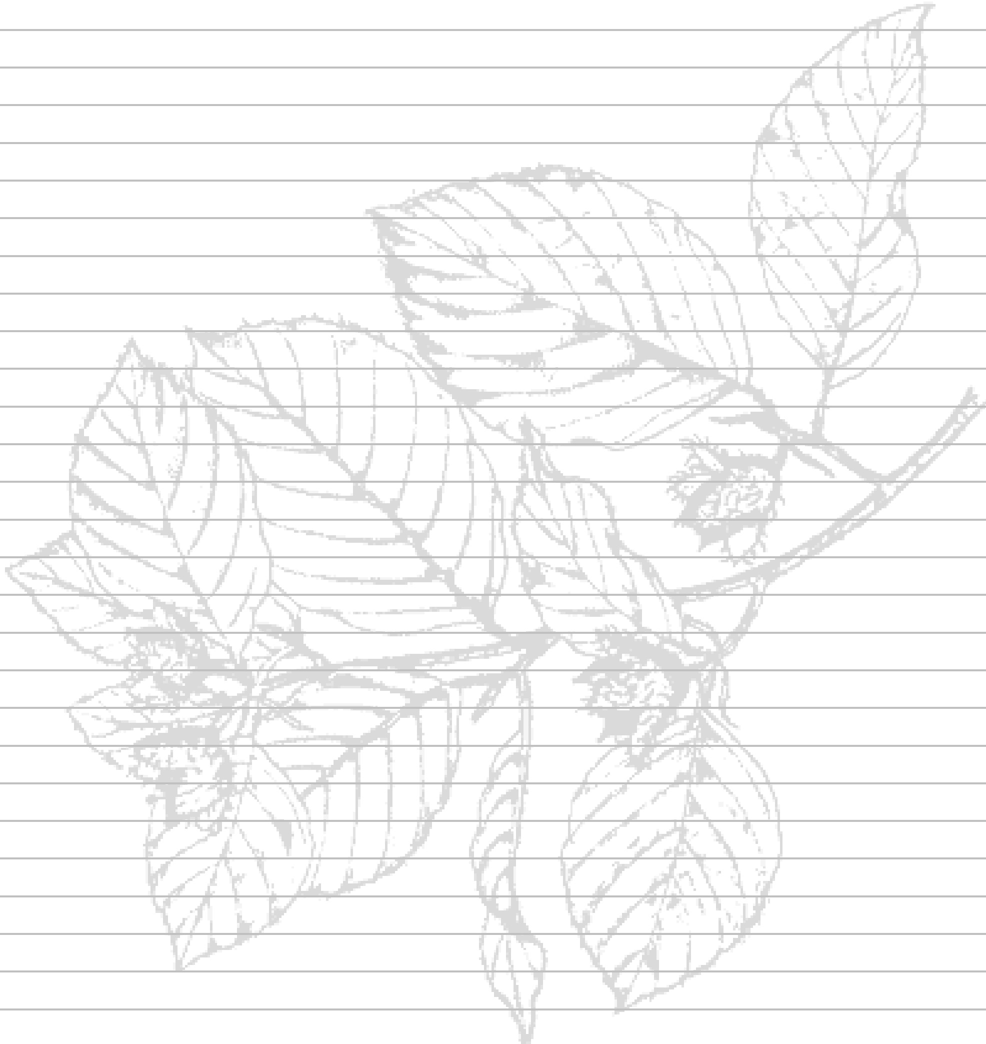

OP2. Beech forest genetic resources in Greece: Their importance and conservation value – Adaptive strategy under climate change

K. Spanos

Summary.- The present work provides an overview of beech forests in Greece. Information on natural distribution of beech and country data is given. Information on ecology of beech, taxonomy and genetics is also provided. Importance of beech at present and in the former times and information on silviculture, propagation and forest management are also highlighted. General information on health status and important diseases, general conditions and threats to beech and its genetic resources, and indications of recent climatic impacts on beech forests is provided. Further particularities, scientific studies on beech, the most important matters/problems of beech ecosystems and sustainable silviculture are also discussed.

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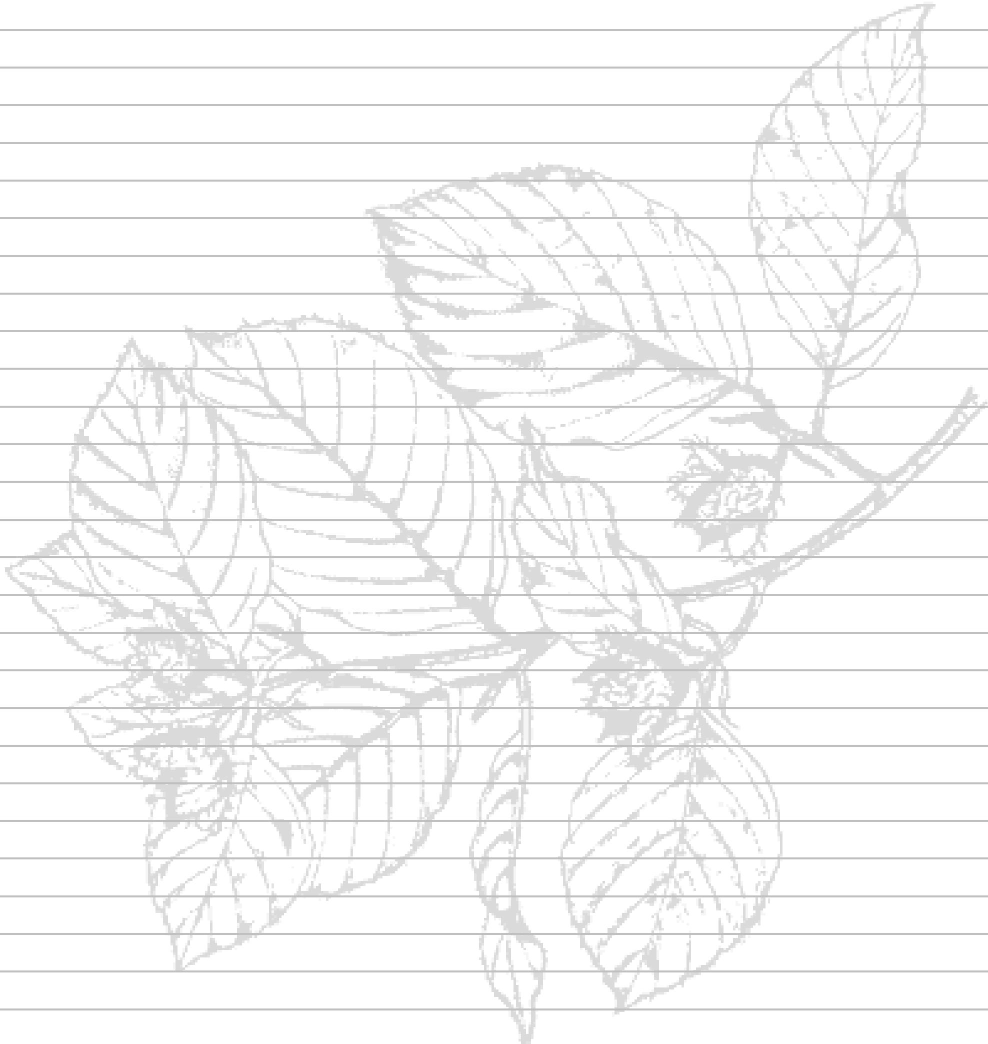

OP3. Genetic differentiation of beech at dry and mesic sites in Switzerland

A. R. Pluess, P. Weber

Summary- Climate change scenarios predict drier climates in the lowlands of Switzerland putting contemporary forest compositions at risk. Specifically, it is expected that the dominant lowland species *Fagus sylvatica* will shift to higher elevations due to a warmer and drier climate. However, beech occurs today also at dry lowland sites on shallow soils and thus, pre-adaptation to drier conditions might exist. This project aims to determine the effect of water availability on growth of beech and hypothesises that beech on drier sites is genetically selected for such conditions. We sampled 40 trees each in three neighbouring population pairs at dry and mesic sites, analysed growth with dendroecological methods, described soil characteristics and assessed genetic variability with AFLP-markers. In a first analysis we determined general genetic patterns and in a second step we will use further exhaustive genetic screening to assess drought-adapted genetic markers in a genome scan. Dendroecological surveys showed that tree growth is adapted differently to water availability at dry and mesic sites. Average ring-width at moderate sites was around double the width at dry sites. Between 1930 and 2006, the stands with lowest available water capacity (AWC) were found to respond most sensitively to drought. However, in recent years, stands with higher AWC showed increasing drought sensitivity. The comparison of these results with the genetic patterns will improve our understanding of the drought-adaptation potential of beech for forest management.

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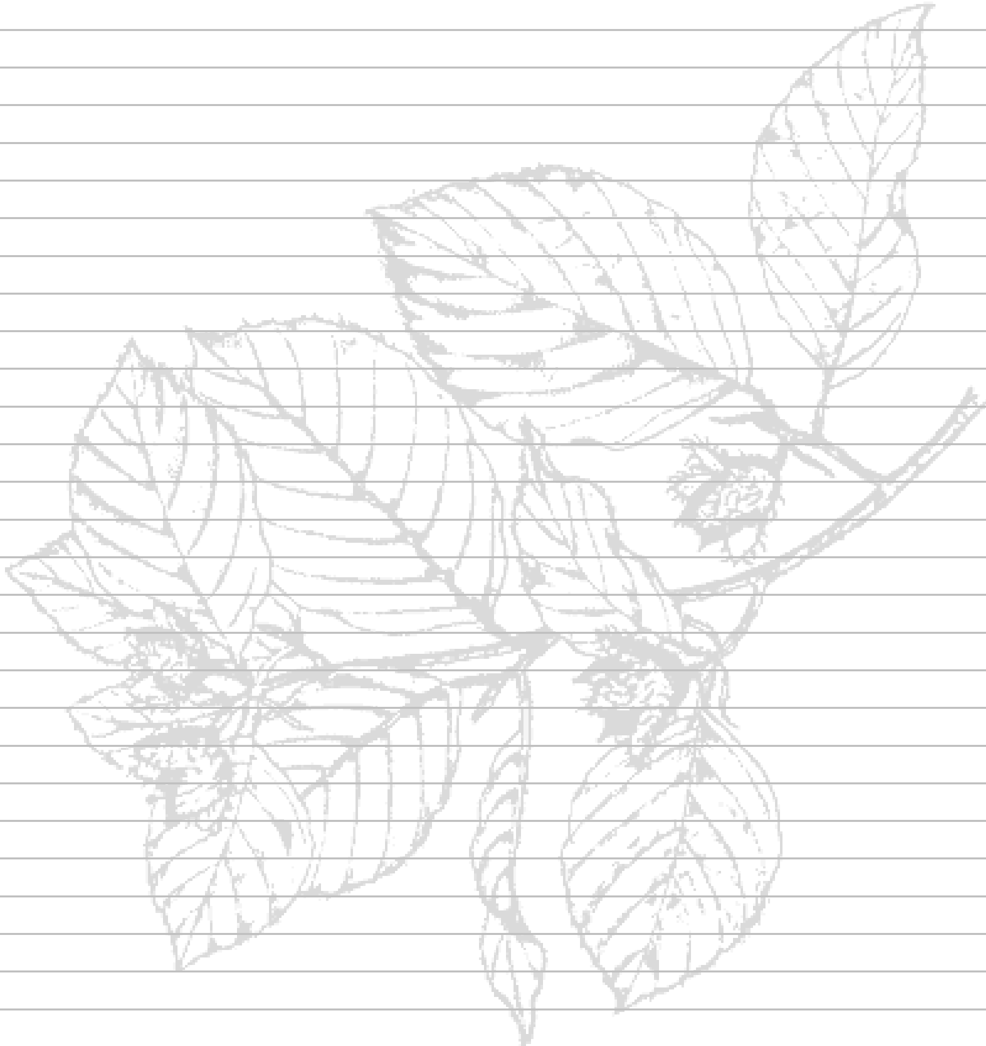

OP4. Some features of the autecology, distribution and silvicultural treatments of beech (*Fagus sylvatica* L.) in the north-west of Spain.

I. J. Díaz-Maroto

Summary.- The northwestern Spain represents the western most limit of the range of *Fagus sylvatica* L., forming pure stands of small size, highly fragmented, but also, going to be part of other forest types as companion species. From a biogeographical point of view, these beech forests are within the province Orocantábrica, Laciano-Ancarense sector, Naviano-Ancarense subsector. In this paper, we have studied various ecological aspects that directly affect the conservation of these forests within the study area (Ancares and Courel mountains, mainly). These beech forests have suffered intensive harvesting, by man, for various uses, until recent years, and today have been reduced to isolated valleys, mostly on siliceous substrates, with a very complicated orography, and always oriented to the north, which, in part, it has allowed conservation. According to different authors, poor soil conditions, and other factors of human nature, they can cause nutritional limitations that directly affect their preservation.

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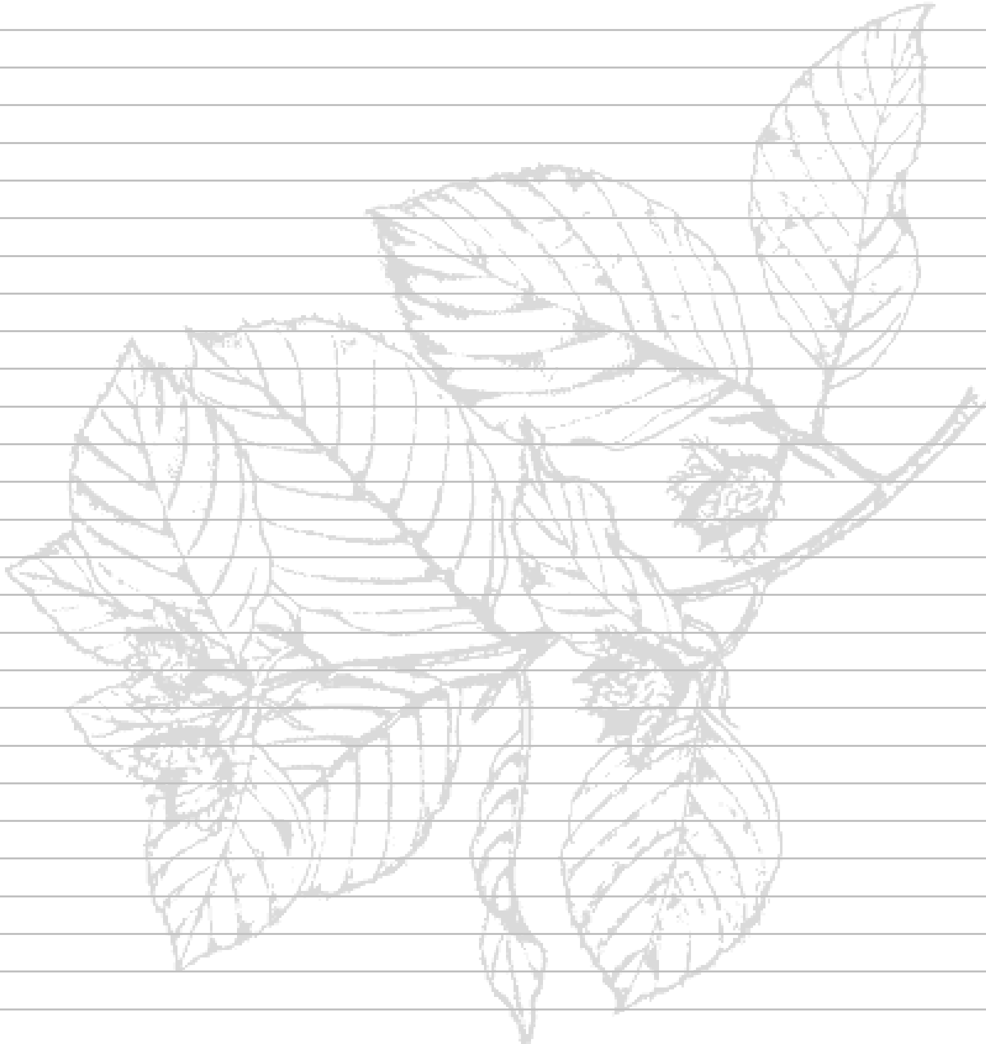

OP5. Seed and seedling dispersal of *Fagus sylvatica* L. in a mixed beech-oak forest in Central Spain

M. Millerón, U. López de Heredia, Z. Lorenzo, L. Gil, N. Nanos

Summary.- Dispersal patterns for seeds and recruits of *Fagus sylvatica* L. were examined in a mixed beech-oak forest reserve in Central Spain. The study plot was intensively managed for cattle feeding until 1964. Since then, natural regeneration (of seedlings and saplings) without human management led to a total coverage of the plot surface, generating two well defined cohorts of centenary trees and young recruits. An Intensive Study Plot (ISP) was installed in a pure stand of European beech within the central part of the forest. Fresh leaves of the potential parents and the recruits included within the ISP were collected for DNA genotyping. Additionally, seed dispersal from adult trees was monitored in 49 traps of 1 m^2. Seed-DNA was extracted from the seed mesocarp, (a diploid tissue with exactly the same genotype as the mother tree). Six highly polymorphic microsatellites were analysed for maternity and parentage analysis. For seeds, unambiguous assignation of the mother tree was done using DNA extracted from the mesocarp tissue. Parents were assigned to the recruits using parentage analysis. Dispersal distances were scored and histograms were generated for seeds and recruits, fitting models for primary and secondary dispersal. The models show contrasting patterns of primary and secondary seed dispersal. Primary seed dispersal is highly restricted with 50% of seeds dispersed less than 6 m from the mother tree. For recruits, dispersal restriction was much smaller; a high frequency of long-distance dispersal events was observed, reaching in some cases more than 500 m suggesting animal-mediated dispersal has important implications for recruitment.

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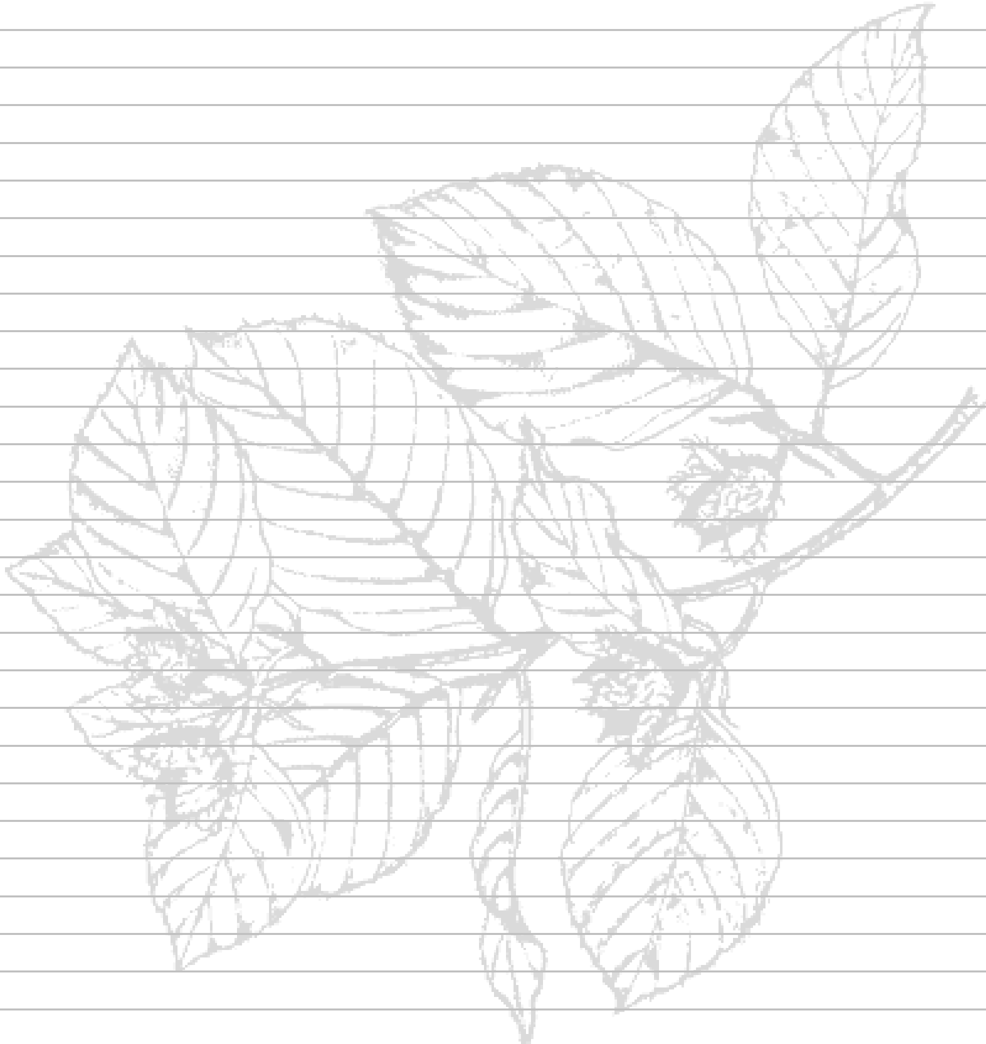

OP6. Candidate gene variation along an altitudinal gradient in *Fagus sylvatica*

H. Lalagüe, B. Fady, P. Garnier-Géré, S.C. González-Martínez, Y.C. Lin, S. Oddou-Muratorio, F. Sebastiani, G.G. Vendramin

Summary.- Beech forests (*Fagus sylvatica* L.) cover about 12 million hectares in Europe. Beech wood is much appreciated worldwide so that many beech forests are regularly harvested for timber production. Apart of its economical importance, European beech has also a major role in soil preservation and water cycles, which makes this species a target of ecologically-minded conservation. In order to confront the observed and predicted climatic trends, beech populations will have to adapt in situ and/or to migrate to higher latitudes/altitudes. Except in the southern part of Europe where beech seems to suffer of drought, beech groves are expending their distribution range. Then, understanding how adaptive traits and the underlying molecular variation in candidate genes evolve is a relevant subject of research.

Here we present our strategy for the identification and selection of putative candidate genes involved in the response to abiotic stress in beech. About 40.000 ESTs, sequenced within the European Network of Excellence "Evoltree", have been processed. Different criteria were adopted to select the genes. Some hundreds primer pairs were designed and tested for amplification and polymorphism. Polymorphisms at the selected genes will then be genotyped to estimate level and distribution of diversity within a population sampled along an altitudinal gradient and to dissect the role of selective pressures and demographic dynamics in European beech.

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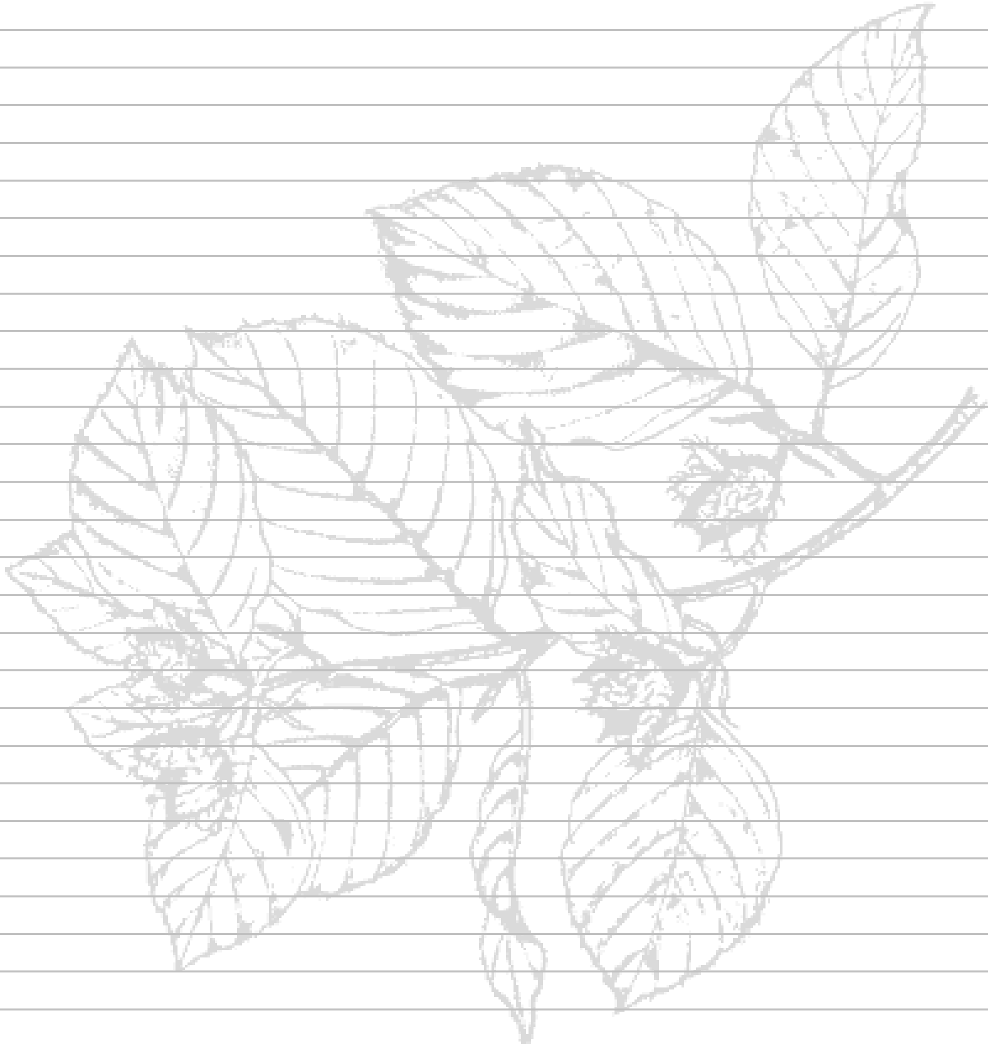

OP7. Conservation status of centenary trees in a marginal beech population.

U. López de Heredia, M. Tomé, M. Millerón, J. Alonso, I. González-Doncel, L. Gil

Summary.- The forest of Montejo in Central Spain contains a marginal population of beech (*Fagus sylvatica* L.) at the southwestern edge of its distribution. The forest was intensively managed in the past for cattle grazing but nowadays constitutes a reserve where human action is avoided. A dense regeneration of seedlings and saplings cover the area with an overstorey of centenary trees, existing two well defined cohorts. The conservation status of the centenary trees in Montejo beech forest was assessed through an exhaustive inventory of all trees with DBH>45 cm in a surface of 125 ha. Measures of DBH, height, shape, vitality and levels of damage were scored in visits along 2008-2009. The centenary beech population is composed by 760 trees at a density of 6.08 trees/ha. Remarkably, 27.8 % of the beeches were dead at sampling time and 19.7 % were in an advanced stage of decay. As compared to a preliminary sampling in 2007, it was observed that decrepit beeches can die in a very short time-span, compromising the persistence of centenary beeches in the forest. Intervention in the sapling population is suggested to accelerate the incorporation of beeches to the high diametric classes.

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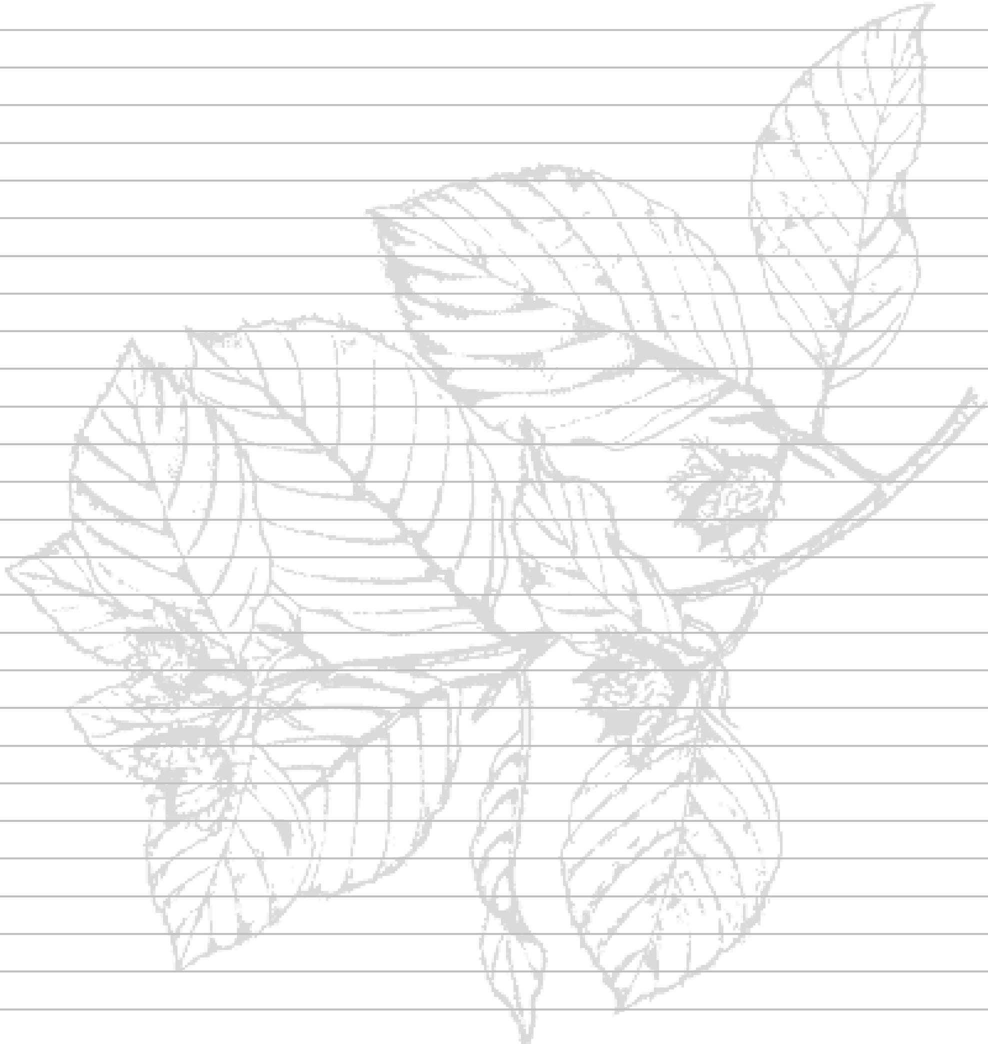

OP8. Concept and Design of the International Beech Provenance Trials of 1995 and 1998, and Suggestions for Future Trials

H.J. Muhs, L. Paule, L. Ionita , G. von Wühlisch

Summary.- Situation: Increasing beech seed imports mainly from South-East Europe since the late 1970ies make the testing of the seed sources necessary because the suitability of the plants grown from seed imported to Central European conditions was not known. But soon it became obvious that solely matching provenances and sites was not sufficient, thus the scope of testing was extended and a concept was needed to find the best design for the trial.

Concept: It was known that the growth rhythm and habitus of beech was different from that of the conifers, from which experience existed in many provenance tests. Thus the concept for beech provenance trials must consider the characteristic features of the species *Fagus sylvatica*, a high number of seed samples (provenances) from throughout the distribution, a long test duration (beech shows its growth potential after some 50 to 60 years), simple design for test sites containing a large number of provenances and easy to maintain, a variety of test sites and a way connecting series of trials established in different years (1995 and 1998). Beside this, the feasibility, logistics of seed collecting and distributing of the plants, as well as financing and many other aspects must be taken into account.

Objectives: The trials shall serve for several types of studies: provenance testing, studies for variation of phenological, physiological and form traits, adaptedness, gene conservation, wood properties, resistance to biotic and abiotic factors, and other studies. Therefore the objectives are manifold. In the first years, survival, early height growth, flushing and cessation of growth are of interest, but the plant material can be used for a lot more studies as shown already.

Design: The trials must be designed in a simple way, easy to establish and to take measurements and even usable after losses of plants. Therefore a block design with three replications were chosen, each block is composed of randomised plots comprising 50 plants (5 rows with 10 plants each) per provenance.

Suggestions: If the trials will exist still after 60 years in the field, the growth potential and expected merchantable wood can be estimated reliably. Average number of trees/plot may be as low as 5 or even less. Thus, 90% of the trees will either die or can be used for investigations with destructive methods (physiological studies, wood properties) in the meantime. In some cases new trials may be necessary, if the selection of provenances, the standardization of the material or the consistency of the sites of the trials (1995 and 1998) is not sufficient.

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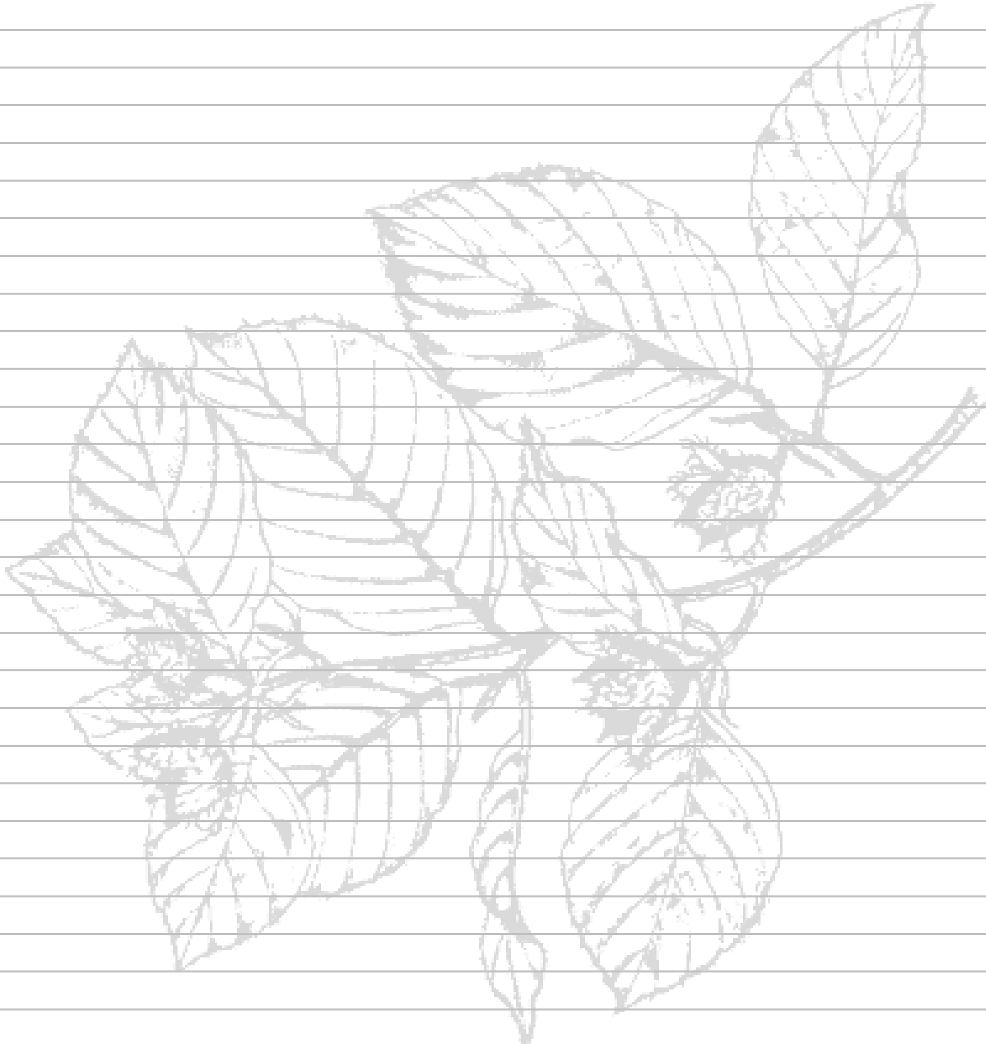

OP9. Description of the trial sites and mother stands of the International Beech Provenance Experiments of 1995 and 1998

M. Liesebach, E. Rasztovits, G. Huber, T. M. Robson

Summary.- Beech is a major forest tree species in western and central Europe, covering roughly 12 million ha. Initially, a series of beech field trials was established in the early 1980s, but because of the political situation at that time, the sample of provenances neither included stands representing the whole species range nor did the trial locations represent all the habitats inhabited by beech. Subsequently, with heightened interest in beech reforestation, the necessity to comprehensively evaluate the genetic resources of beech became evident. Therefore, following political changes in Europe another series of 49 trials was designed.

In 1995 a series of 23 trials, and in 1998 26 trials, were established on forest sites (28), agricultural land (14) and various other sites (7). These trials span a wide range of altitudes from 5 m asl to 1350 m asl. Half of the sites are located on hillsides. Loam is the most common type of soil on the sites. Most of the sites (29) have a good nutrient availability, and a high (19) or average (19) water holding capacity. Across the sites the mean annual temperature varies between 6.1°C and 12.6°C, and the mean annual precipitation varies between 467 mm and 1327 mm. The range between coldest month (January) and the warmest month (July) varies from 10.0 K to 23.3 K.

The large number of sites and their different site characteristics promise interesting results to come from these beech experiments in the future.

An overview of the mother stands of the provenances includes in the two trial series will be given. In the first experiment 1993/95 the 128 seed samples were seeded in 1993 and most of the sites were established in spring 1995. The majority of the mother stands are originated in central Europe. The number of provenances per site varies depending on the size of the sites between 26 and 100.

For the other experiment the concept was changed. The number of provenances was lower (61), and the collected seed samples should better represent the distribution area of beech. On the sites established mostly in spring 1998 the number of provenance varied from 13 to 34. Some research stations added some additional provenances.

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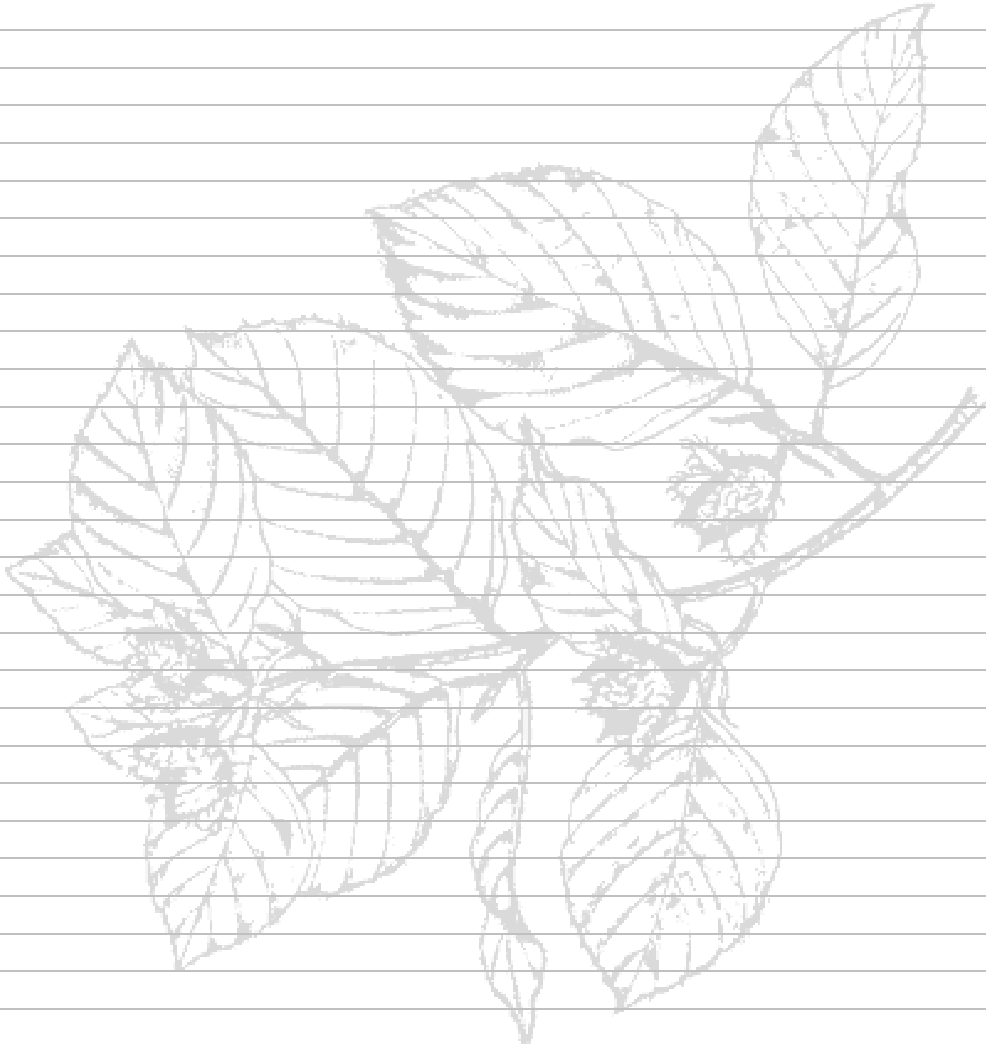

OP10. Early results from provenance trials with European beech established 2007

G. von Wühlisch, D. Ballian, S. Bogdan, M. Forstreuter, R. Giannini, B. Götz, M. Ivankovic, S. Orlovic, A. Pilipovic, M. Sijacic Nikolic

Summary.- It is accepted, that beech (*Fagus sylvatica* L.) has survived the recent period of glaciation in the Balkan region in several refugia, from where beech has migrated to the present range of distribution. As opposed to regions into which beech has re-migrated north of the Alps starting from very few or even only one refugium it can be expected that the genetic variation in the Balkan region is larger. The extent of genetic variation found may differ, depending, if the traits studied are more or less relevant for adaptation. To study the genetic variation relevant for adaptation among provenances in the Balkan region, 20 provenances of Croatia, Serbia and Bosnia and additional 12 for comparison from Austria, Germany, Hungary, Italy, Switzerland, and Romania were planted, of which 15 provenances are common to all trials. A total of seven provenance trials were established in Bosnia, Croatia, Serbia (2) Germany (2), and Italy. First results of survival, height growth, flushing and leaf retention are presented.

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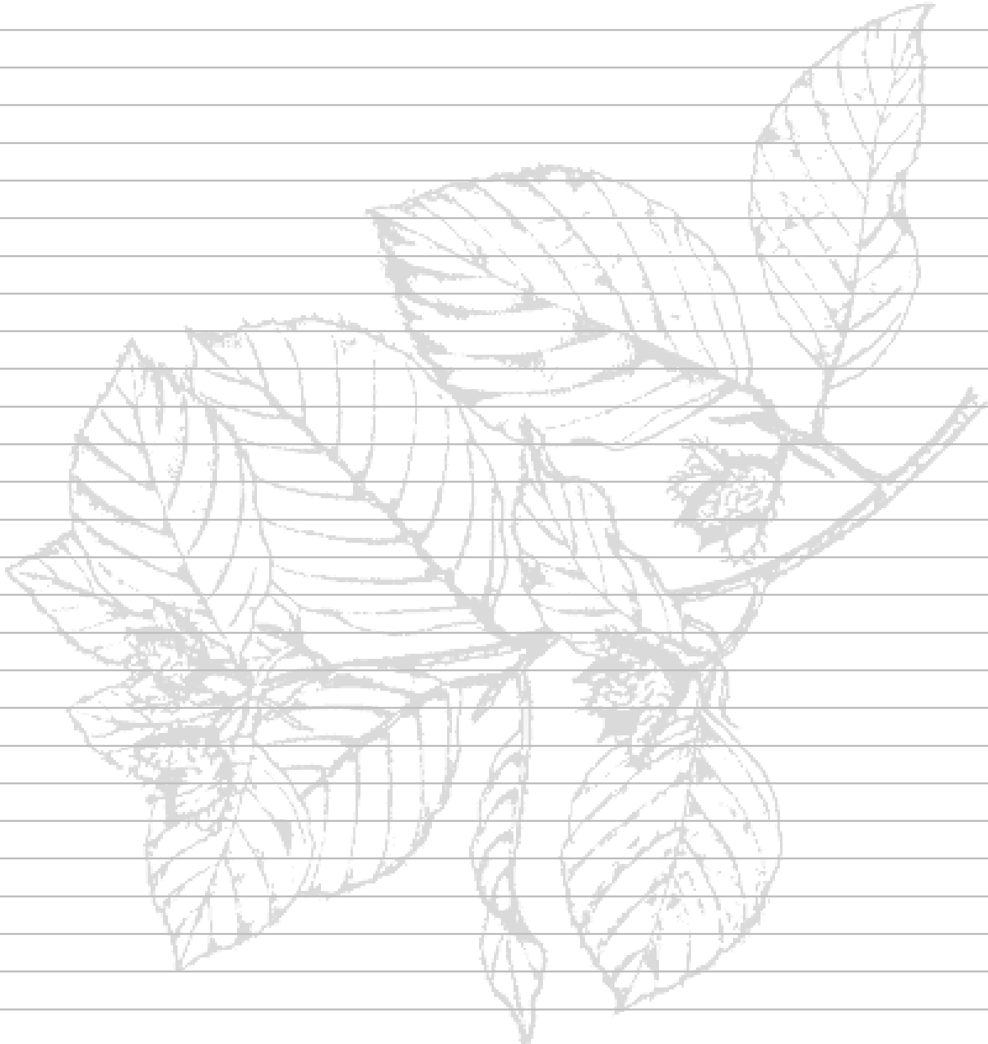

OP11. Variability of morphological and physiological parameters of different European Beech (*Fagus sylvatica* L.) provenances in international provenance trial in Serbia

S. Stojnic, S. Orlovic, A. Pilipovic, V. Galovic, G. von Wühlisch

Summary.- The paper presents the results of research of some morphological and physiological parameters of different Beech (*Fagus sylvatica* L.) provenances in the international provenance trial located on the site Fruska Gora Mountain in the Northern part of Serbia. Test consists of 25 provenances, where each provenance is represented by 50 plants, planted in 5 rows with 2x1m spacing.

Morphological parameters investigated in the study included: (I) growth parameters (diameters and heights of seedlings) and (II) leaf area and leaf number per single plants and whole provenances. Also, the following physiological parameters were observed: (I) rate of net photosynthesis, (II) transpiration rate, (III) rate of stomata conductance and (IV) concentration of photosynthetic pigments in leaves.

Results of study reference on significant differences between provenances, which is important for future determination of suitable provenances for beech growing in Serbia. Detailed long-term researches of morphological and physiological characteristics will provide data about adaptability of different beech provenances on given ecological conditions.

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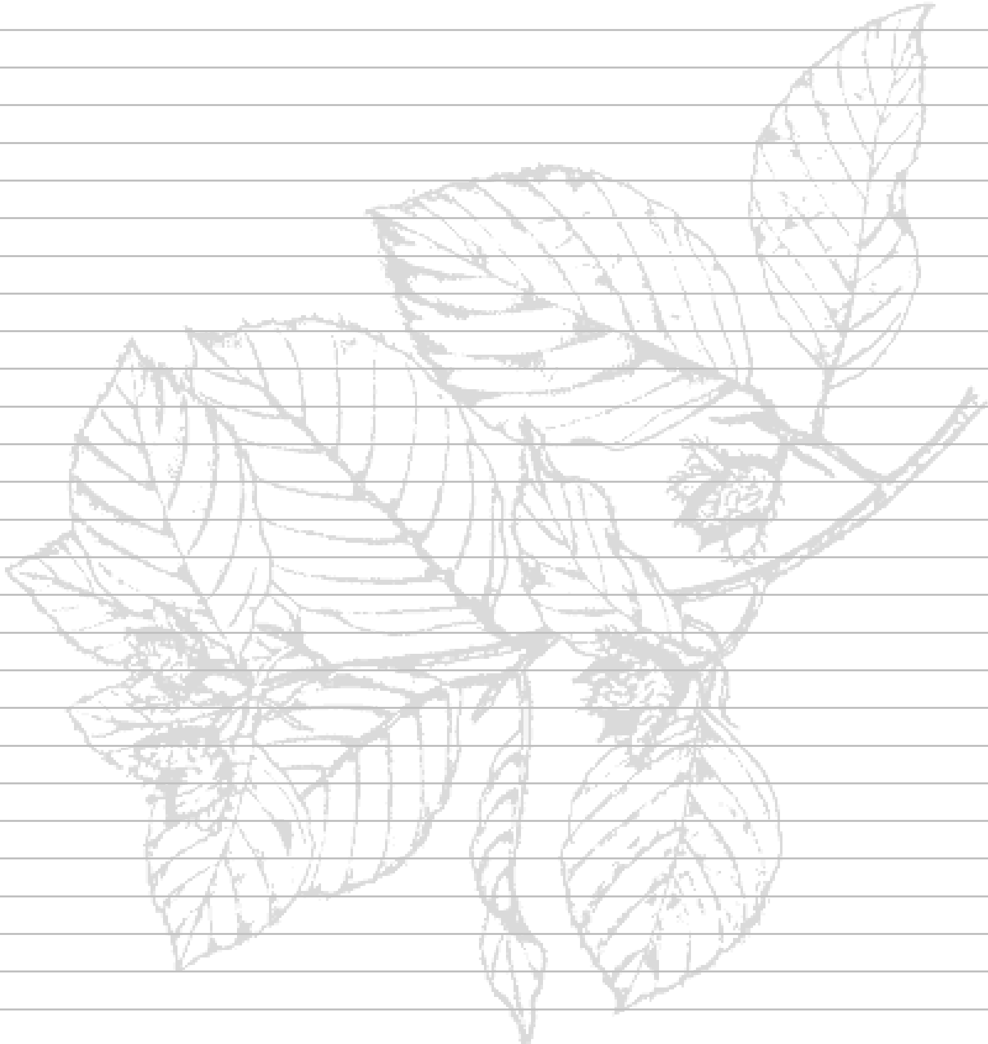


OP12. Variation in winter leaf retention between beech provenances.

M. Ivankovic, S. Bogdan, G. von Wühlisch

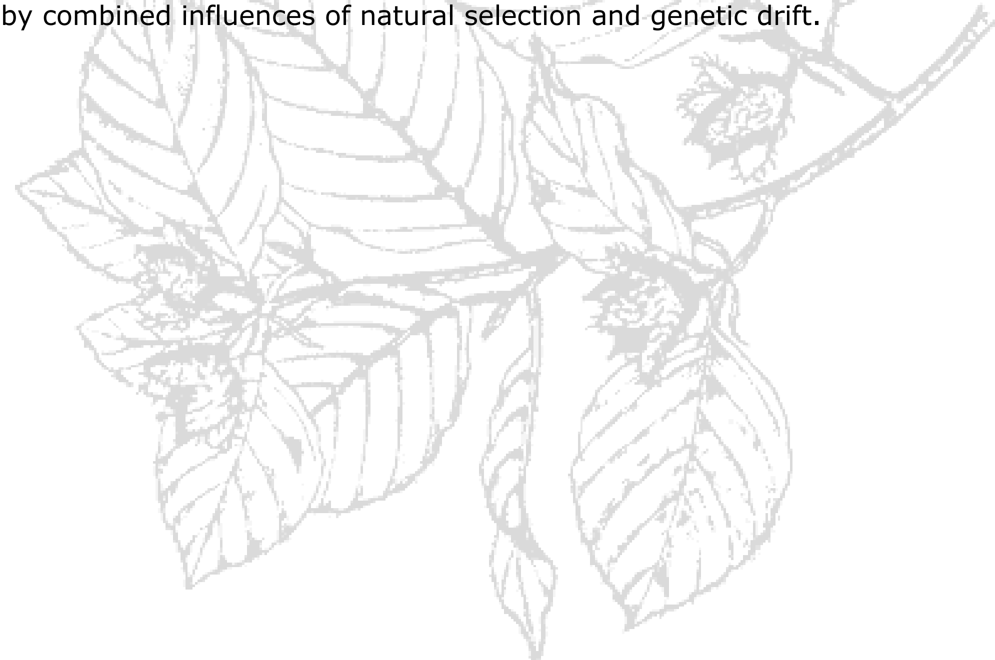
Summary.- Several studies of various sets of European beech provenances have shown that traits connected to flushing phenology are highly heritable and important adaptive traits.

Winter leaf retention is well known phenomenon within genera *Quercus* and *Fagus*, but precise explanation of its causes is still an open question. Some authors tried to explain it as a juvenile physiological peculiarity, others as an adaptation to various ecological conditions such as infertile sites, frost, dry wind or interspecific competition.

The aim of this study was to determine amount and pattern of genetic variation of flushing and winter leaf retention in beech, as well as to discuss its possible causes.

Differences between studied provenances in winter leaf retention were statistically highly significant. Several provenances showed significantly higher proportion of plants which retained dead leaves until flushing. These results strongly support genetic determination of the trait as was reported for *Quercus robur*.

Statistically significant, negative correlation between leaf retention and yearly mean temperature was found, though it explained low percentage of variation. Also, quite high negative correlation coefficient was found between flushing time and winter leaf retention. Those results indicate that observed genetic differentiation could has been driven by natural selection conditioned by frosts and low winter temperatures. Observed genetic differentiation could have been driven by genetic drift or by combined influences of natural selection and genetic drift.



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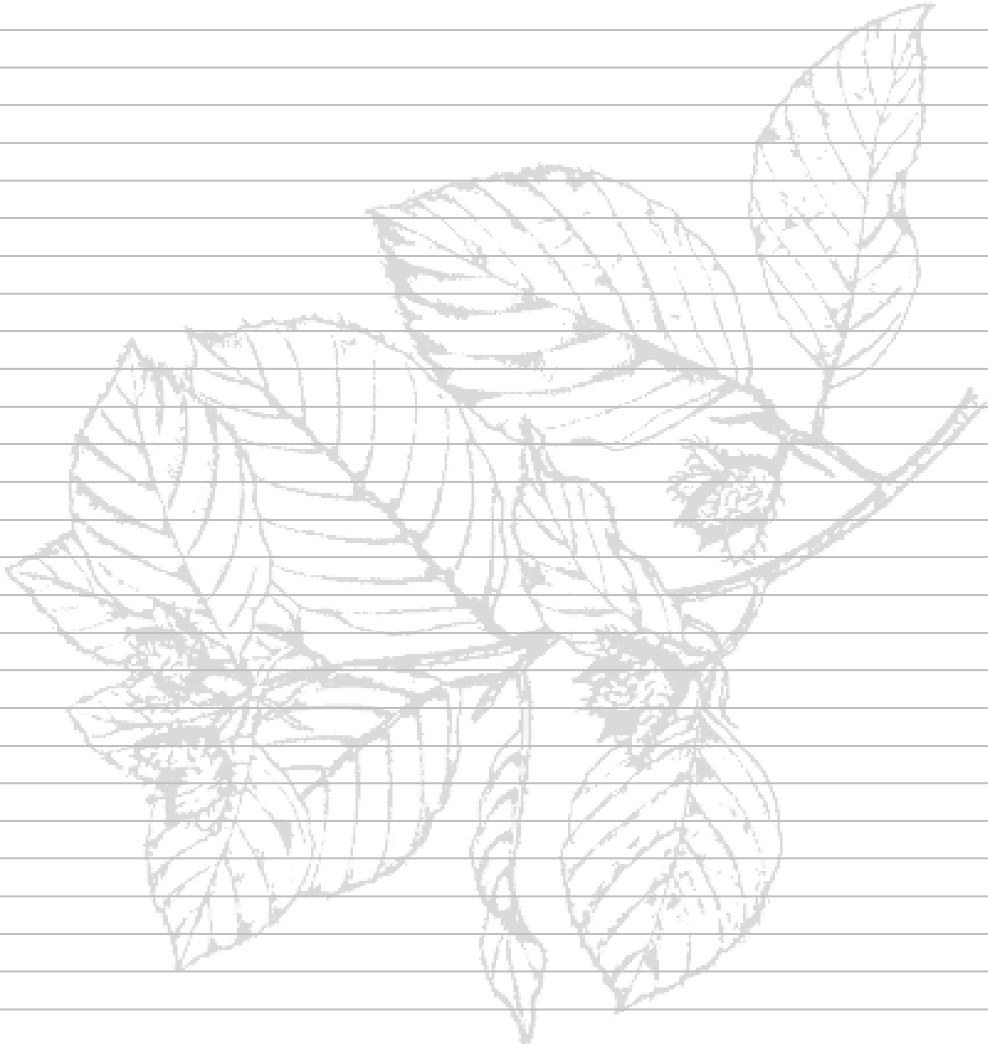

P1. Cost E52 Beech database for the Analysis of provenance test

M. Liesebach, M. T. Robson, D. Barba, G. von Wühlisch

Summary.- The COST E52 is focused in analysing the multi-site provenance test established in different locations along Europe. The Beech Database is the results of the effort of compilation of the measurements realized in the different provenance tests by the different COST E52 members. The data base includes standardized information on Locations, Provenance used in the different experiments, and the raw data. This database is managed by the Institute of Forest Genetics (Grosshansdorf) and can be accessed by the different COST E 52 members.

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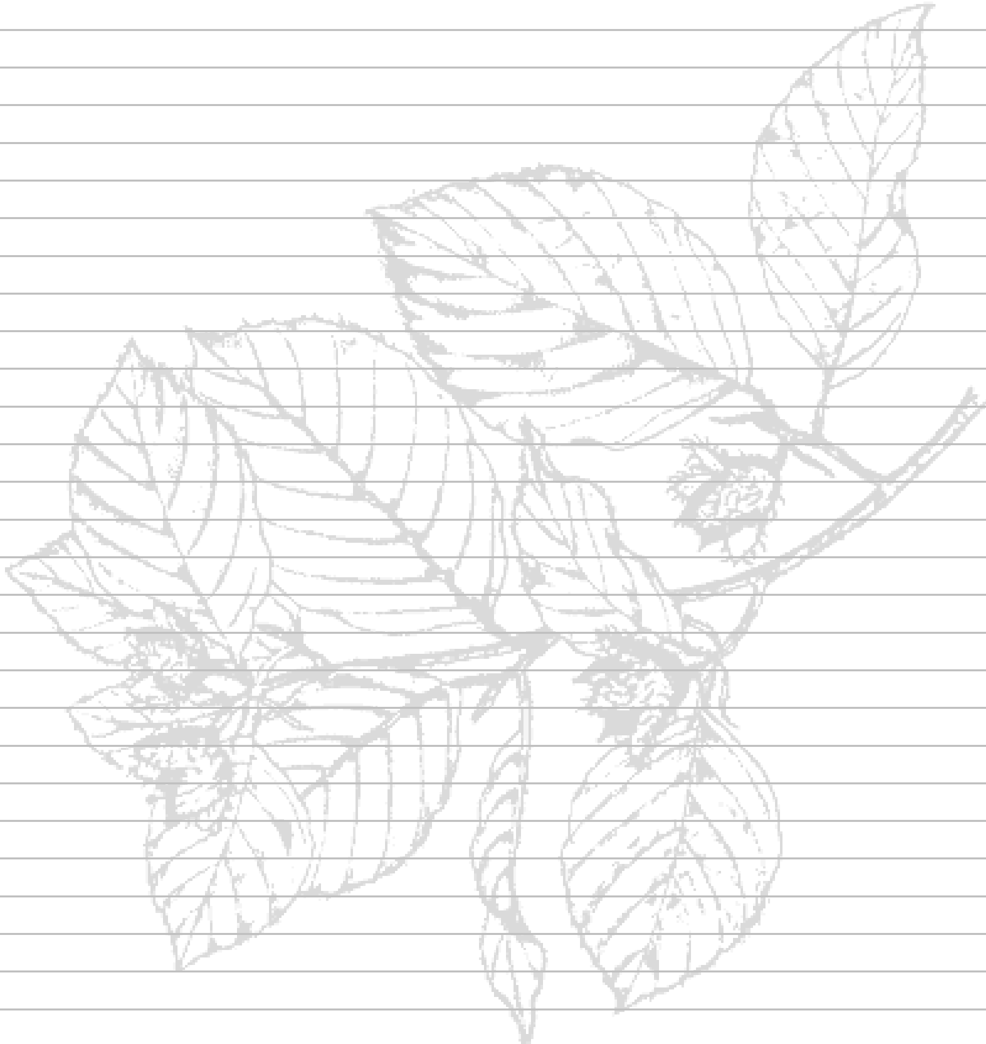
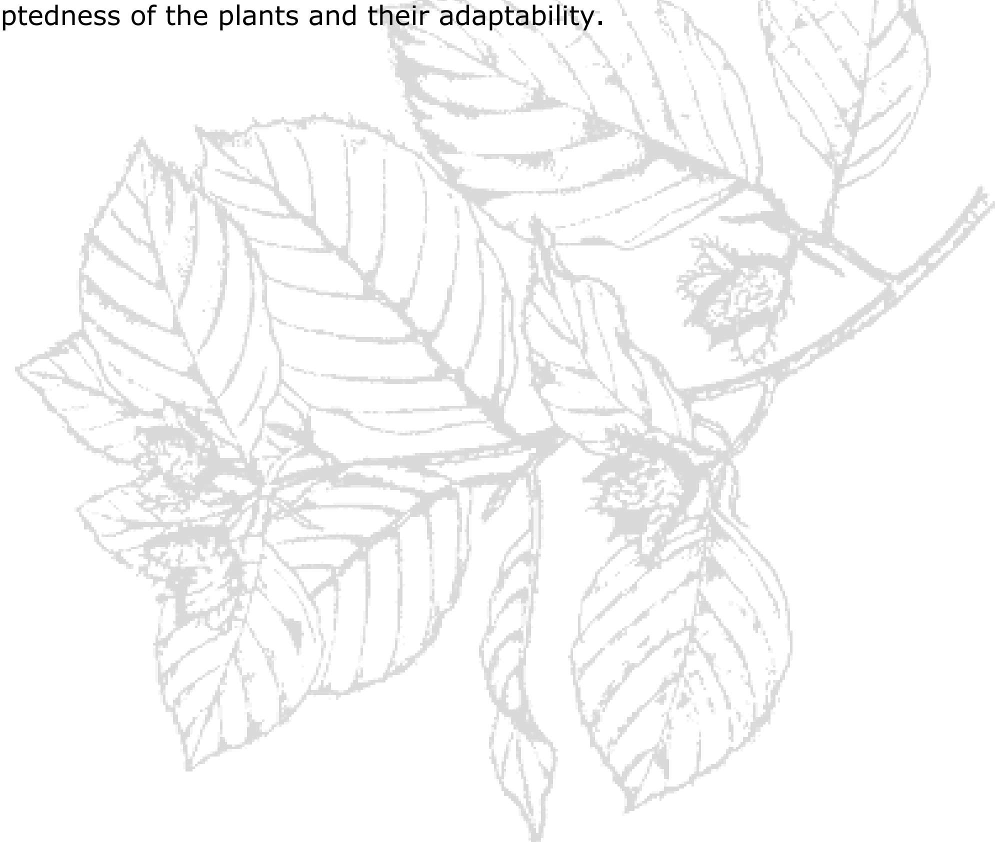


P2. Bibliography of Published Literature from the Bu 19 and Bu 20 provenance trials of European beech (*Fagus sylvatica* L.)

H. J. Muhs, G. von Wühlisch

Summary.- Since 1995 more than 30 contributions have been published, which focus on the material of the international beech provenance trial of the series Bu 19 (1995) and Bu 20 (1998) of European beech (*Fagus sylvatica* L.). Contributions have been delivered from 10 countries, containing at least abstracts in English. Most of the contributions are published in journals or proceedings, but also a book chapter and an undergraduate-thesis dealt with the material. Early publications aim at the information of the international provenance trial and at growth and survival of the young plants in the field trials from various sites. Date of flushing has also been assessed at several locations. The material has also been used for studies on population genetics and variation on seed traits. Physiological investigations on young plants grown in a CO_2 enriched atmosphere show relationships to climate change-studies. Some studies focus on root system and ectomycorrhizae in young plants of different provenances. Other publications analysed the reaction of beech plants exposed to different climatic regimes and discussed the results in respect of the adaptedness of the plants and their adaptability.



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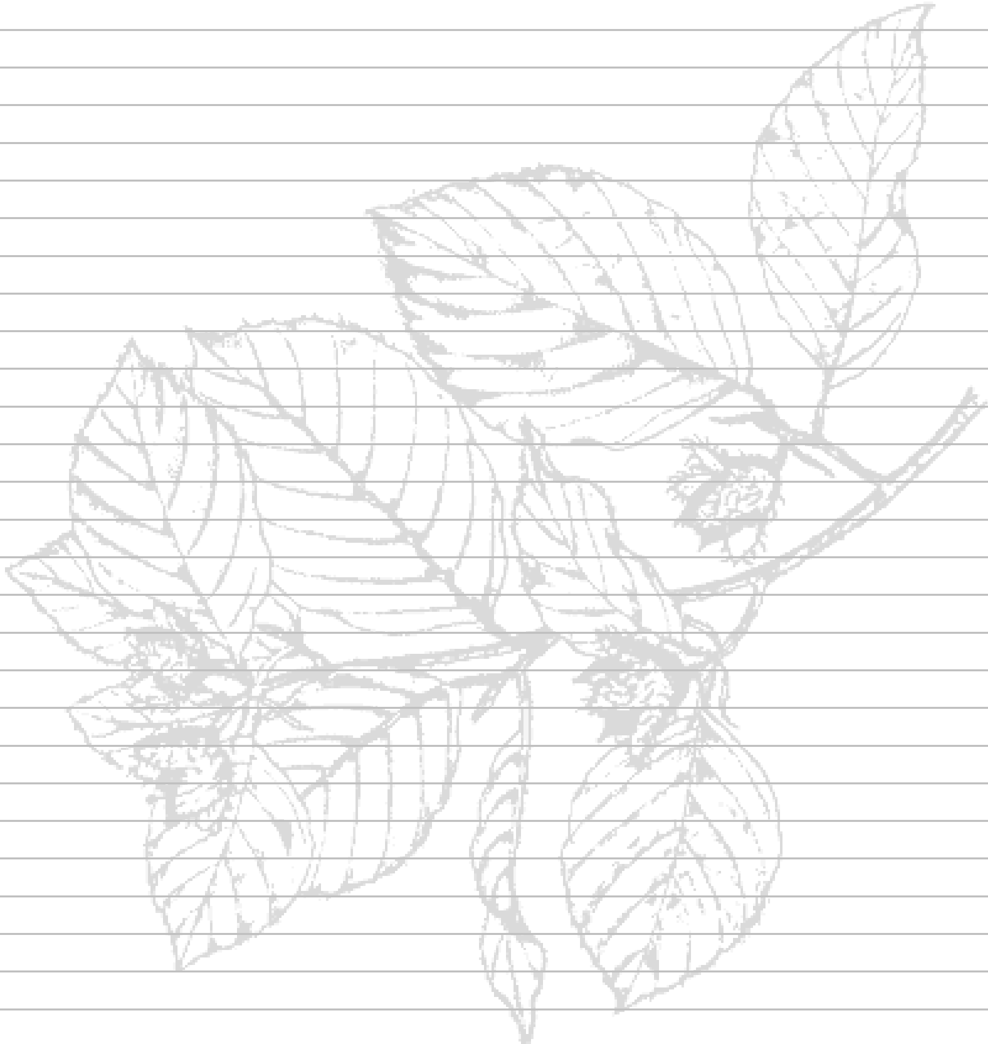

P3. Beech sensitivity to drought at the southern-most range area of distribution. A functional overview from seedling to maturity.

I. Aranda, J. Rodríguez-Calcerrada, J. Cano, T.M. Robson

Summary.- Beech is one of the most widespread species in Europe. Current models of climatic change predict significant shifts in the ecological and climatic conditions across the full range of the species. Populations from the south are especially sensitive to a harshening in the intensity and recurrence of drought periods. However, this perturbation is not new for these populations. Since 1994, different studies carried out at the *Montejo de la Sierra* beech-wood have advanced understanding of many functional response patterns also observed in more northern zones during extreme events such as the drought in 2003, which had a very negative impact upon the performance of beech in forests covering extensive areas of Central Europe. We summarise the response of beech at different scales; from young seedlings during establishment to the performance of mature trees, in an overview of the functional response to drought which synthesizes different studies carried out under natural conditions during the last 15 years. In mature trees, carbon uptake is limited during those years with acute scarcity of rainfall during spring and summer, and even slight decrease in soil moisture (predawn water potential~ -0.4MPa) induce stomatal closure across the full canopy. Tight control of water loss reflects a conservative response to periods of low soil moisture and high evaporative demand, both of which are expected to increasingly affect beech stands in the future. During juvenile phases, a higher impact of drought on potential carbon uptake than on respiration may explain high rates of mortality under deep shade. Starvation of reserves, linked with a low capacity to endure water stress in terms of tissue dehydration and maintenance of hydraulic function, can exacerbate the negative effects of water stress during regeneration and jeopardize, from a demographic point of view, effective recruitment under the deep shade cast by the overstorey. Ultimately, and considering the sensitivity of the species throughout its ontogenic states, it could be expected that the species range will retreat from marginal areas such as Montejo de la Sierra. Otherwise, this population may represent an important genetic reservoir in terms of adaptation to drought. To illuminate this issue, current experiments focus on comparing functional response to water stress at the population level with that of populations from the north.

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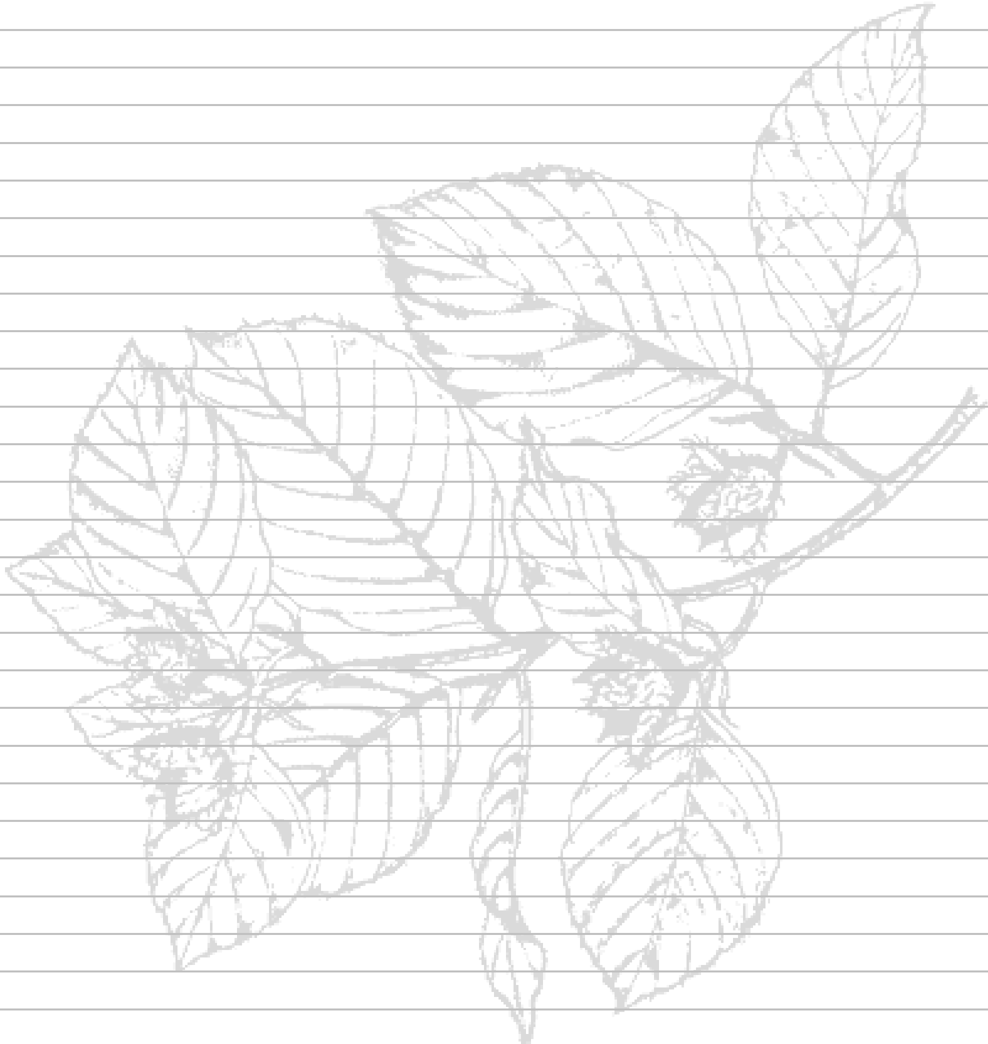

Session 2: Adaptation of Beech to Present and possible Future Conditions: What we know and what we Lack?. Chair: M. Forstreuter

OP13. The concept of adaptation: Adaptedness and adaptability, how adaptable is beech?

U. Mühlethaler, R. Alia, D. Gömöry, M. Liesebach

Summary.- Since forest ecosystems have existed, climate change has always occurred – usually slowly (e.g. glaciations), but sometimes abruptly, e.g. due to volcanic activities. Hence, existing forest ecosystems either persisted at least for another generation due to good adaption capacities, or were replaced by better-adapted ecosystems, or died on site. For about 20 years, indicators have clearly signalled that we are confronted with a major and probably long lasting disturbance, caused by a very fast climate change. Forest managers and authorities wonder to what extent the adaptedness of existing forest types will be able to deal with this disturbance, and they want to learn from researchers what adaptation strategies and silvicultural management measures will be recommended to anticipate future problems (e.g. assisted migration of drought-resistant provenances). Fagus sylvatica, as the flagship species of most forest types in temperate oceanic bioclimatic zones, is of special interest for the above-mentioned target groups.

The memorandum of understanding of COST Action E52, "Evaluation of Beech Genetic Resources for Sustainable Forestry", describes its main objective as "…to make predictions of the future distribution range of beech forest ecosystems under the assumption of certain scenarios of climate change…" In this context, terms like 'adapted', 'adaptedness', 'adaptable', 'adaptability', and 'adaptive strategy' are frequently used. But what exactly do we mean by these terms in the context of beech forest ecosystems? Does a beech ecosystem have an inherent adaptive strategy or should the term "strategy" be used more restrictedly (e.g. human activities)? How can we assess adaptive qualities? What is the spatial scale: what information do we get by focussing on single trees, stands or populations? What is the time scale of genetic research: do we get answers to the above questions by looking at adaptation as a topic of phylogeny, rather than ontogeny? And how do we deal with the complexity emerging from the process of co-evolution between organisms and their environments?

The intention of this talk is to clarify the above terms and relate them to our target species and its ecosystems, as well as to link this knowledge with interim results from COST Action FP0703 "Expected Climate Change and Options for European Silviculture ECHOES".

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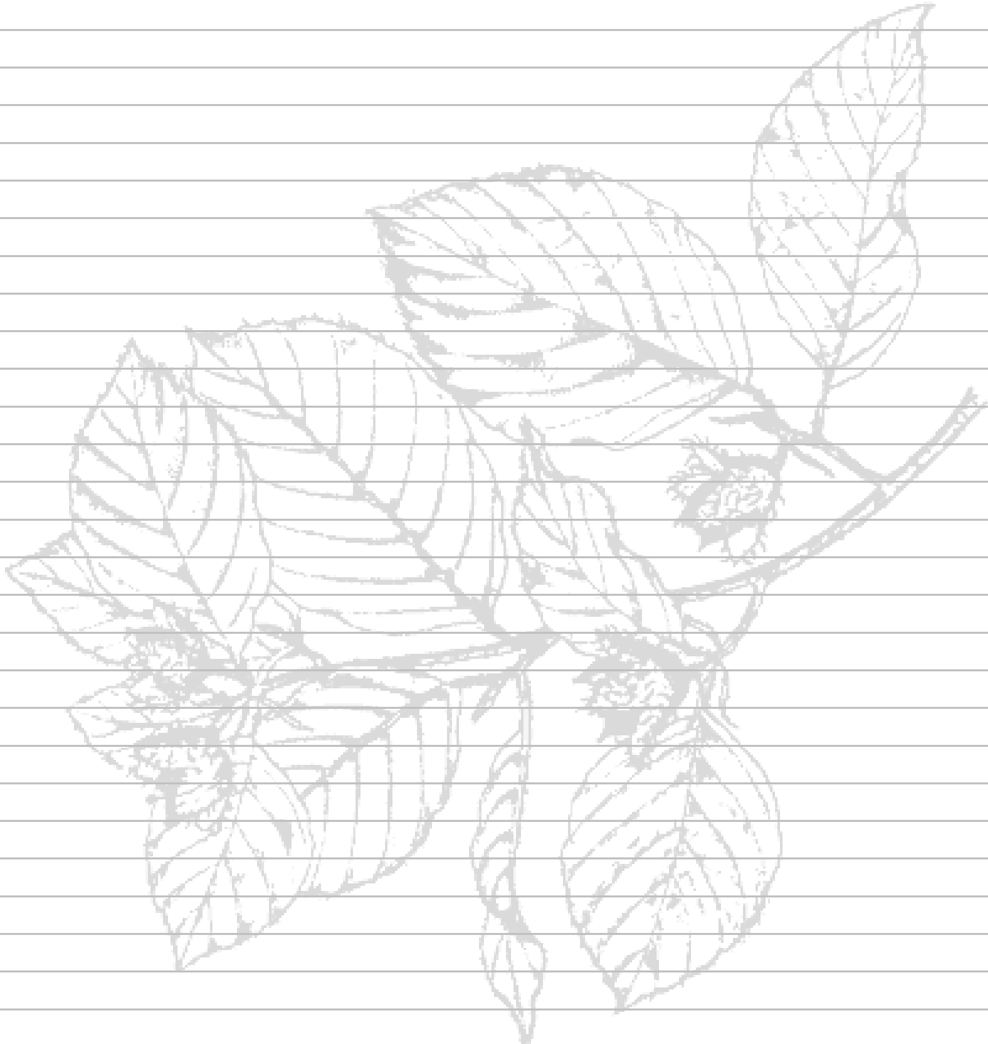

OP14. The survival and performance of beech provenances over a Europe-wide gradient of climate

R. Alía, M. Robson, G. Bozic, D. Gömöry, G. Huber, A. Doucouso, E. Rasztovits, G. von Wühlisch

Summary.- We analyse the information from 57 Provenances located in a gradient around Europe in the Internationa provenance tests established in the COST E52 action. The objectives of this presentation are:

Determine levels of genetic variability of Beech in Survival and Height, analyse the correlations among traits, and the importance of GE interaction. We also produce Europe-wide maps of variability in beech survival and performance, based on provenance level BLP and SDs from the beech trials, and maps of relative provenance survival and performance at each site where they were planted, based on site-level BLP and SDs.

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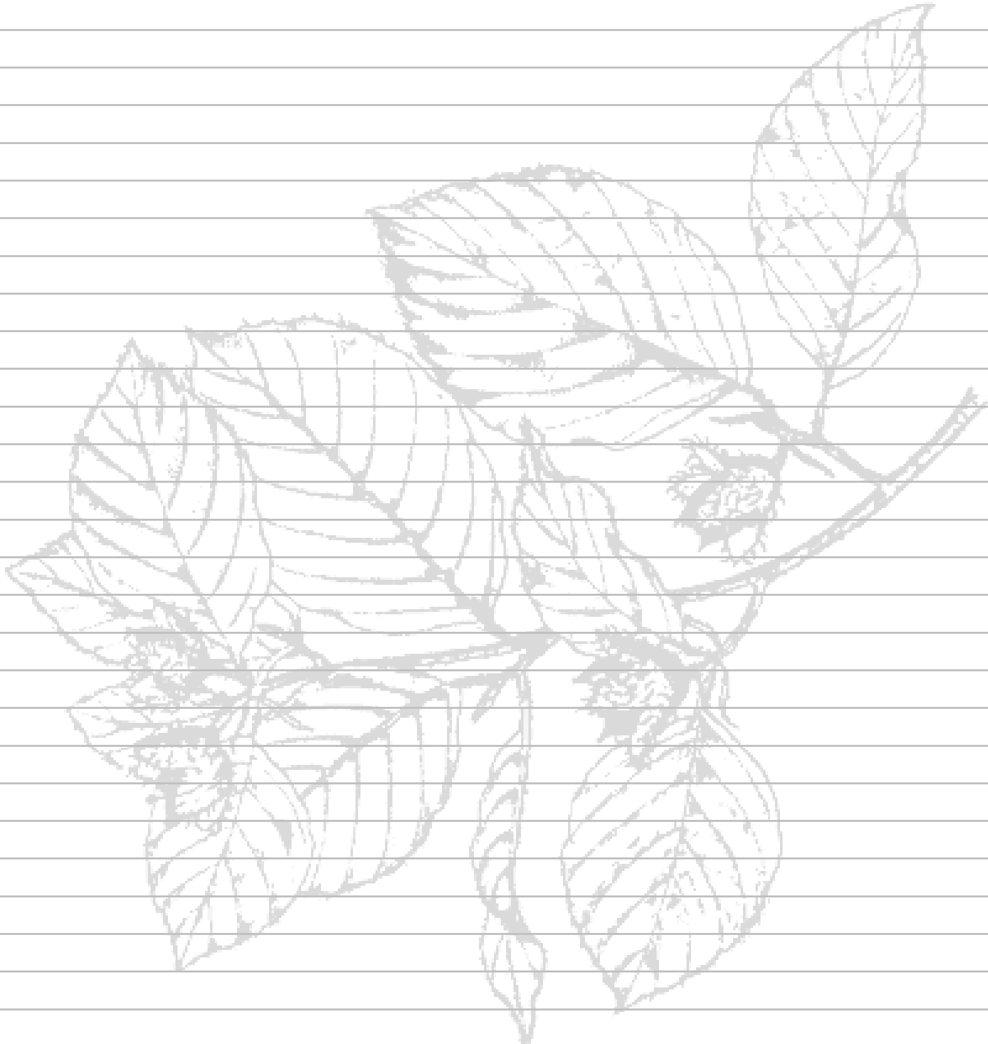

OP15. Preserved ecotype beech forestry in geographical plantation and environmental factors. The response of beech ecotypes to environmental factors in a forest plantation.

H. Krynytskyy, I. Delehan

Summary.- In a common-garden provenance trial in the Ukraine, the was high variability in survival (39%-90%) among beech ecotypes of different origins. Survival was highest in provenances from Brody (Ukraine), Lower Saxony (Germany), Ungeny (Moldova), Smolenitse (Slovakia) among others. These difference resulted from environmental factors and the genetic factors related to the origin of the provenances.

Our analysis of the affect of frost damage and other abiotic stress factors on survival allowed the ecotypes to be separated into four distinct groups: ecotypes 1. - 11 that are damaged by late spring and early autumn frosts; ecotypes 2. - 14 damaged by late spring frosts only; ecotypes 3. - 28 damaged by early autumn frosts only; and ecotypes 4. - 17 neither damaged by late spring nor early autumn frosts.

Ecotype survival in the common-garden trial was correlated with late spring frosts r = -0,31, $t_{5\%}$ and early autumn frosts r =- 0,58, $t_{5\%}$ in a strictly rectilinear relationship, and some biotic factors, e.g. demage by *Deporaus betulae* (L., 1758) r = -0,24-0,59, $t_{5\%}$; *Hartigiola annulipes* Htg., and *Mikiola fagi* Htg., and fungal necrosis r = -0,42-0,70, $t_{5\%}$.

There was a weak linear relationship between the frequency of early autumn frost damaged trees and their latitude of origin (r = 0,23; $t_{5\%}$). There was also a moderate linear relationship between early autumn frost damage and the number of trees of a particularly ecotype affected by *Hartigiola annulipes* Htg., *Mikiola fagi* Htg., and fungal necrosis (r = 0,45-0,49; $t_{5\%}$). Early autumn frost damage was greater in trees weakened by pests and fungal diseases. There was a weak link between trees with *Deporaus betulae* lesions and those weakened by late spring (r = 0,27; $t_{5\%}$) and early autumn frost(r = 0,28; $t_{5\%}$).

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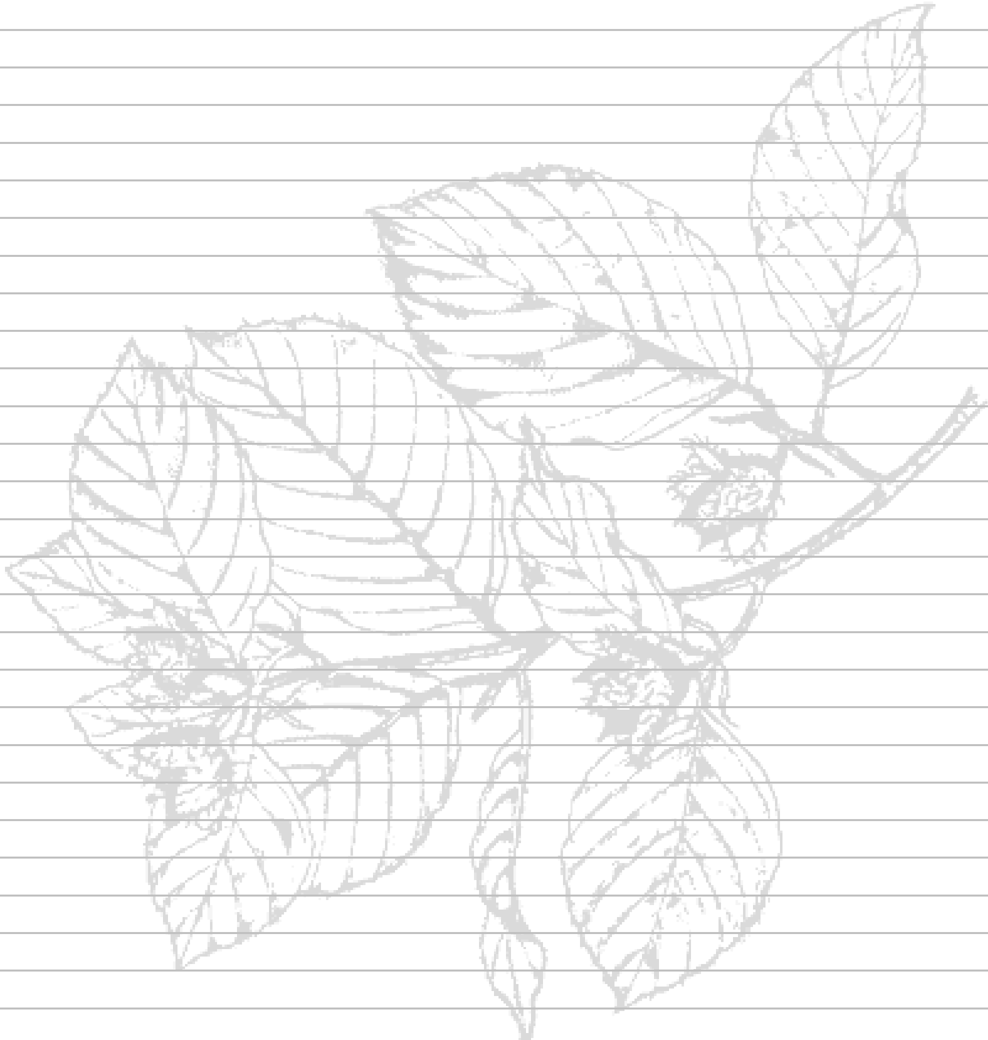

OP16. Influence of provenance origin and site of growth on the timing of leaf flush in beech saplings.

T.M. Robson, D. Gömöry, E. Rasztovits, P. Mertens, M. Liesebach, M. Zitová, L. Ionita, G. Bozic, M. Sulkowska, R. Alia, M. Forstreuter, G. von Wühlisch

Summary.- The timing of bud burst and leaf development in trees determines growing season length and their potential for carbon assimilation. Hence, there are important fitness consequences deriving from phenology, meaning that it is a trait under strong selection pressure, and varies considerably due to intra-specific genetic differences in populations across its distribution area. In beech, a combination of photoperiod and chilling to break dormancy over winter and priming by warm temperatures during spring are needed for bud burst. To determine the relative influence of these factors we censused beech populations growing in common-garden trials across European beech's range on multiple occasions during the spring to estimate the progression of flushing. In some cases census were performed over several years. We related these data to daily temperatures calculated from a Europe-wide database. We compared different models fitting the timing of bud burst across sites and in provenances of diverse origins to try and obtain a mechanistic interpretation of the Europe-wide patterns that emerge. In general populations of beech from the south-east of Europe flush early in the spring and those from the north and west of Europe are late flushing, but altitude and local climate also moderate these regional trends. We consider how warming may bring forward the growing season and benefit beech provenances with a low temperature sum requirement in the spring, but caution that productivity gained by transferring early-flushing populations from the south east of Europe further north may be offset by increased frost damage and altered water use.

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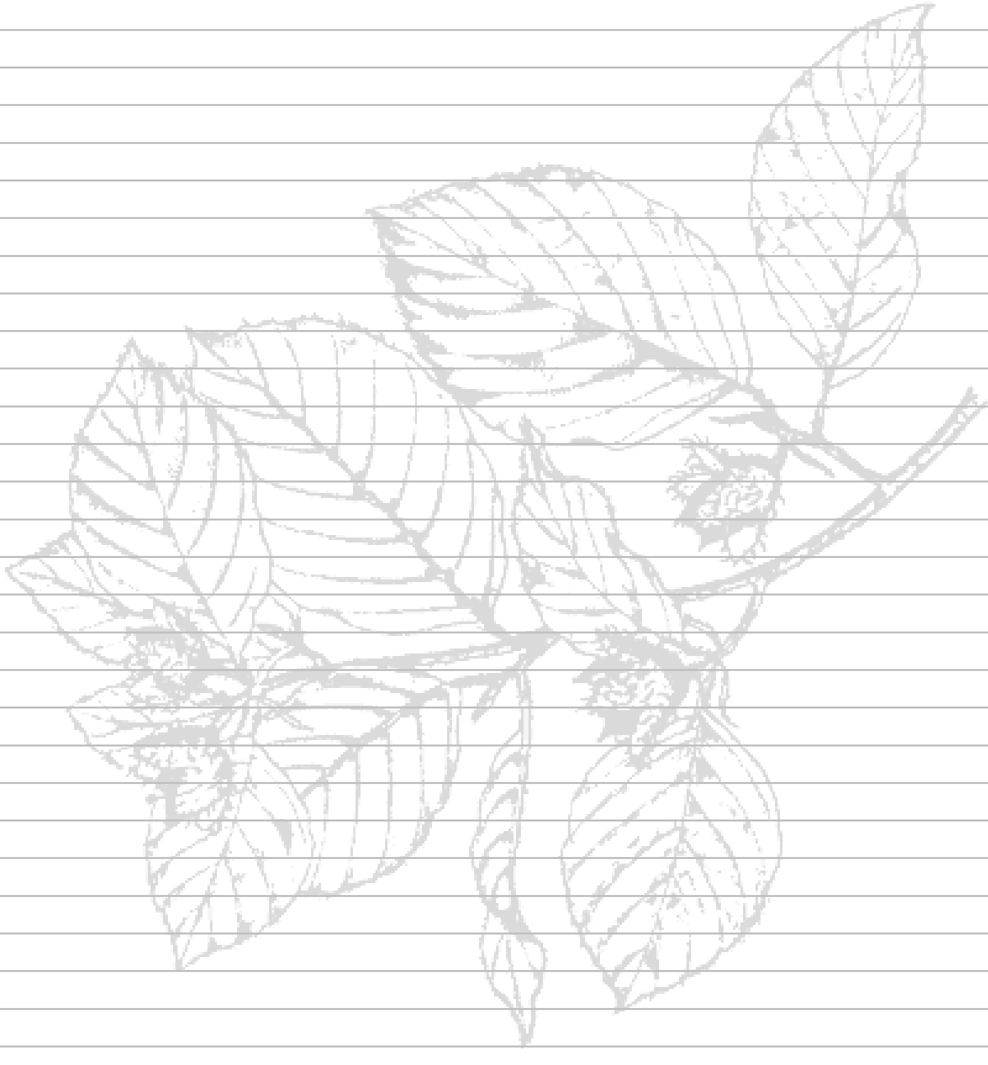
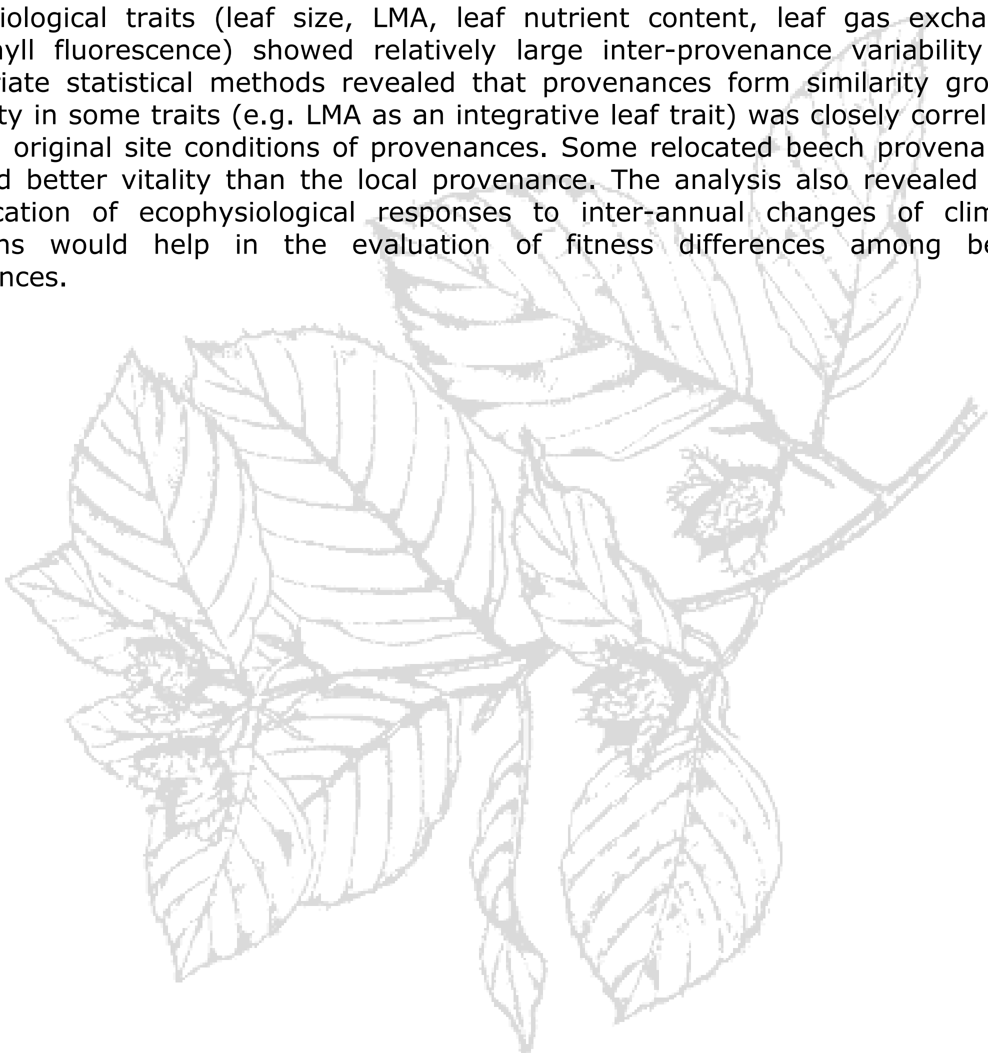


OP17. Analysis of ecophysiological plasticity of European beech provenances in the Hungarian provenance trial

I. Mészáros, V. Oláh, Sz. Veres, Á. Lakatos, E. Rasztovits, Z. Herke

Summary.- An experiment was established with 36 provenances of European beech (*Fagus sylvatica* L.) in South Hungary (Bucsuta) in 1998 as part of the international network of beech provenance trials. A set of leaf traits were investigated in all 36 provenances, and between eight and eleven of them, including the local Hungarian one, were selected for detailed ecophysiological studies . Five of the selected provenances originated from somewhat drier habitats and the other five provenances from wetter habitats than the climate conditions at Bucsuta the experimental site.

Ecophysiological traits (leaf size, LMA, leaf nutrient content, leaf gas exchange, chlorophyll fluorescence) showed relatively large inter-provenance variability but multivariate statistical methods revealed that provenances form similarity groups. Variability in some traits (e.g. LMA as an integrative leaf trait) was closely correlated with the original site conditions of provenances. Some relocated beech provenances exhibited better vitality than the local provenance. The analysis also revealed that quantification of ecophysiological responses to inter-annual changes of climatic conditions would help in the evaluation of fitness differences among beech provenances.



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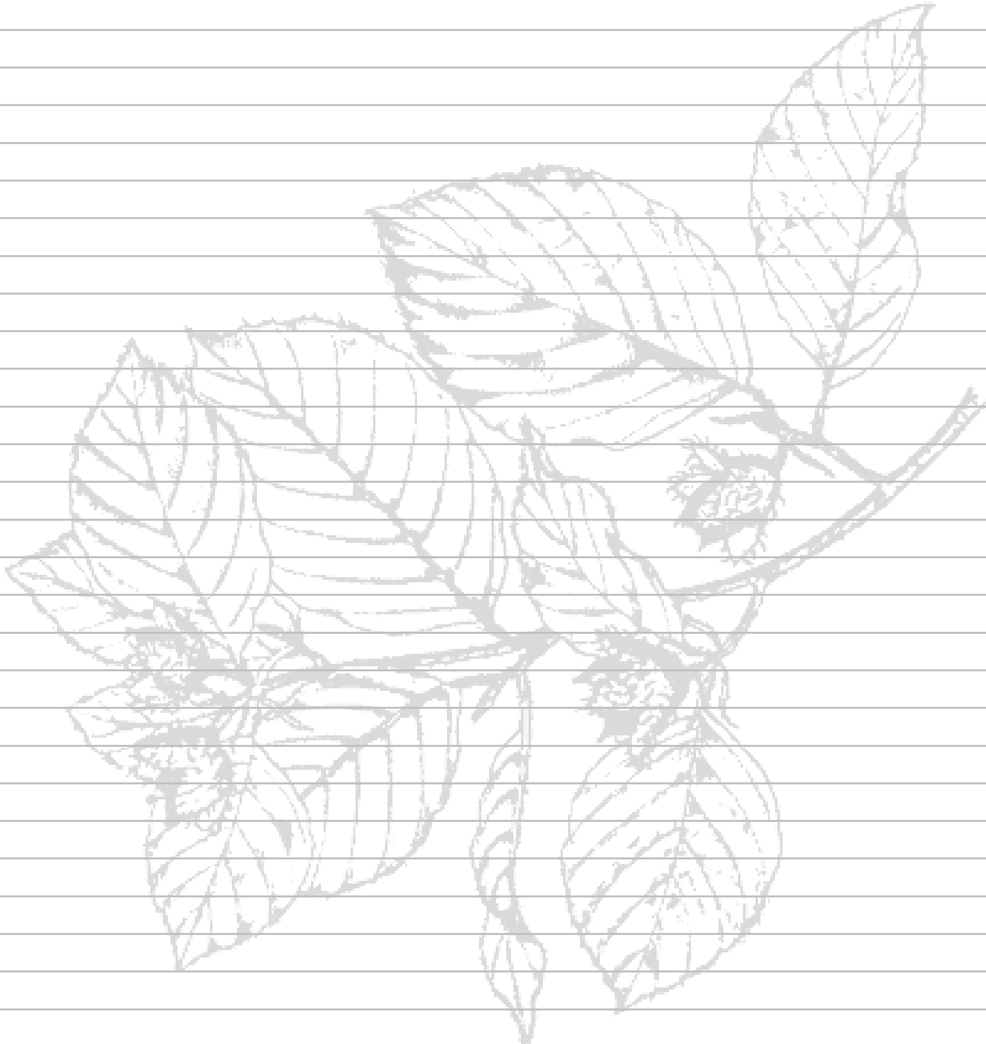

OP18. Variation in Leaf Morphology and Nitrogen content reflect intraspecific differences in adaptation across beech distribution.

T. M. Robson, M. Zitová, D. Sanchez-Gomez, O. Urban, M. Forstrueter, I. Mészáros, I. Aranda

Summary.- Leaf morphological and physiological traits combine to determine the limits of plasticity in the response of water regulation and gas exchange to environmental stress. While leaf physiology can acclimatise to match the environment during the growing season, morphology is largely fixed during leaf development. Since beech has determinate growth its leaf morphology is still less-flexible and is particularly reflective of plant condition at bud-set. Thus, by comparing equivalent leaves of different populations we can identify differences in potential photosynthetic performance, investment, and strategy. Leaf Mass per Area (LMA) reflects differences in leaf density and leaf thickness, and is known to vary with drought, light, nutrient stress, and thermo-stress. Leaf nitrogen content (LNC) reflects photosynthetic investment and combined with LMA gives a baseline estimate of relative growth rate (RGR), and together with photosynthesis allows estimation of photosynthetic nitrogen use efficiency (PNUE). Measuring changes in these traits during the spring and summer reveals the phenological progression of leaf life-span. To identify the genetic versus environmental components of variation in LMA and LNC in beech, we harvested leaves in mid-summer from six populations covering the Europe-wide distribution, growing in common-garden provenance trials in Spain, Hungary and the Czech Republic. The climate at the site of growth and at the origin of each provenance influenced leaf size and LMA, while LNC was also affected by timing of spring flush and correlated with other performance-related traits. Morphological and physiological trait co-variation is compared and discussed in the context of fitness under future climate change scenarios.

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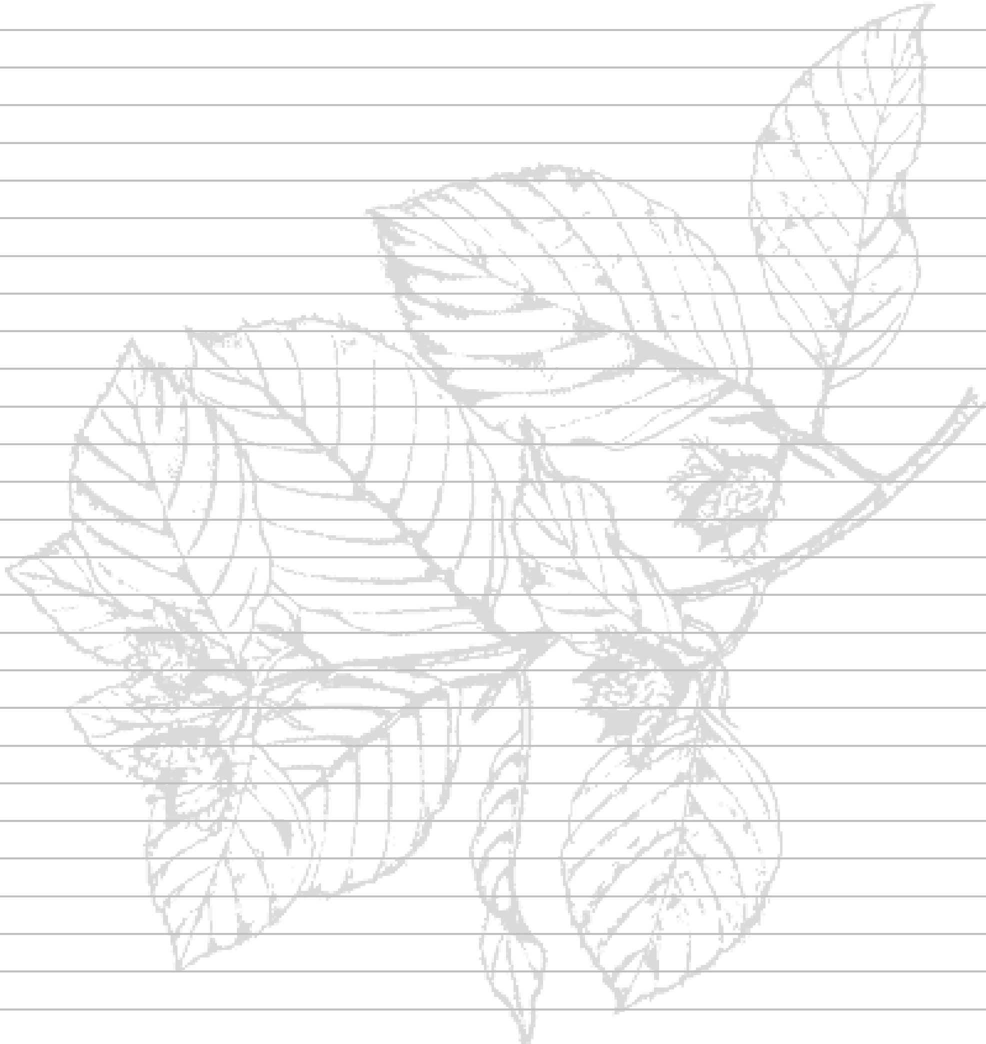

OP19. The contribution of fine roots and mycorrhiza to carbon allocation belowground illustrated by the case study of three beech provenances

P. Železnik, M. Westergren, M. Bajc, T. Grebenc, G. Božič, H. Kraigher

Summary- In forest ecosystems more than 75% of carbon is part of forest soils. Carbon dynamics depends predominantly on living constituents of forest soils and actors in belowground processes, i.e. on fine roots, fungi and microorganisms. Although the fine roots (<2 mm in diameter) of forest trees contribute less than 2% of tree biomass in mature forests (appr. 6-8 t/ha in temperate and boreal forests), they contribute largely to the belowground C stocks as they are short-lived organs with life expectancy from weeks to several years and a rapid turnover. Further to fine roots, approximately 20-30% of current assimilates are allocated to the mycorrhizal fungi. Fungal mantles and extrametrical mycelia of mycorrhizal fungi are estimated to have a biomass of about 0.5-0.7 t/ha. Their turnover is species and strain dependent and can vary due to changing environmental conditions. In order to differentiate between the plant population based and environmental based differences in fine root and mycorrhizal turnover we have studied fine root growth and mycorrhizal community structure at three provenances of beech in the international beech provenance trial in Slovenia. Selected results will be presented and discussed.

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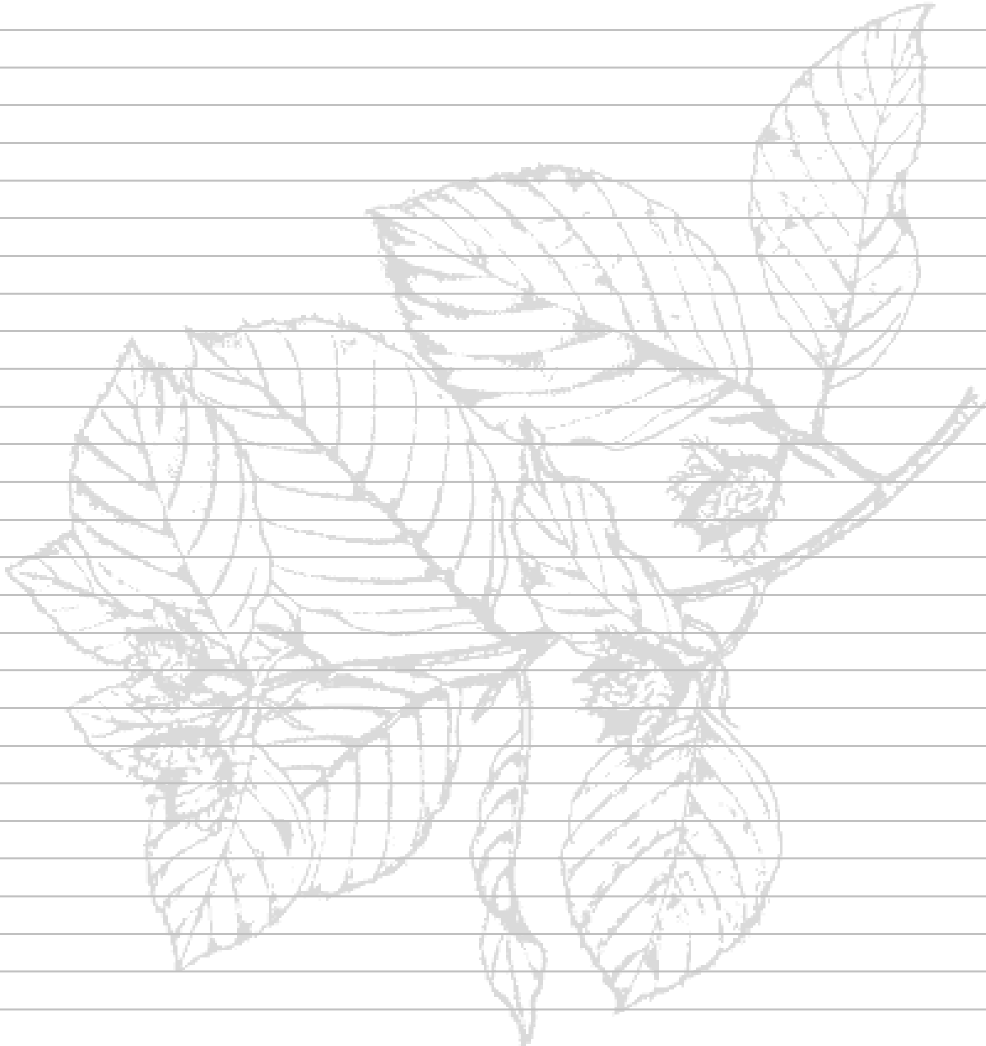
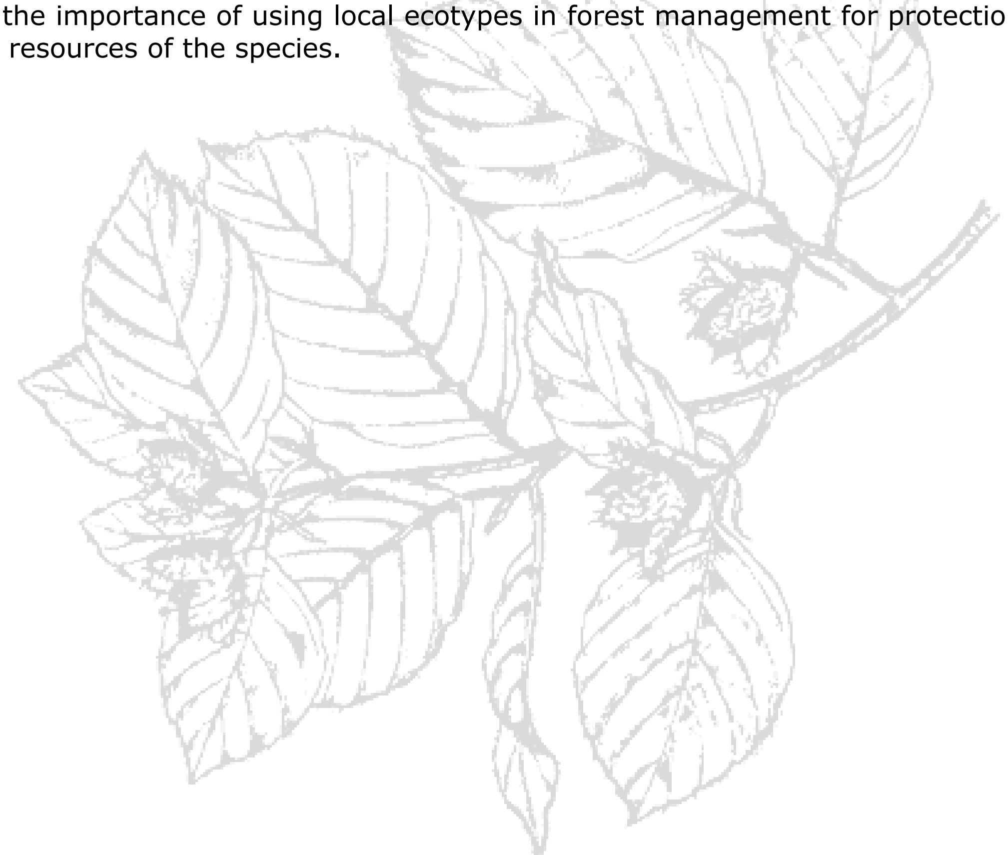


OP20. Ecotype variation of European beech in Poland on the basis of soil differentiation

M. Sulkowska

Summary.- Aim of the study was characteristics of European beech site ecotypes in Poland on the basis of estimation genetic diversity of populations and their progeny in natural geographic range and soil characteristics of their habitats.

The genetic diversity and differentiation of investigated populations and mineral content and basic soluble site components important for grow of the trees were estimated. The possibilities of adaptation were measured through changes of genetic structure of the mother populations compared to progeny on the basis of isoenzyme analysis. There were established 9 beech experimental plots of t ha area in selected stands located in: fertile Pomeranian beech (Gryfino and Kartuzy), fertile Sudeten beech (Zdroje), fertile Carpathian beech (Lutowiska and Łosie), and acid beech (Miechów, Suchedniow, Tomaszów Lubelski and Zwierzyntec). Important correlations were found for genetic diversity and differentiation of beech populations and their progeny and the level of mineral and ion content important for growth and functions of plants. The very high inter-population diversity was shown and the investigations reviled the importance of using local ecotypes in forest management for protection of genetic resources of the species.



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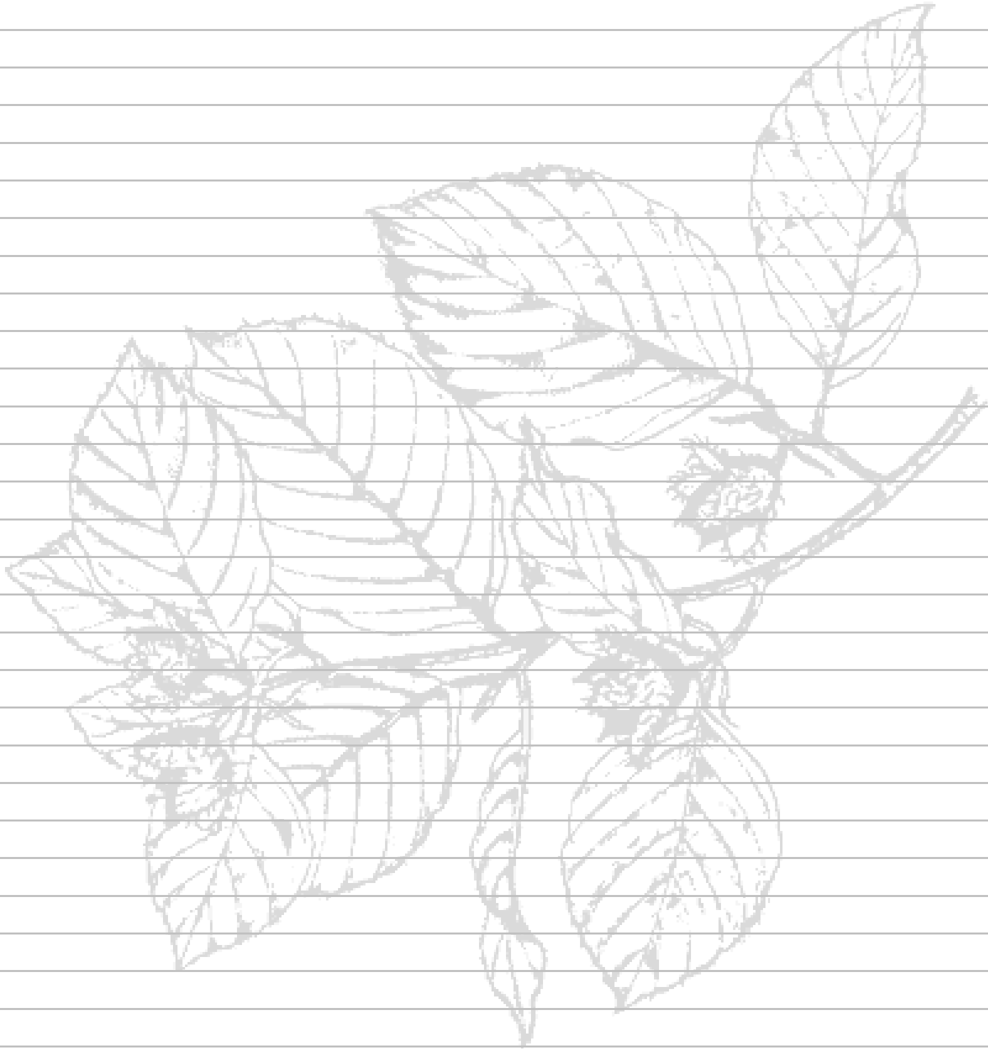

OP21. Comparison of climate-growth-relations of *Fagus sylvatica* provenances growing on three sites of the International Beech Provenances Experiment of 1993/95 in Central Europe

M. Liesebach, S. Schüler, H. Wolf

Summary.- European beech covers a large geographic area of Europe and is a strong competitor with other tree species in Central Europe. At the Institute of Forest Genetics in Grosshansdorf in 1993 seed lots were sown for the establishment of an International Beech Provenance Experiment, and subsequently 23 trials were established in spring 1995. The presentation will concentrate on three sites with 47 common provenances, where survival and height growth were monitored: Schaedtbek (Germany, Schleswig-Holstein), Malter (Germany, Saxony) and Gablitz (Austria). Climate data are available for these trial sites and the sites of provenance origin.

The seed lots where many of the tested provenances originated lay to the west or southwest of the trial sites, in a cooler damper habitat than the trials. Hence for practical purposes this east- / northeast-wards translocation of provenances simulates the predicted climate change for this region.

In addition to climate, growth rate could be influenced by the previous use of the sites. Beech is growing much better on the two sites established on agricultural soils than on forest land. Overall survival is similar among the sites or likewise affected by management.

Height growth of provenances from the centre of the distribution area was rather unresponsive to climate, but provenances from the eastern part did response to climate. On the three trial sites some provenances from the eastern distribution area grow consistently under different climate conditions. Other provenances were sensitive to transfer to different sites: i.e. they have the tendency to grow better on some sites than others.

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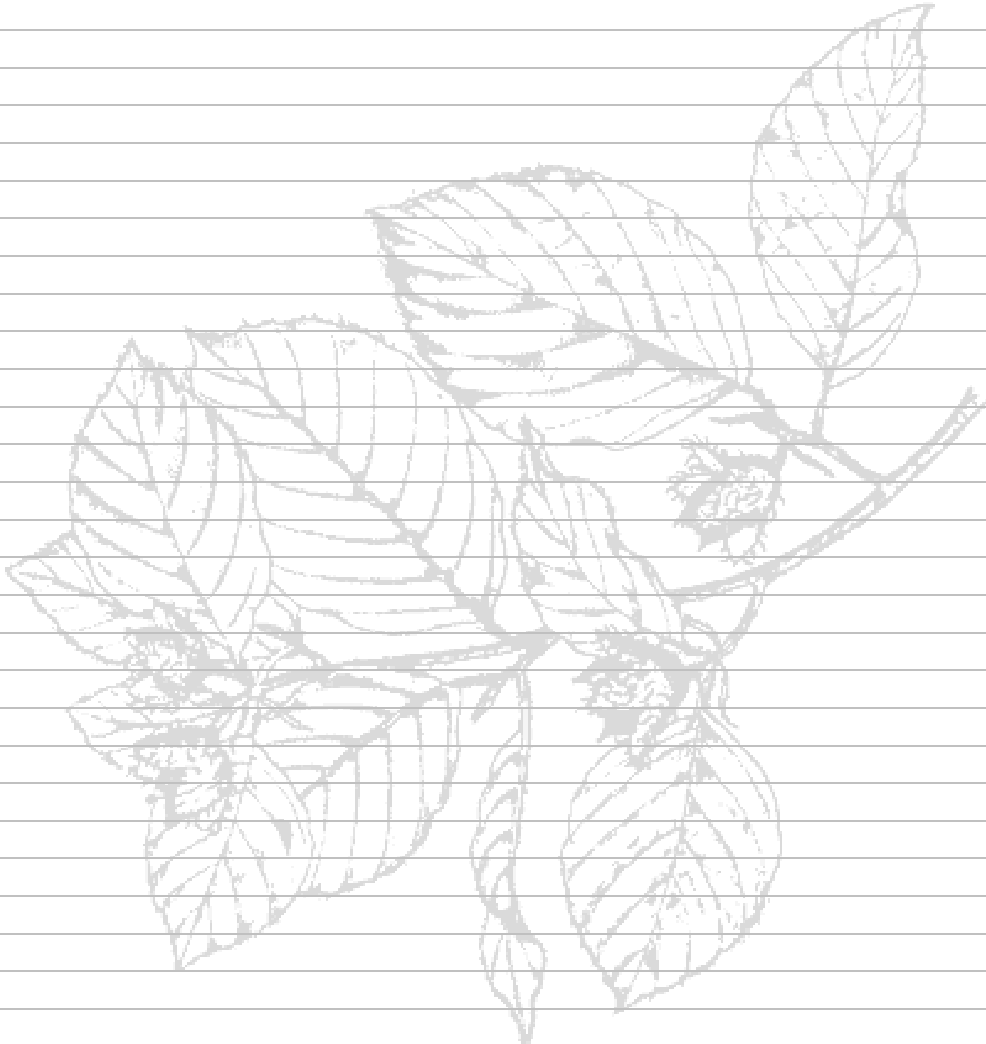

OP22. Genetic diversity in *Fagus* spp. and implications for conservation and breeding: the importance of molecular markers and of the International Beech Provenances Trials

C. Vettori, T. Geburek, A. Ducousso, D. Gömöry, G. G. Vendramin, L. Paule, D. Paffetti, G. Bozic

Summary.- The classification of beech in Western Eurasia accepted by Flora Europaea recognizes one species, *Fagus sylvatica* with two subspecies *F. s. sylvatica* and *F. s. orientalis*, and two intermediary types, *F. moesiaca* and *F. taurica*. Recent studies by chloroplast DNA sequence analyses seem indicate that the Asiatic species are more ancient than the European ones, and *F. orientalis* seems to be originated early from the other European groups. These studies show that it is possible to discriminate by molecular markers the different *Fagus* species, and *F. orientalis* can be regarded as the ancestral species in European beech. Nevertheless, it has been found that within the European *Fagus* spp. the differences are very few suggesting that speciation process within this group might be still in progress.

In additional studies, chloroplast markers have showed that the southernmost parts of the natural range of beech have higher genetic diversity than the central and northern areas, the highest number of haplotypes being detected in the southern Balkans and in Italy. In addition nuclear markers allowed the detection of groups of populations, undetected with chloroplast markers, and which resulted in separate groups for the Iberian Peninsula, the Italian Peninsula, the south-east of France and the Carpathian. The complementary palaeobotanical and genetic data indicate that:(i) beech survived the last glacial period in multiple refuge areas; (ii) the central European refugia were separated from the Mediterranean refugia; (iii) the Mediterranean refuges did not contribute to the colonization of central and northern Europe; (iv) some populations expanded considerably during the postglacial period, while others experienced only a limited expansion; (v) the mountain chains were not geographical barriers for beech but rather facilitated its diffusion.

The genetic data, in general, indicate that European *Fagus* spp. are relatively "young species" and several populations with high level of allelic richness in multiple European refuge areas (eastern foothills of Alps, Iberian, Italian and Balkan Peninsula, and southern part of France) are present. These populations have to be considered at high priority in conservation programme also in consideration of the climatic changes. Therefore, this highlight the importance of the International Beech Provenances Trials established in 1995 and 1998 and a comparison with the genetic data available will be discussed.

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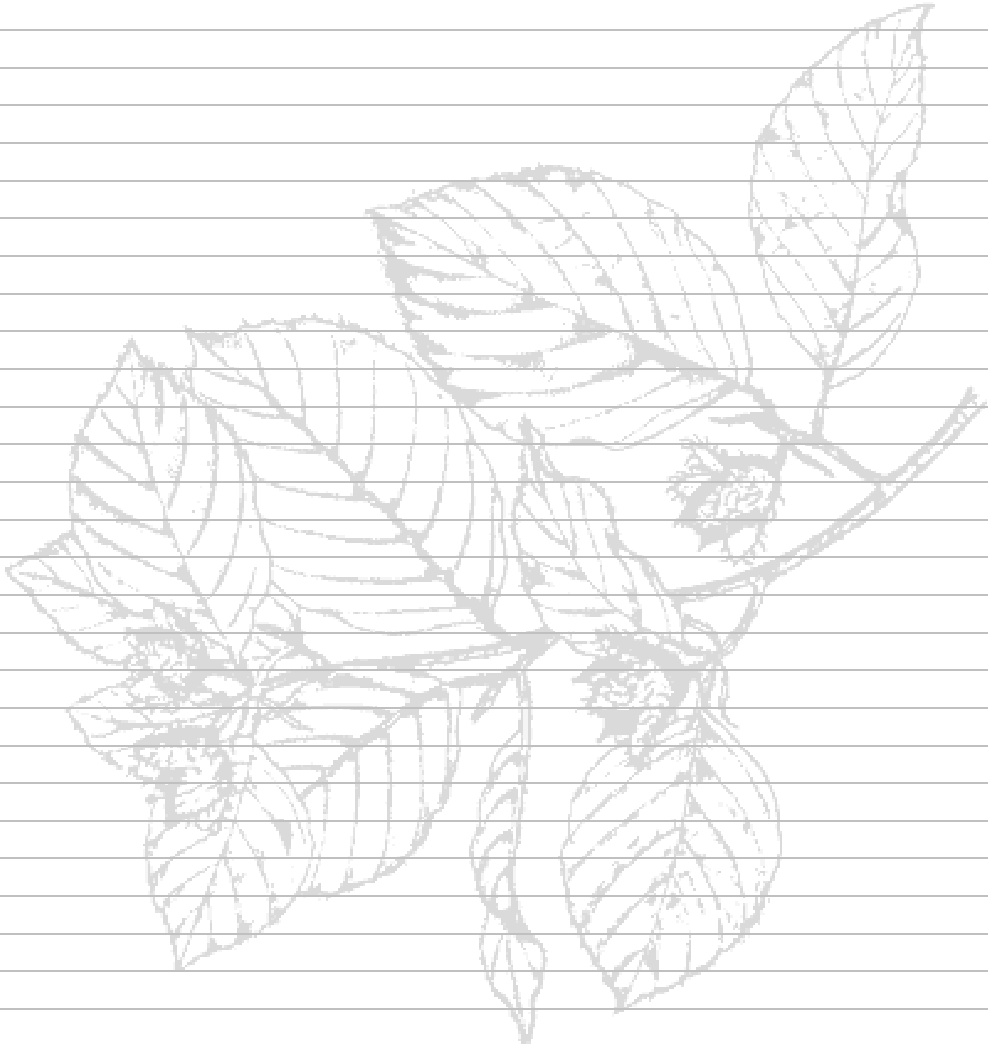

OP23. Transcriptional signatures in leaves of juvenile and adult European beech trees (*Fagus sylvatica* L.) of different genotypes under abiotic stress

D. Ernst, C. Vettori, D. Paffetti, M. Forstreuter, M. Fladung, K.H. Häberle, R. Matyssek, J. B. Winkler, G. Welzl, M. Olbrich

Summary.- Ozone is one of the most harmful air pollutants, alone and when interacting with increased atmospheric CO_2 concentrations. To investigate the ozone responsiveness of trees, as well as effects of elevated CO_2 we carried out a microarray analysis on leaves of European beech. Two different *F. sylvatica* genotypes were grown in climate chambers under controlled conditions and 450 ppm or 1000 ppm of CO_2. The effects of ozone exposure on juvenile and adult beech trees was investigated under outdoor free air fumigation producing double the ambient ozone conditions over a period of two years. Here we report a first glimpse of genes that may be most sensitive to elevated CO_2 in both genotypes. Transcriptional profiling of juvenile beech revealed significant changes in gene expression caused by ozone. In contrast, elevated ozone produced only small differences in adult trees, thus demonstrating an ontogenetic effect. There were transcriptional differences between sun and shade leaves, as well as between different years, , which may indicate that external factors, in addition to ozone, affected gene expression.

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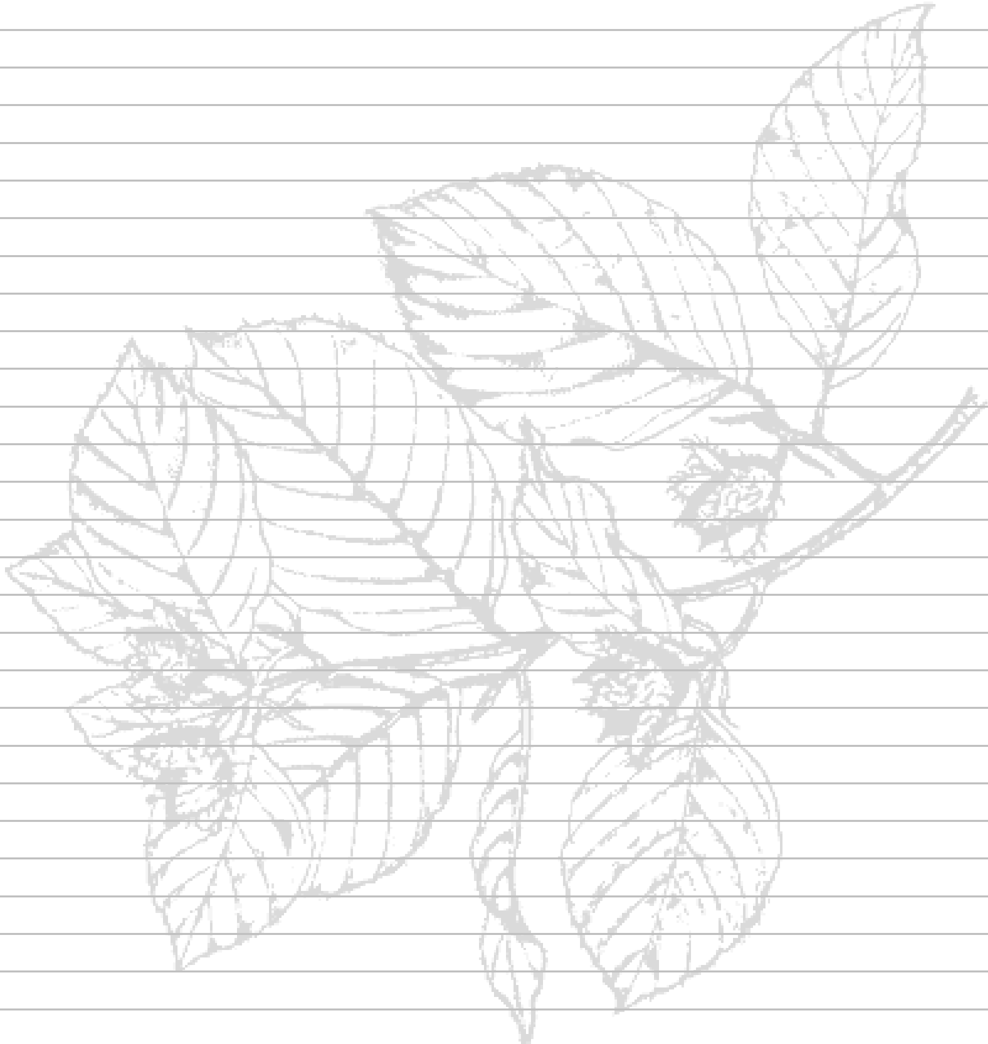

P4. Beech provenances coming from mountain sites tend to flush early

P. Maertens

Summary- The data base built up during the EU Action COST-E52 describes many beech provenances compared in two series of international trials. These includes provenances' geographical location (latitude, longitude and altitude) and climatic descriptions covering the distributional area of this species, presently from the Pyreneans to the Black Sea, and from the Apennines to the Baltic region. Variations in the average monthly temperature and the total precipitation during the growing season from May to September, have been chosen to best describe climatic variation over the distributional area of beech. Most of the provenances described fall within a "Central Climatic Zone", which is characterised by low altitude (<600 m), relatively-low average growing-season temperatures (13-17°C) and a precipitation of 250-450 mm during the growing-season. This contrasts with "Mountain Sites", of high altitude >600 m, with a lower average temperature (10-14°C), and higher precipitation (>500 mm) than other categories. Less data are available for sites in the Pyreneans with higher average temperatures (>16°C) and precipitation close to the lower limit for the species.

Spring flushing is the adaptive trait considered in this study. To allow cross-comparison of a group of common provenances, variation in spring phenology was monitored in several trial sites from different climate zones where beech occurs. These comparisons highlight that consistently-earlier flushing by provenances from " Mountain Site" when they are placed in the "Central Climatic Zone" and in warmer sites in general. The trends illustrated here are consistent with the results obtained by Gömöry & Paule (2009), and expose specific patterns in flushing with climate and altitude.

Variation in timing of bud burst, both between provenances and among trees of each provenance, was nevertheless high. The differentiation of certain beech populations may partially explain how beech is able to adapt to certain climatic conditions within its current distribution area. These results and their consequences in relation to climatic changes will be discussed in this presentation.

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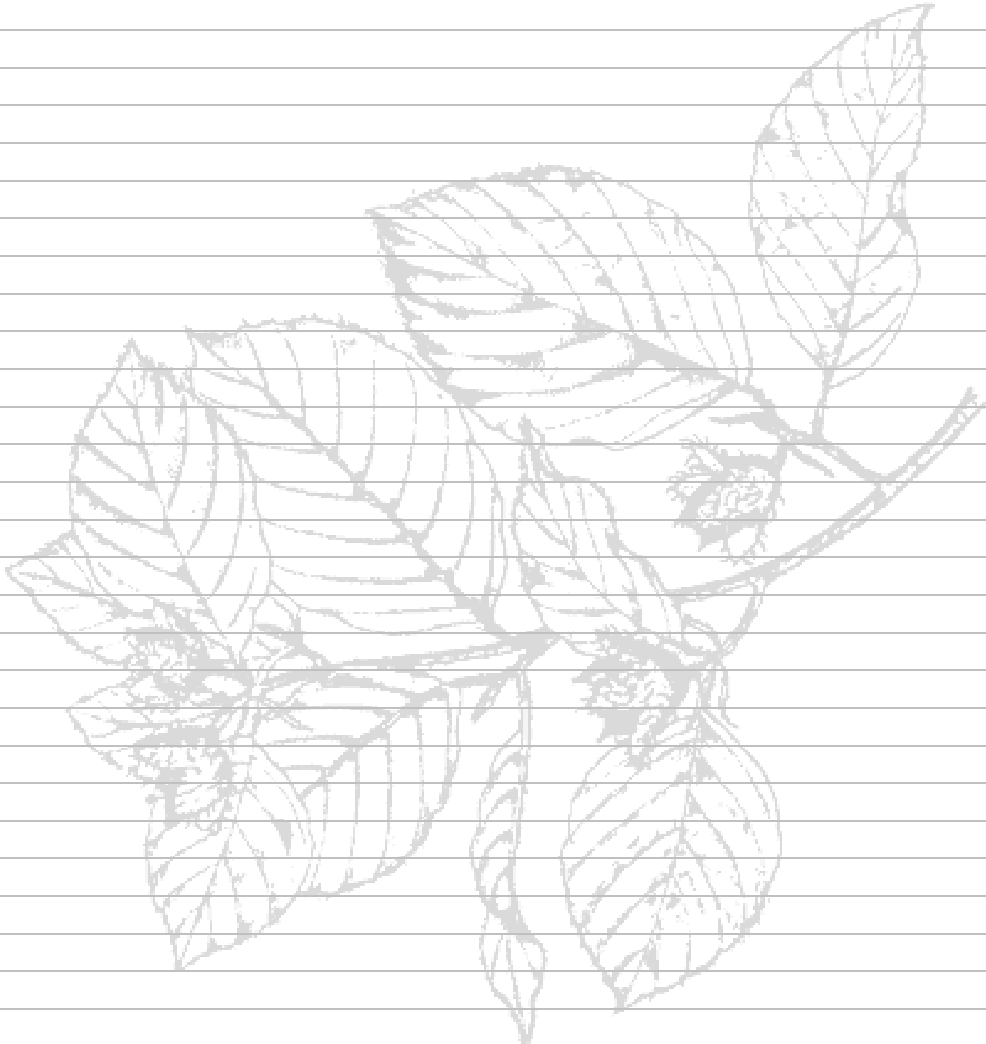

P5. Ozone fumigation (twice ambient) reduces leaf infestation by the endophytic fungus *Apiognomonia errabunda* of adult European beech trees

M. Olbrich, C. Knappe, M. Wenig, E. Gerstner, K. Häberle., M. Kitao, R. Matyssek, S. Stich, M. Leuchner, H. Werner, K. Schlink, G. Müller-Starck, G. Welzl, W. Heller, D. Ernst, G. Bahnweg

Summary.- The Kranzberger Forst research site near Munich offers the unique opportunity to study factors affecting the susceptibility of adult European beech to infection by leaf pathogens and endophytes under natural environmental conditions. In June 2006, a controlled infection study was initiated using an *A. errabunda* spore suspension. *A. errabunda* infestation levels quantified by Real-time PCR increased significantly only in shade leaves not fumigated with additional ozone. Transcriptional data were obtained from sun and shade leaves exposed to ambient und twice-ambient ozone. Microarray ESTs were prepared from an ozone- and *Phytophthora citricola*-responsive cDNA library. Only a few transcripts changed their expression level after the infection with *A. errabunda*. Both the ozone treatment and the light conditions (shade v. sun) affected gene expression more strongly than pathogen infection. Chemical and biochemical analyses of leaf traits such as dry mass,lignin, and cellulose contents, phenolic compounds and other metabolites, polyamines, salicylic acid, 1-amino-cyclopropane-1-carboxylic acid (ACC), and gas exchange revealed differences only between sun and shade leaves. Small, but significant, differences due to ozone treatment, affected cell wall components and ACC, presumably involved in cell wall strengthening – which might in part have lead to the inhibition of fungal infection.

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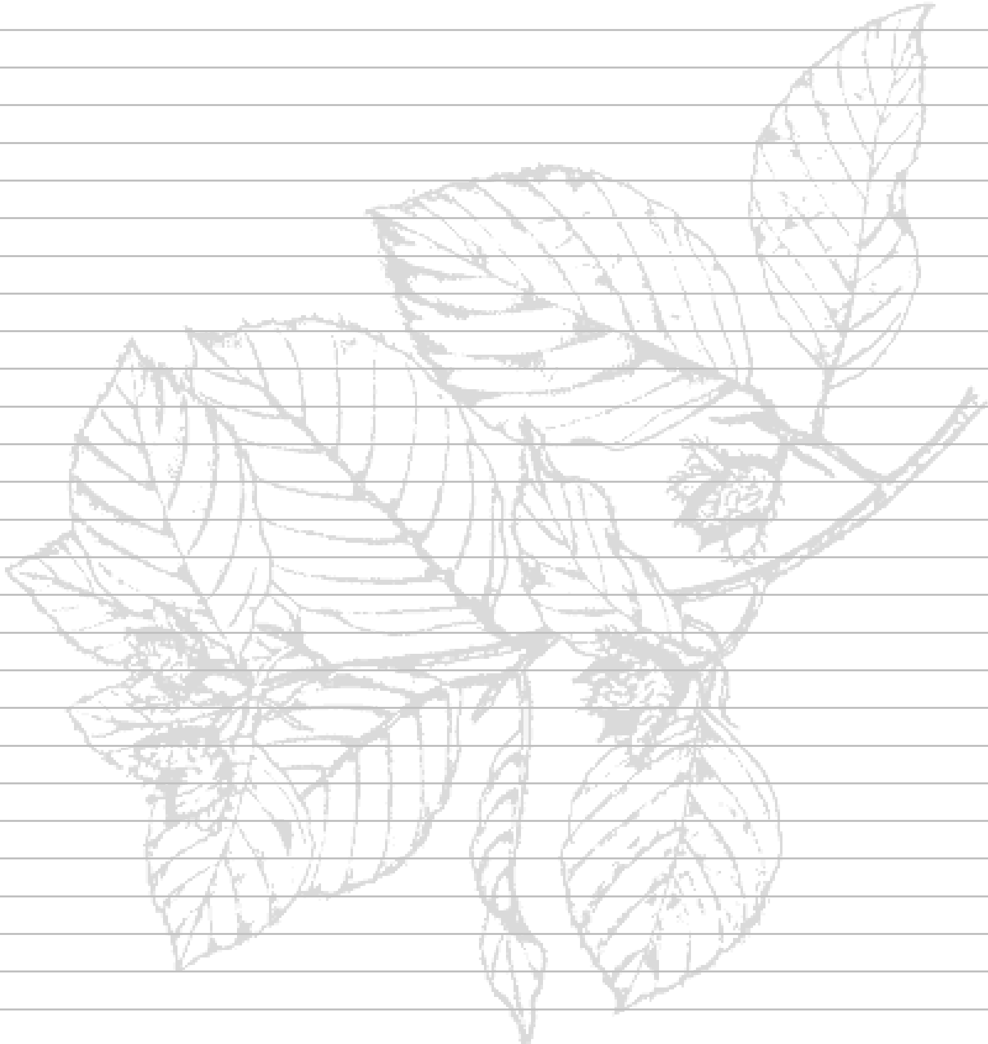
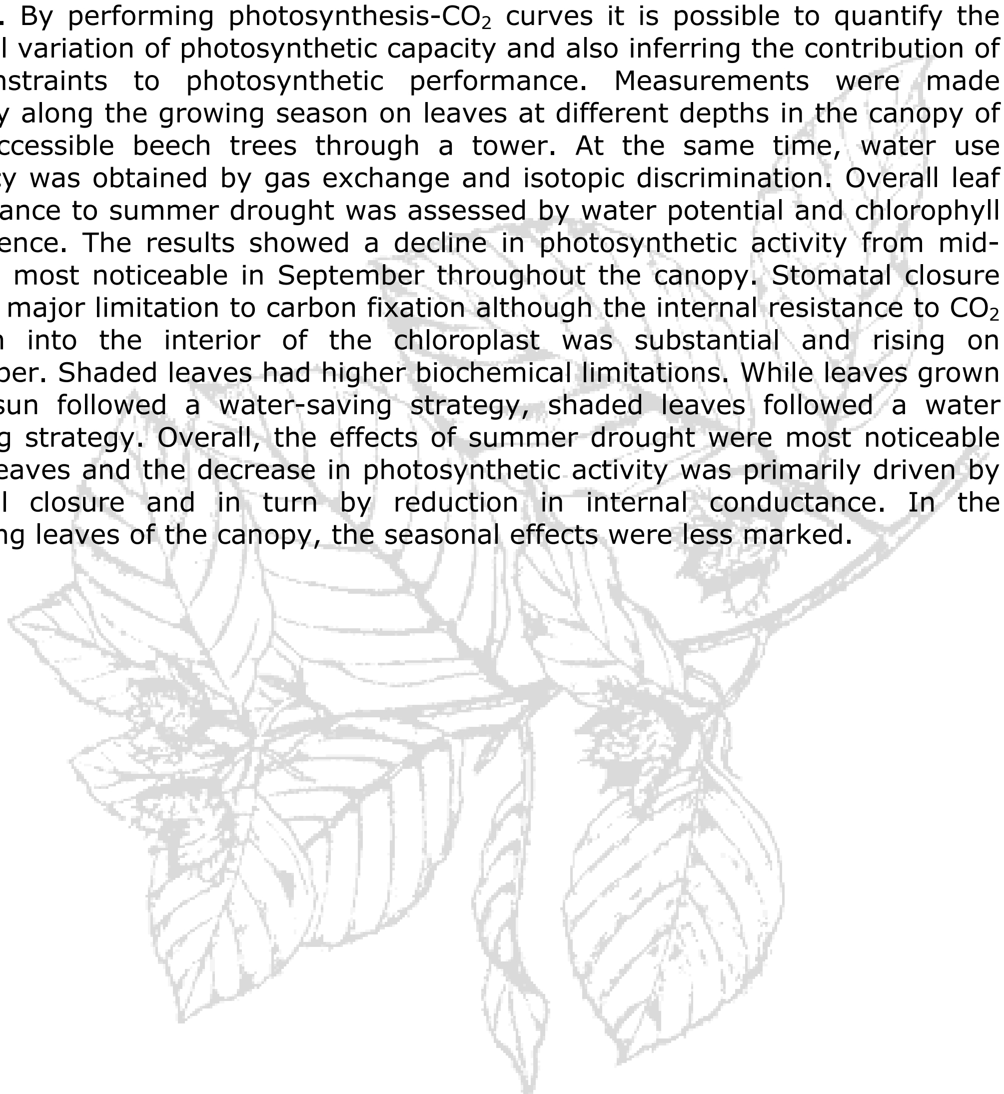


P6. Limitations to photosynthesis along beech canopy profile during summer drought in a population in its southern limit of distribution.

F. J. Cano-Martín, D. Sánchez-Gómez, A. Gascó, T. M. Robson, L. Gil, I. Aranda

Summary.- Beech is considered both shade tolerant and drought intolerant. Its southern limit reaches the siliceous mountains in Central Iberian Peninsula. At this latitude, beech occupies areas with sub-Mediterranean climate characterized by high daytime summer temperatures and at least one month of physiological drought. By performing photosynthesis-CO_2 curves it is possible to quantify the seasonal variation of photosynthetic capacity and also inferring the contribution of the constraints to photosynthetic performance. Measurements were made regularly along the growing season on leaves at different depths in the canopy of three accessible beech trees through a tower. At the same time, water use efficiency was obtained by gas exchange and isotopic discrimination. Overall leaf performance to summer drought was assessed by water potential and chlorophyll fluorescence. The results showed a decline in photosynthetic activity from mid-July but most noticeable in September throughout the canopy. Stomatal closure was the major limitation to carbon fixation although the internal resistance to CO_2 diffusion into the interior of the chloroplast was substantial and rising on September. Shaded leaves had higher biochemical limitations. While leaves grown in full sun followed a water-saving strategy, shaded leaves followed a water spending strategy. Overall, the effects of summer drought were most noticeable in sun leaves and the decrease in photosynthetic activity was primarily driven by stomatal closure and in turn by reduction in internal conductance. In the remaining leaves of the canopy, the seasonal effects were less marked.



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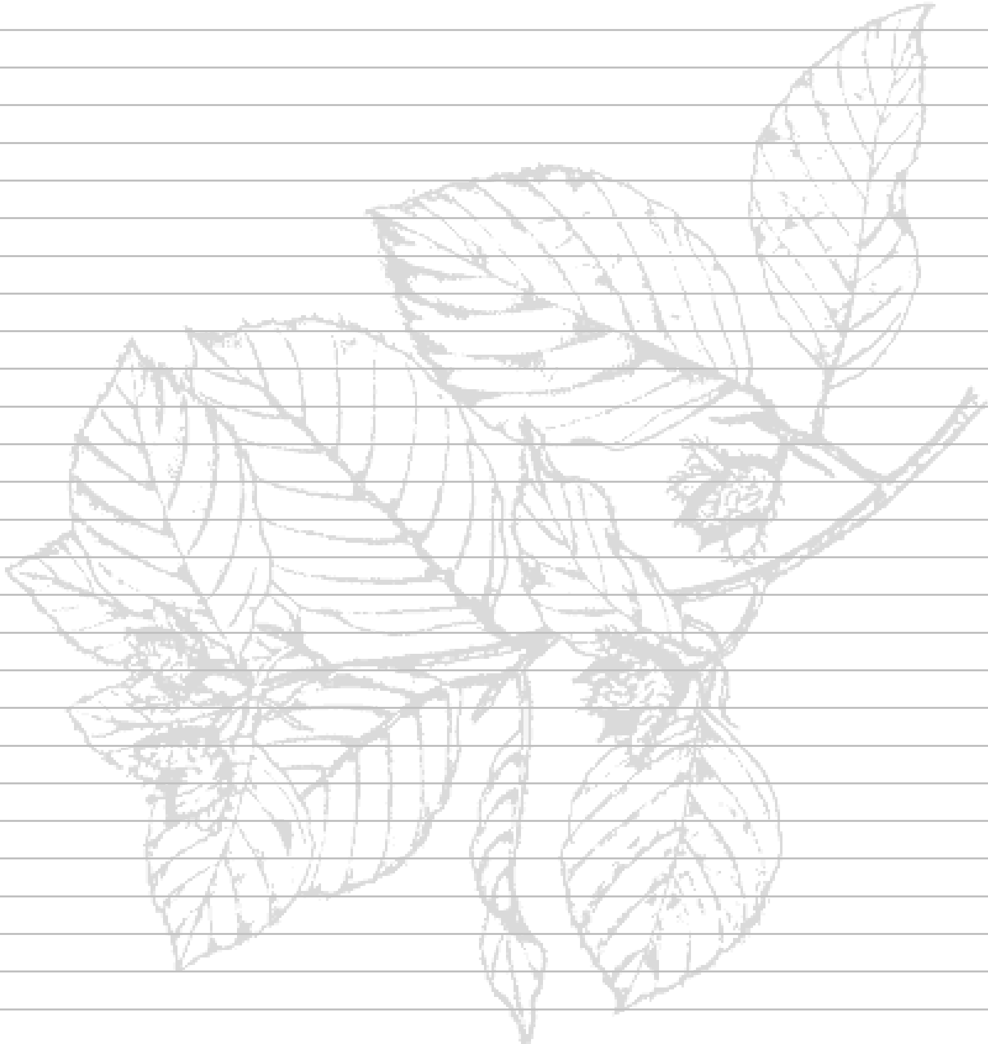
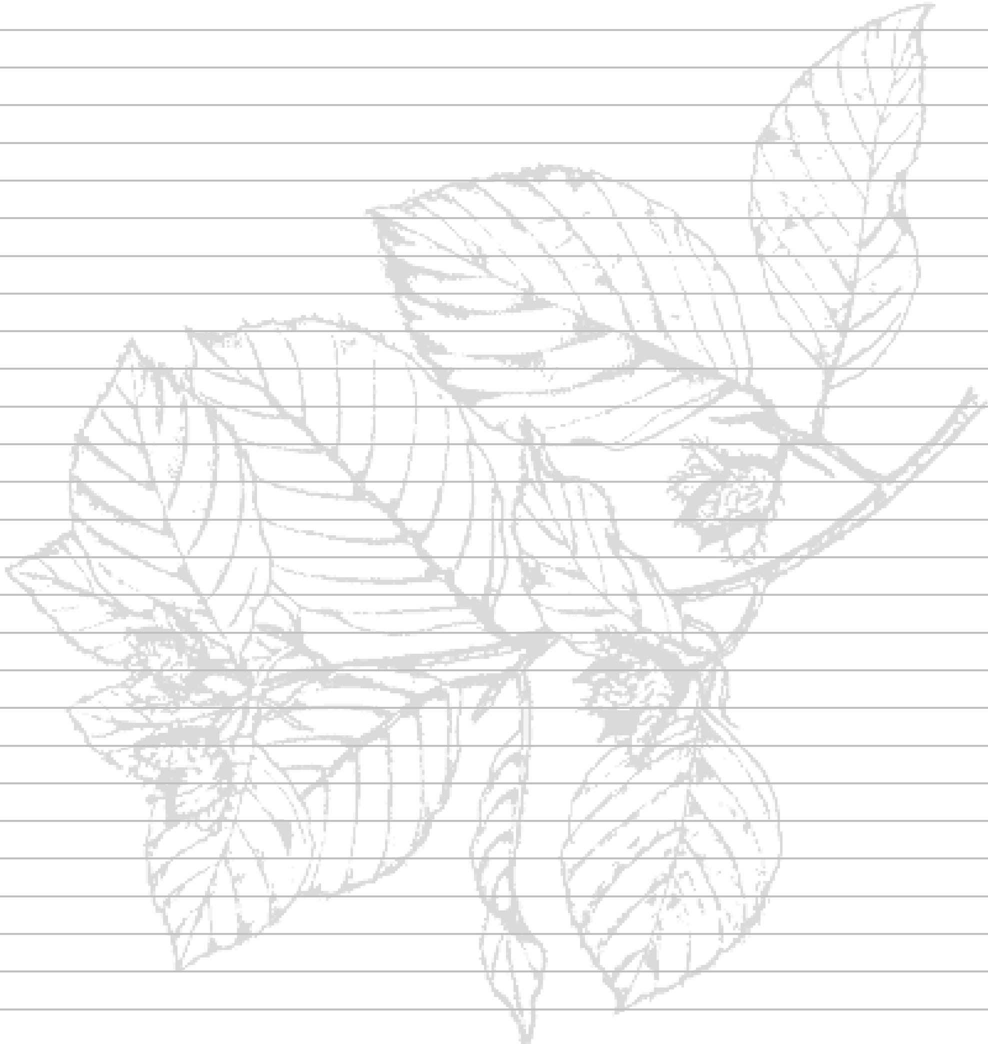


P7. Inter- and intra-population variation of a South American beech in germination traits

F. Barbero, L. Gallo, M. Pastorino.

Summary.- Nothofagus is an emblematic genus of the southern hemisphere represented in the temperate Patagonian forests of Argentina by six species. N. obliqua, one South American "cousin" of *Fagus sylvatica* with high breeding potential, is the target of a domestication program in Argentina, in the frame of which field and nursery trials are being conducted. Here, we present the results of a germination analysis performed under controlled conditions. Each of 101 open pollinated families corresponding to seven natural populations (13 to 15 families per population) were represented by 400 seeds distributed in four germination trays and arranged in a four-block experimental design. Seeds were surveyed every 48 hours during 38 days recording the number of germinated seeds. Germination capacity (GC) was the relative number of germinated seeds at the end of the trial. A Gompertz exponential curve was fitted to the cumulative germination data for each repetition of each family, thus estimating germination energy through the slope parameter of the curve (S) and the time at the maximum germination rate (T). Significant differences among populations were shown for these three variables through an ANOVA test with a mixed model with random families nested within fixed populations. In fact variation was quite large, since one population had a mean GC of 1.5% while another rose till 57%. Family factor resulted significant for the three variables too, with mean GC ranging from nil to 77%. Maternal effects are important at this stage; however, the observed variation seems a promising trend when thinking on conservation and genetic improvement.

Notes:



Session 3: State and possible Use of Beech Genetic Resources: Meeting the Challenges of Future Generations. Chair: S. M.G. de Vries

OP24. Geographical distribution of gene conservation efforts for European beech (*Fagus sylvatica* L.) within the species' distribution range

J. Koskela, S. de Vries, J. Hubert, A. Alexandrov, K. Spanos, M. Bozzano

Summary.- As one of the widely occurring and economically important tree species, European beech (*Fagus sylvatica* L.) has been included in national gene conservation programmes in many countries and various protected areas also harbour numerous beech populations. According to the State of Europe's Forests 2007 report, over 166,000 hectares of beech forests were managed for *in situ* gene conservation in 2005. This suggests that the genetic resources of beech have been conserved well. However, the area of beech forests reportedly managed for gene conservation in different countries reveals little on the geographical distribution of the gene conservation efforts that is crucial for properly assessing how well the genetic resources of beech are conserved across the species' entire distribution range in Europe. Harmonized and geo-referenced data on dynamic gene conservation units of forest trees is now being compiled by European countries as part of the EU-funded EUFGIS action. Based on preliminary data, we present the geographical distribution of the gene conservation units of beech, and assess how well these units covers the geographical distribution of the genetic diversity (chloroplast haplotypes and isozyme groups) made available by recent range-wide studies on beech. As the network of beech provenance trials serves as a complementary *ex situ* conservation measure, we also analyze how much the genetic material used in the trials is currently conserved *in situ* and managed following the principles of dynamic gene conservation. Finally, we discuss the implications of the findings for the conservation of beech genetic resources in Europe.

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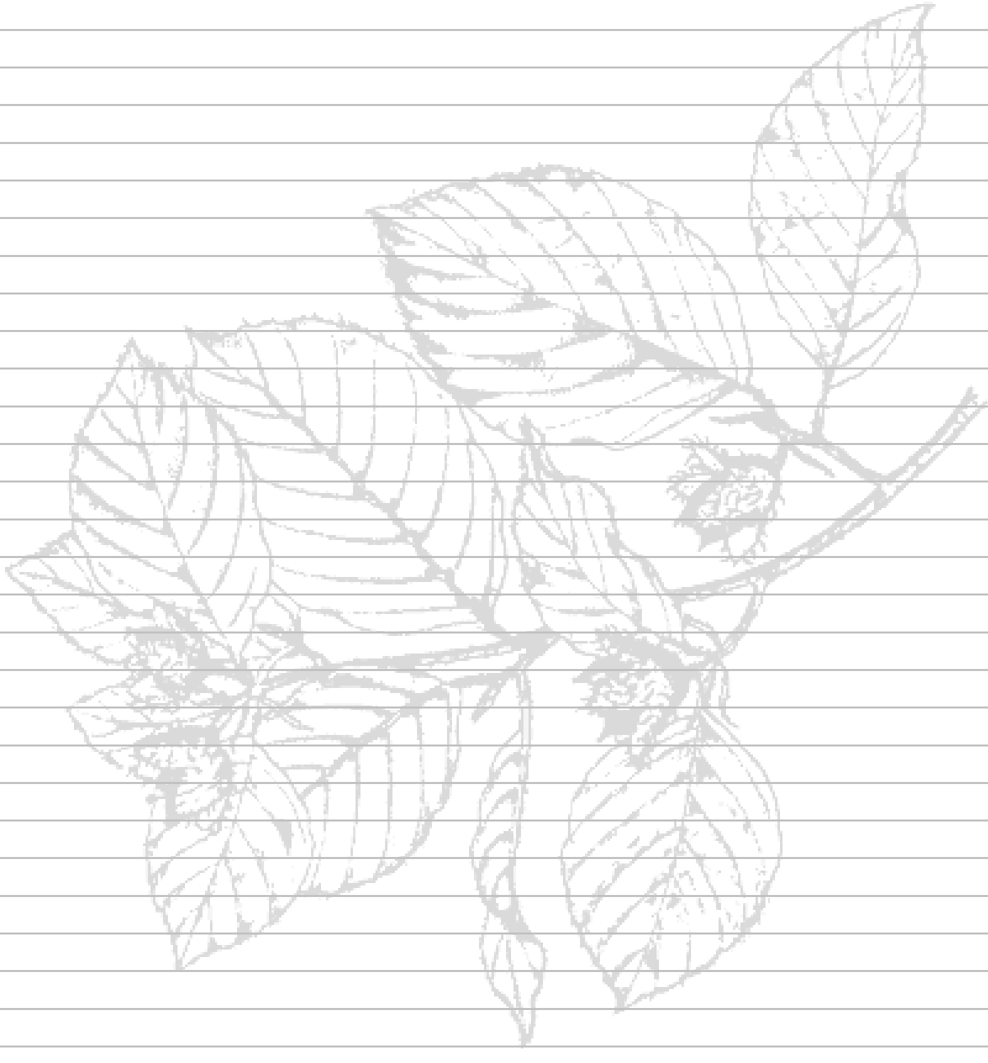
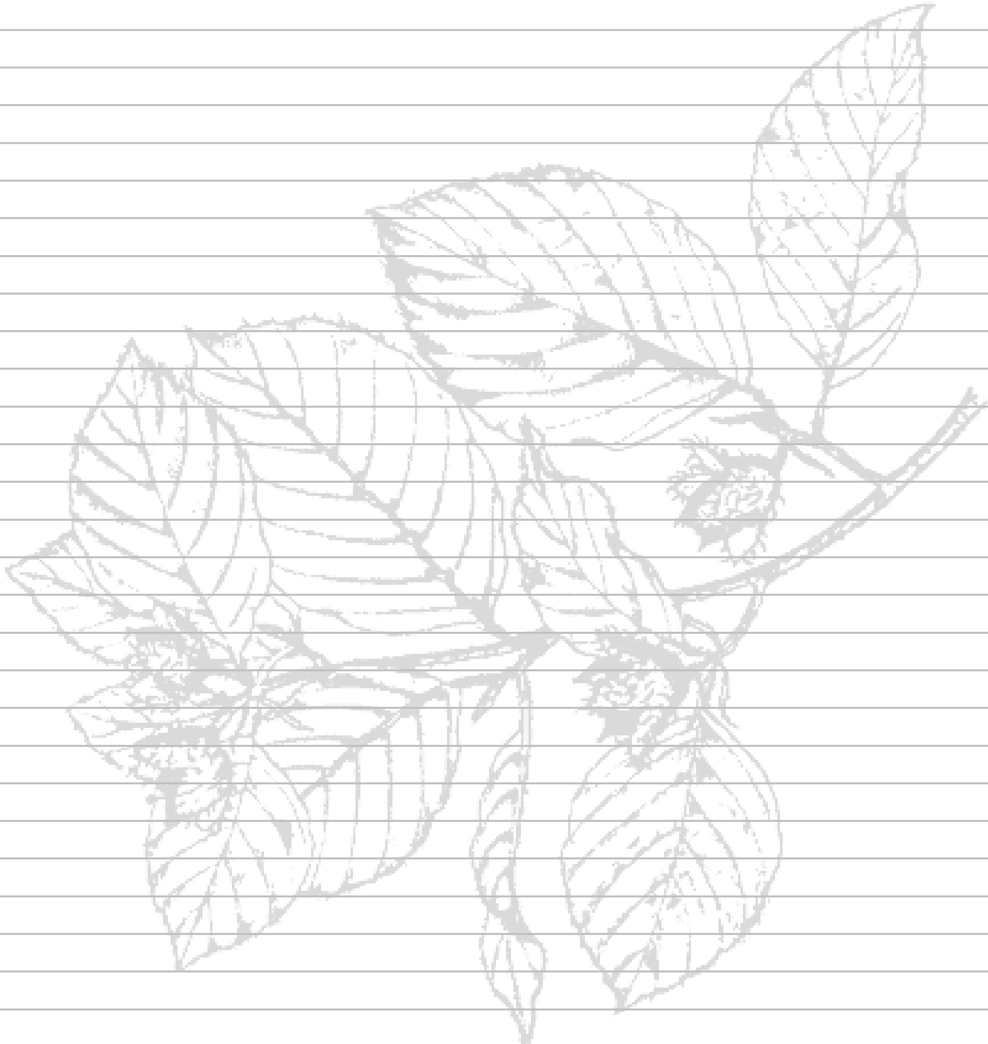


OP25. Current state of European beech forests and their genetic resources, a summary of the national reports.

J. Frydl, P. Novotny, A. Alexandrov

Summary.- Presentation includes short extracts from individual information about European beech on national level prepared by participants of COST Action 52 Project. These individual information have been agreed by COST Action 52 MC to be published as common publication about current state of E. beech gene-pool sources and its management in European countries, where this species is naturally distributed. This common publication presents one from planned outputs of COST Action 52 Project.

Notes:



OP26. Reactions of beech provenances to transfer in growth, adaptive and qualitative traits

D. Gömöry

Summary.- The reactions of beech provenances in height growth and survival to transfer were tested based on the measurements of the international beech provenance experiment series 1998. The concept of ecodistance was used, defined as the difference in geographical coordinates (longitude, latitude, altitude) and basic climatic parameters (mean annual temperature, annual precipitation total) between the place of plantation and the place of origin. Average height and average survival of each provenance at each trial site were regressed against ecodistances by provenances; to determine the optimum rate of transfer, quadratic regression model was used and the maximum of the regression function was calculated from the first derivative of the regression function. In spite of outliers, the geographical distribution of the optimum transfer rates is generally spatially continuous; moreover, rangewide trends can be identified in most cases. Generally, both growth and survival improve with the transfer towards the center of the range.

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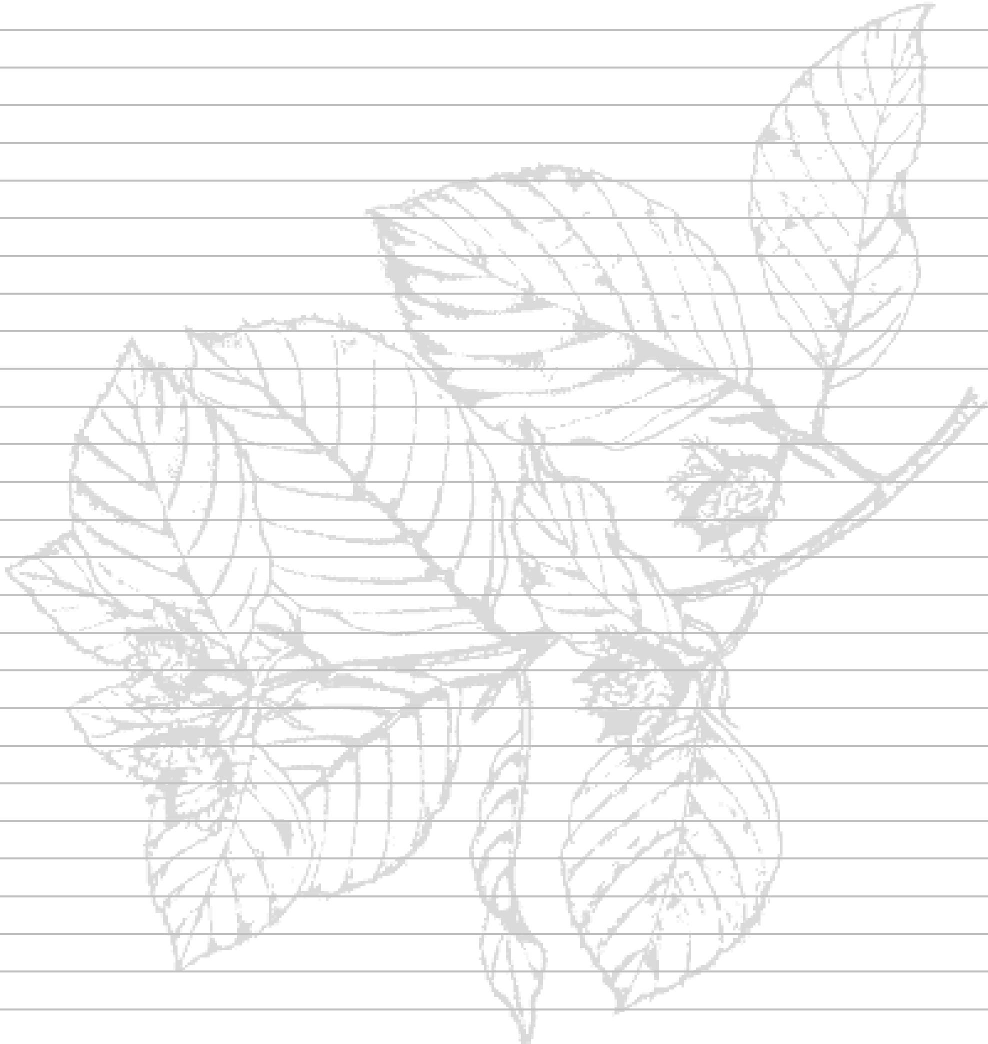

OP27. Modelling exploration of the future of European beech (*Fagus sylvatica* L.) under climate change—Range, abundance, genetic diversity and adaptive response

K. Kramer, B. Degen, T. Hickler, W. Thuiller, M. Sykes, W. de Winter, I. van den Wyngaert, B. van der Werf

Summary.- We explored impacts of climate change on the geographic distribution of European beech by applying state of the art statistical and process-based models, and assessed possible climate change impacts on both adaptive capacity in the centre of its distribution and adaptive responses of functional traits at the leading and trailing edge of the current distribution. The species area models agree that beech has the potential to expand its northern edge and loose habitat at the southern edge of its distribution in a future climate. The change in local population size in the centre of the distribution of beech has a small effect on the genetic diversity of beech, which is projected to maintain its current population size or to increase in population size. Thus, an adaptive response of functional traits of small populations at the leading and trailing edges of the distribution is possible based on genetic diversity available in the local population, even within a period of 2-3 generations. We conclude that the adaptive responses of key functional traits should not be ignored in climate change impact assessment on beech. Adaptation to the local environment may lead to changes in the genetic and phenotypic structure of population over the species area within a few generations, depending on the forest management system applied. We recommend taking local differentiation into account in a future generation of process based species area models.

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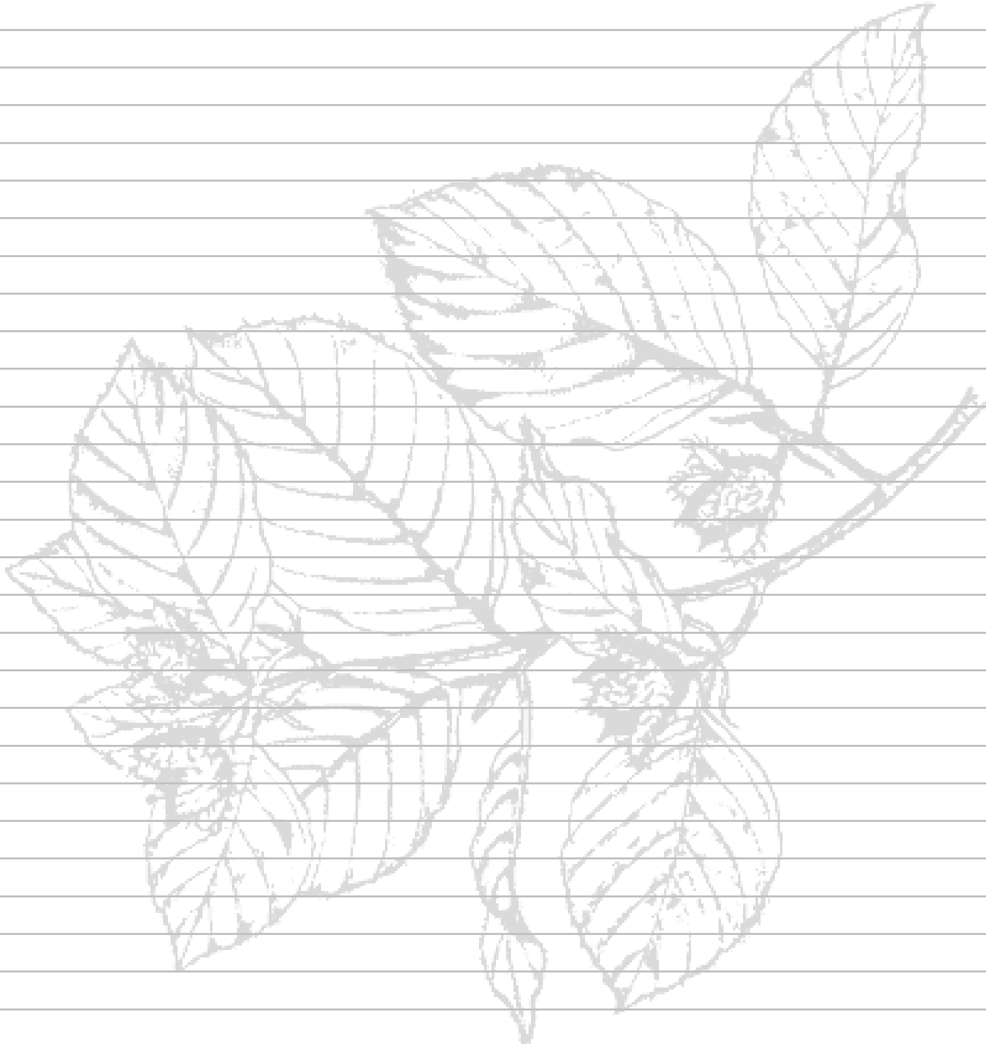

OP28. Modelling future distribution ranges of beech by integrating aspects of evolutionary ecology

C. Mátyás. I. Berki, S. Bogdan, G. Božic, B. Czúcz, B. Gálos, D. Gömöry, M. Ivankovic, N. Móricz, E. Rasztovits

Summary.- Inferences about potential range shifts of tree species following climatic changes are usually derived from climatic envelopes or process-based dynamic models. The evaluation and analysis of beech provenance tests offers an improvement in modelling through integration of phenetic response observations from field studies.

The analysis of provenance experiments of European beech in SE Europe invalidate earlier doubts about the existence of climate-related adaptation patterns in juvenile growth and justify restrictions of use of reproductive material on the basis of evolutionary ecological evaluation. The response to climatic change is regionally divergent. As boundaries at the leading range edge are primarily determined by temperature conditions (i.e. they are thermic limits), expected warming sets off a progressive improvement of abiotic environmental conditions and successive colonisation, respectively growth acceleration.

Low elevation and low latitude distributional limits are, on the other hand, often determined by a combination of constraints on water availability (therefore: xeric limits) and other factors contributing to the decline of competitive ability, such as pests and diseases. The latter are especially difficult to model and field observations are therefore essential. Regression tree analysis identified Ellenberg's drought index as one of the best indicators for modelling xeric limits. To model expected phenotypic response, investigations of SE European trial sites have been combined with observations of sites under extreme climate selection pressure. Under the stressful and uncertain conditions at the lower (xeric) limits of the species, growth decline and retreat of limits has been modelled according to future scenarios. Stability and survival of populations in these regions will depend first of all on the activity of silviculturists to practice human-supported recruitment and migration of beech into suitable sites.

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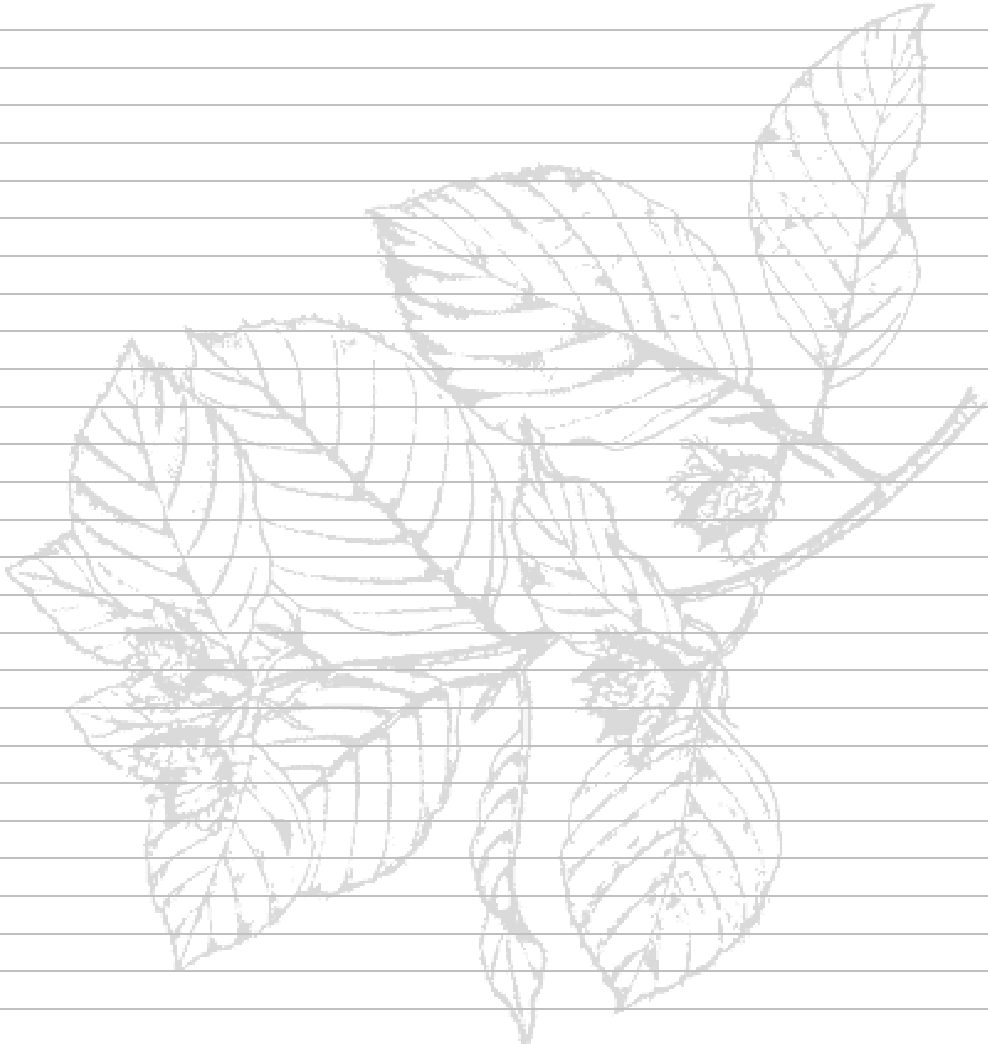

OP29. What lessons can be learned from the International Beech trials in Europe regarding the movement of reproductive material of Beech in relation to Climate Change?

S. M.G. de Vries, R. Alia, J. Fennessy, H.J. Muhs

Summary.- Beech is one of the most important forest tree species in Europe. Because of possible future climate change it is anticipated that the health status of many beech stands in Europe in the near future might be negatively affected. In order to maintain the important economical and ecological position beech has in European forestry it is important to consider a changed climatic situation in which human intervention is needed to mitigate the negative effects of climate on local beech populations.

One of the options for mitigation in the future is to transfer forest reproductive material of beech to different locations within the distribution range. This should only be done after very careful consideration.

On the basis of results from the International Beech provenance trials collated by the COST Action E52, a number of recommendations with respect to future use and transfer of beech forest reproductive material (FRM) have been formulated. The results of a questionnaire regarding the movement of FRM of beech in Europe and how different countries within the distribution range of European Beech deal with the delineation of Regions of Provenance are also discussed.

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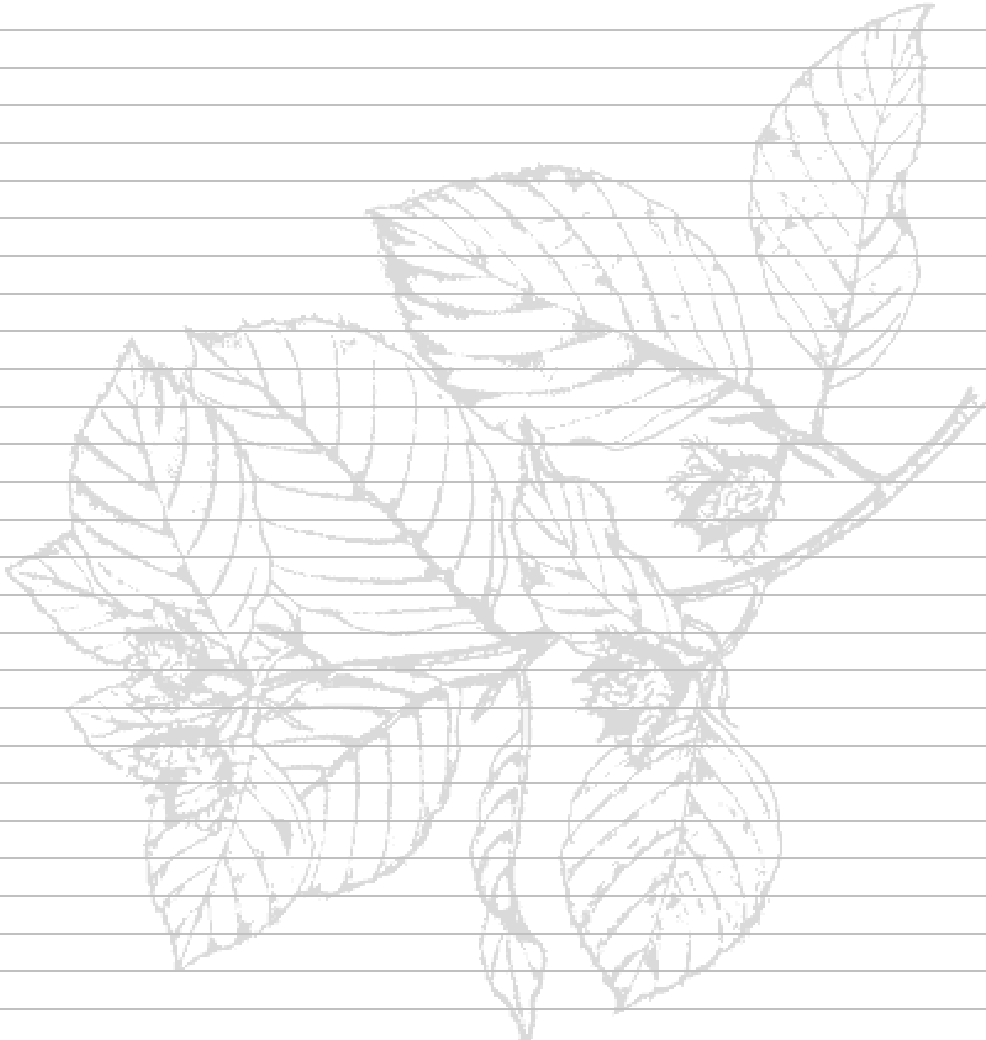

P8. Regions of provenance of European Beech *Fagus sylvatica* L.

F.J. Auñon, J.M García del Barrio, J.A. Mancha, S. M. G. de Vries

Summary.- The European Council Directive 1999/105/CE, concerning the marketing of forest reproductive material, establishes a Region of Provenance as the basic unity for trading tree reproductive materials (fruits, seeds or plants) and defines it as "the area or group of areas subjected to sufficiently uniform ecological conditions in which stands or seed sources showing similar phenotypic or genetic characters are found". The identification of Regions of Provenance is a crucial issue for a sustainable management of forests that includes activities linked with forest trees propagation, including afforestation or *in situ* genetic conservation.

The European experience in the regionalization of management of forest genetic resources comes from the delineation of provenance regions and breeding zones at country level and is based mainly in geo-climatic variation. Following this, it should be of great interest to include all information at country level in a wide dataset at European level. One of the goals of AC TREEBREEDEX and the COST Action E52 is to summarize the knowledge on patterns of geographic variation of European trees in adaptive traits, and *Fagus sylvatica* is a good example of a tree species with a wide distribution and use.

We show a cartographic synthesis of information relative to the European Provenance Regions of European beech along sixteen countries, and a table relating main delimitation methods established by each country. The information for eleven of the more common European tree species is now available at: http://sites.google.com/site/sigforestspecies/home/regiones-de-procedencia-europeas

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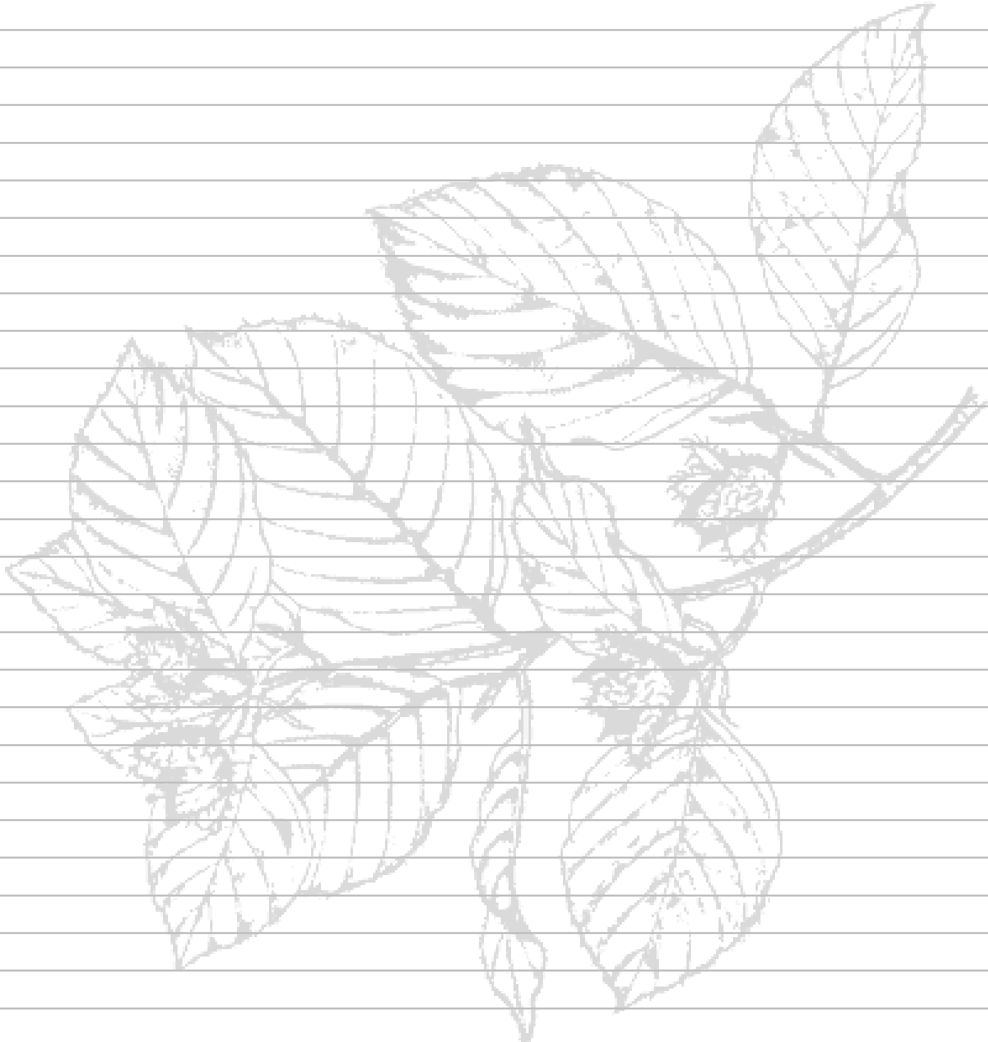


P9. Conservation of beech in depressed areas subject to depopulation and land use changes: Beech Forest Busmayor (Leon).

I. J. Díaz-Maroto, P. Vila-Lameiro

Summary.- The beech (*Fagus sylvatica* L.) reaches in the northwest of the Iberian Peninsula one of its western limits of its natural range. The stands of Busmayor beech (León) are located on the east slope of the main ridge of the Ancares Mountains. The current location of these stands corresponds to shaded areas more closed, and scarce soil depth, why traditionally been rejected for agricultural or for creating mowing grass or tooth, and where it had little effect the fires caused to the intensive exploitation of pastures; as its privileged location natural barrier to fire and failed to penetrate in the stands.

The trend of depopulation and abandonment of farming that was occurring in this area continuously since the forties, encouraged the invasion by different shrub species, and now a budding plant colonizing other tree species as the birch (*Betula alba* L.), abandoned over large areas formerly devoted to crops.

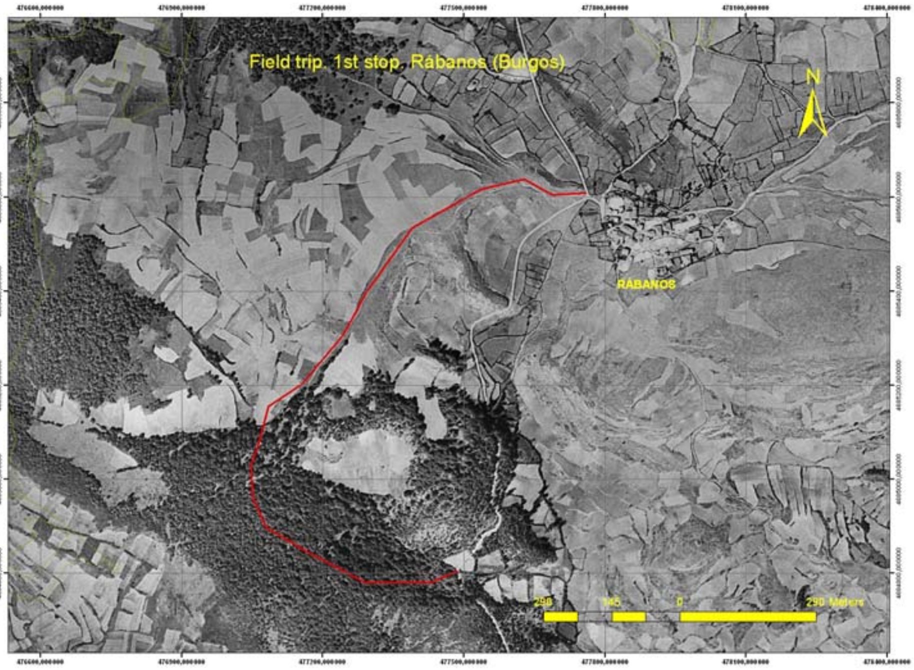
In the particular case of Busmayor beech forest, is formed by a main stand and two small stands isolated, but very close to it. Therefore, the proposed conservation silvicultural actions are aimed at encouraging the union of all stands, preferably naturally and, if it necessary by artificial reforestation using genetic material from the study area.

Field Trip

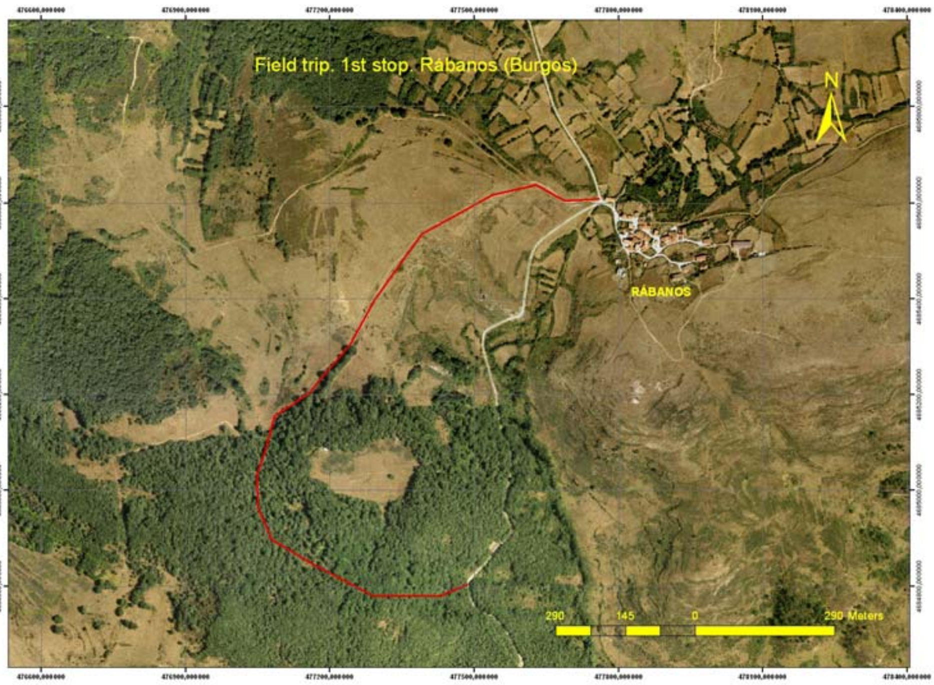
The field trip includes a visit to different beech forests under various management scenarios.
We will also visit a provenance test in Pazuengos (La Rioja).
During the excursion, we will walk by forest trails (1hour walk in the morning and 1.5 hour in the afternoon). This is quite a long walk and may be strenuous in places, to undertake the walk you should be in reasonably good health and used be used to walking along forest trails. Please inform the organizers before the excursion if you think that you may find this amount of walking excessive, and alternative transportation to the trial site will be arranged.
In May the weather is variable in northern Spain, and it can sometimes rain heavily. Please, be well prepared for inclement weather on the excursion.

1st Part of the field trip. Rabanos.
For the past 40 years, most Spanish forests are increasing stocks significantly. Many people living in small villages in the forest moved to major towns and cities in the 60´s and 70´s of the last century. Therefore, human pressure on the forest ecosystems dropped significantly (less fuelwood, cattle, …) and they are still undergoing a forest recovery period.

Rábanos is a good example of this landscape change. With a year-round population of around 20 people (most of them retired people), agriculture has been completely abandoned and forests are getting stocked. "Marojal y Rozas" is a good example of the latter, as can be seen comparing the aerial photographs from 1.957 and 2.007. In addition, it is notable that most of the new trees are beech (*Fagus sylvatica*), while the name of the forest ("Marojal") suggests *Quercus pyrenaica*. It is a small forest which was subject to very little intervention during the past few decades, with big old trees indicating ancient forest used for a mixed cattle-forest system.



Rábanos. Burgos. Aerial photograph. 1957



Rábanos. Burgos. Aerial Photograph. 2007.

2nd Part of the field trip. Ezcaray and Pazuengos Forests.

After entering the *Comunidad Autónoma de La Rioja*, we will visit several beech stands situated in the Pazuengos and Ezcaray Forests. The trip will finish in the trial site of Pazuengos.

Both forests are located in the "Sierra de la Demanda", *Sistema Ibérico* range of mountains. Ezcaray forest belongs to the Ezcaray Village Council and is managed by La Rioja Regional Government. It extends over approximately 13,000 ha's. Half of its surface area is covered with shrubs and rangelands; the other half is forested, one quarter through forestation and the other half mainly by naturally-regenerated hardwoods.

The forest has a management plan orientated to maintain a multi-purpose forest, with four major land uses. Ezcaray is one of the main tourist villages of La Rioja. Activities such as skiing, trekking, mushroom-picking, mountain biking, etc... are promoted for visitors. From a very old farming system, it still remains an important cattle breeding area. Hunting - mainly wild boar, roe deer, quail, partridge and pigeon- is practiced by locals and visitors and it provides one of the main sources of income from the Forest. Timber is another source of revenue, mainly obtained by conifer plantation thinning. In May, the forest will obtain the FFCC Forest Management Certification.

Pazuengos Forest is owned and managed by La Rioja Regional Government. It extends over 1,500 ha's. and is similar in ecology and land use to Ezcaray forest. The main differences are that hunting is managed only by the Regional Government, through the "Reserva Regional de Caza de Cameros- Demanda" that also extends over half of the Ezcaray forest, and also that grazing is done through a Government autochthonous cattle farm.

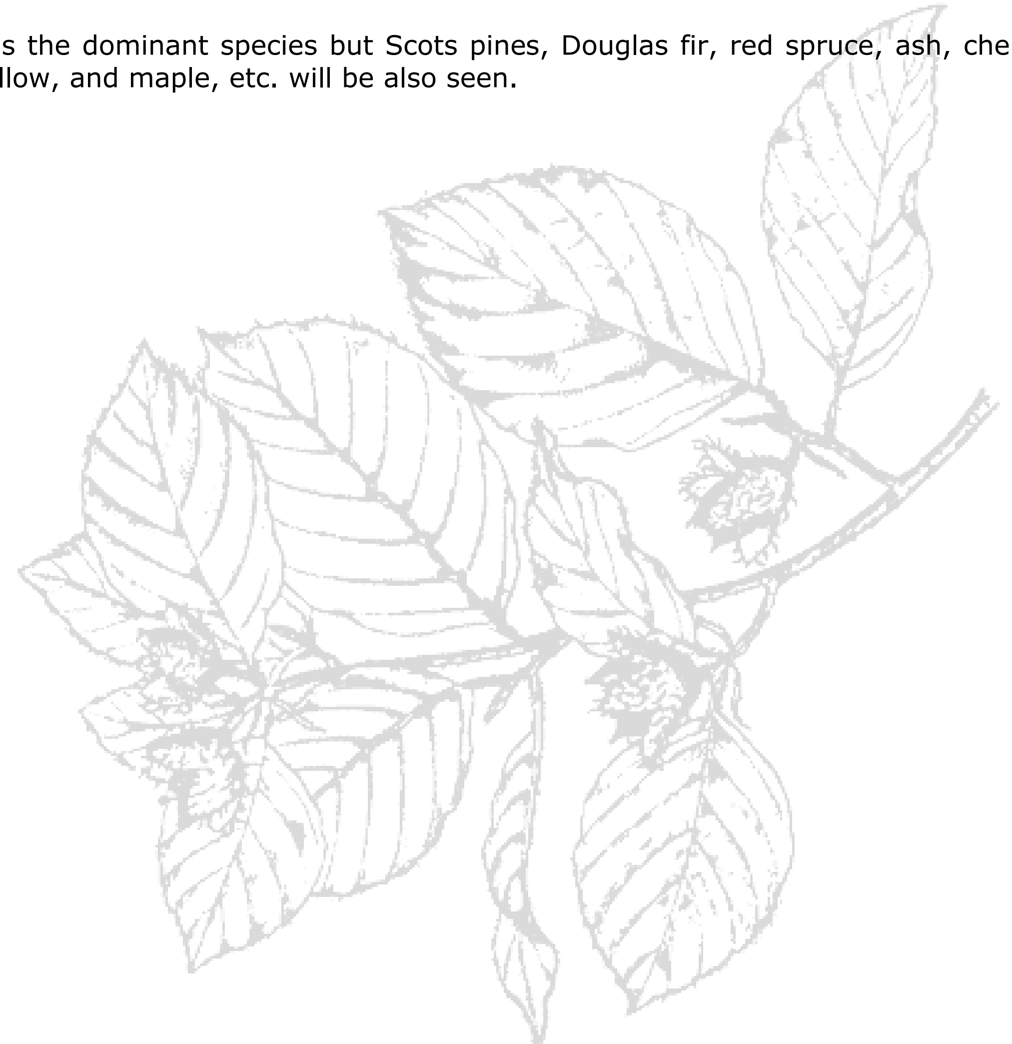
Understanding the stands that will be visited involves thinking in a territory populated many centuries ago. In the Middle Ages, it belonged to the Kingdom of Castilla, being Pazuengos a frontier between Navarra and Castilla Kingdoms. Their Kings promoted the colonization, origin of an intensive agricultural land use that peaked in the sixties and seventies of the last century. Since then the forest has enlarged, due to the changes in their socioeconomic conditions, agricultural land abandonment, the less intensive grazing with decreasing of associated forest fires, the reduction on firewood cutting and selective beech cutting.

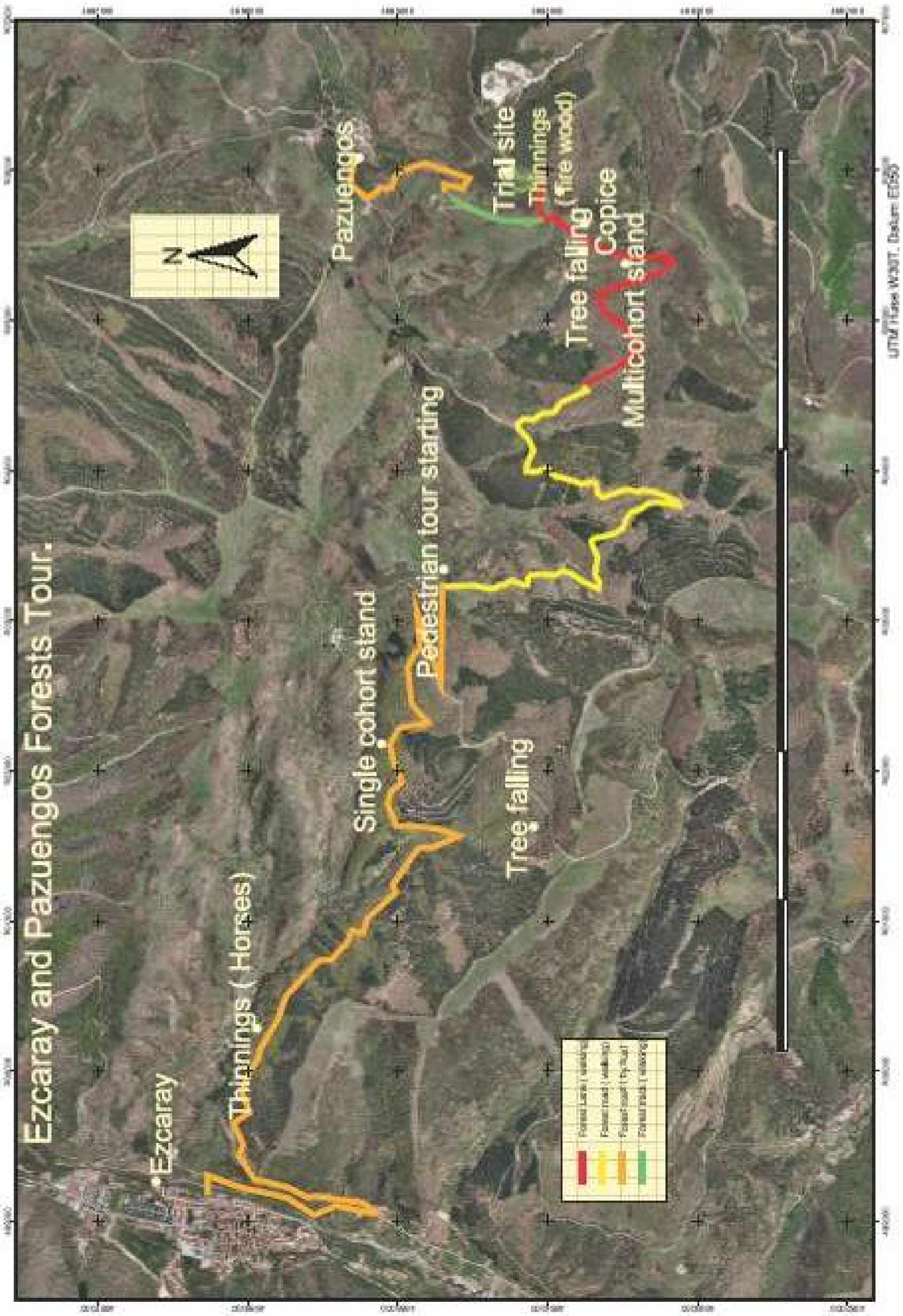
The Forest Service has been present in the territory for the last hundred years.
We will visit advanced-regenerated beech stands in a one-hundred-year-old pine tree plantation . Other successful beech plantations are also present in the forest, but will not be part of our visit.

We will also find beech stands which remain in the valley bottoms. Other stands will be a result of the abandoning of grazing on north-facing slopes, invaded by the former tree species or stump-sprouts from the original forest, as a consequence of the coppice management. The recent origin of many stands and selective cuttings during the seventies, when beech timber prices rose in Spain, have led to a single cohort stand in newly colonized areas and also to two –three cohort stands where bigger beeches were cut.

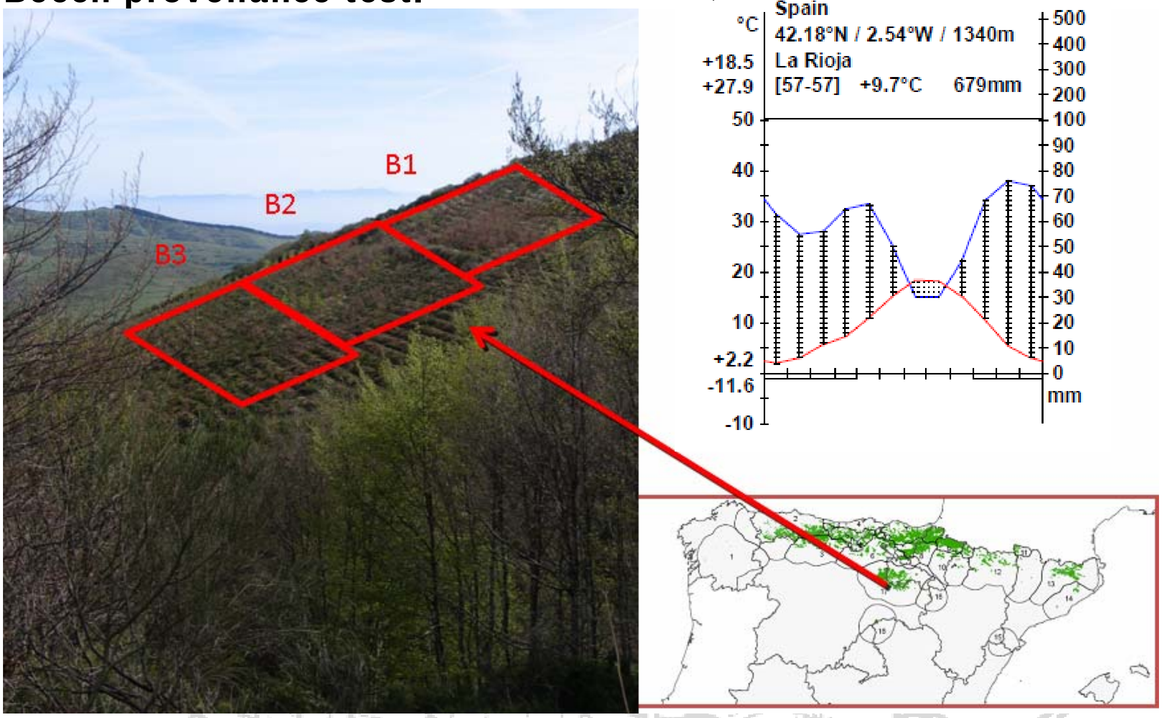
Due to the age of the trees and the good climatic and soil conditions, thinning is necessary in most of the beech stands. However, these are difficult to undertake because of the steep slopes and the low price of thin poles.
Several examples of thinning, made with horses, skidders or by local people for fire wood as visible, mixed with untreated stands where bioenergetics or new management techniques -as selective thinning- could be a solution in the future.

Beech is the dominant species but Scots pines, Douglas fir, red spruce, ash, cherry, oak, willow, and maple, etc. will be also seen.




Ezcaray and Pazuengos Forests Tour.
Ezcaray
Thinnings (Horses)
Single cohort stand
Tree falling
Pedestrian tour starting
Pazuengos
Trial site
Thinnings
(fire wood)
Tree falling
Copice
Multicohort stand

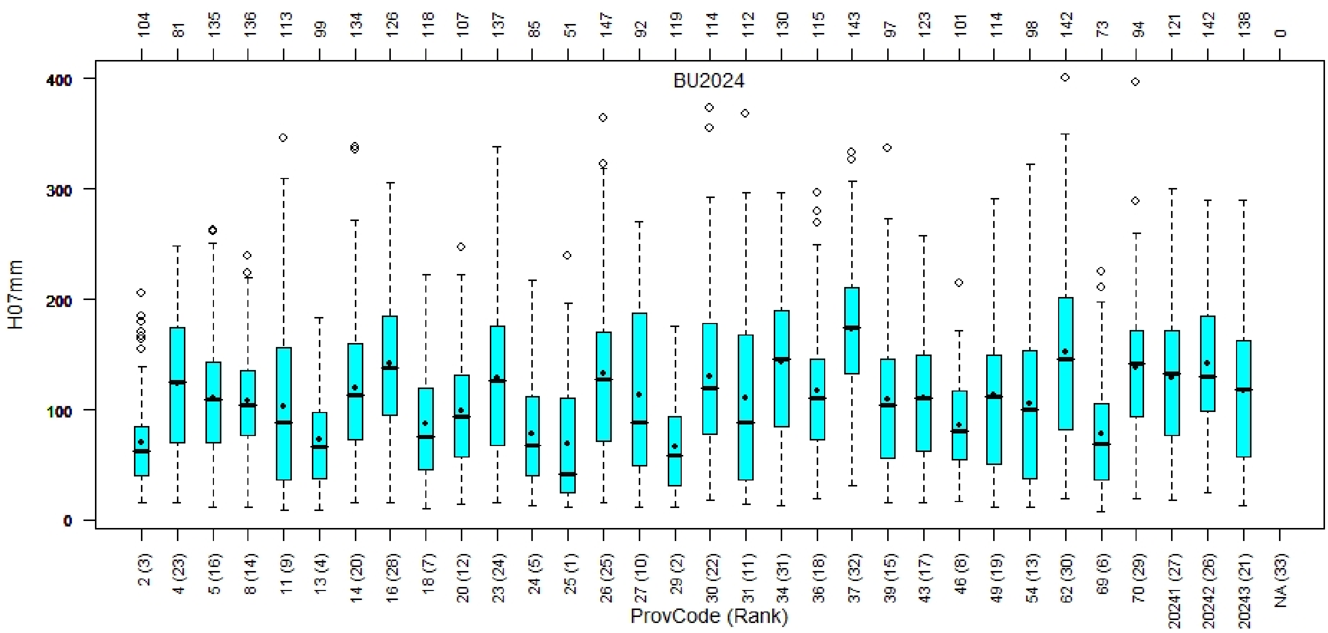
Beech provenance test.



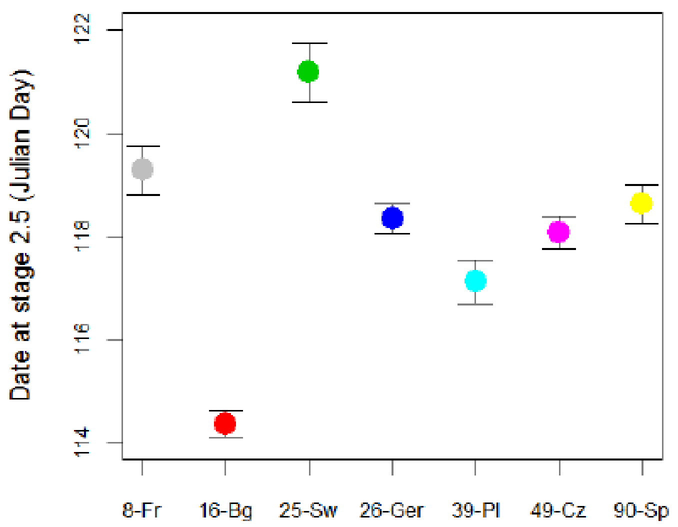
LAY-OUT OF FIELD SITE - EZCARAY BU20-24

61	29	8	20									BLOCK 1	
2	24	43	E2	70	4	30	49	54	16	11	5	46	23
69	13	37	14	39	25	31	34	E1	27	E3	36	26	18
24	49	5	23	14	62	11	39	18	E1	8			
	16	25	31	E3	43	2	34	69	26	36		BLOCK 2	
70	13	54	27	20	29	46	30	37	4	E2			
23	18	E1	25	11	29	39	2	31	14				
30	34	5	49	62	26	54	24	E3	27			BLOCK 3	
70	69	4	E2	16	43	8	13	20					

Trial_cod	Prov_cod	Seed_cod	Site	Country
2	P002BOR	9236	Bodure Man.	France
4	O004SUD	9239	Sud Massif Central	France
5	P005BRE	9240	Bretagne	France
8	P008PYR	9243	Pyreness Or.	France
11	P011HEI	9194	Heinerscheid	Luxembourg
13	P013SOI	9191	Soignes	Belgium
14	P014AAR	9170	Aarnink	Holland
16	P016GOT	9092	Gotze Delchev	Republic of Bulgaria
18	P018BE95	9192	Buthurst E 95 400	United Kingdom
20	P020BE95	9207	Lowther E	United Kingdom
23	P023TORU	9183	Toyup	Sweden
24	P024TRO	9186	Trolle	Sweden
25	P025GUL	9187	Gullmarsherg	Sweden
26	P026FAR	9181	Farchav SH	Germany
27	P027GVW	9209	Graf v Westf	Republic of Bulgaria
29	P029DIL	9234	Dillenburg He	Germany
30	P030BEL	9208	Belzig ST	Germany
31	P031URA	9182	Urach	Germany
34	P034OBE	9112	Oberwill	Switzerland
36	P036EIS	9206	Eisenerz	Austria
37	P037VAL	9114	Val si Sella	Italy
39	P039JAW	9217	Jaworse	Poland
43	P043JAW	9226	Jaworrik 92b	Poland
46	P046DOM	9180	Domazlice-Vyhi	Czech Republic
49	P049BRU	9202	Brumov-Sidonie	Czech Republic
54	P054IDR	9188	Idrija-II/2	Slovakia
62	P062AAR	9111	Aarberg	Switzerland
69	P069SUC	9218	Sucha	Poland
70	P070BUC	9197	Buchlovice	Czech Republic
E1	P00E1		Zorraquín- Rioja	Spain
E2	P00E2		Srra. Demanda/Burgos	Spain
E3	P00E3		Urbasa-Navarra	Spain



6-provenance comparison of Flushing (2008)



16. BG Gotze Delchev
25. SW Gullmarsberg
26. Ger Farchau
39. PL Jaworze
49. CZ Brumov-Sid
E1 ES Ezcaray (Local)

List of participants

Name	**Center - email**
Alexandrov¸ Alexander	Forest Research Institute. Kliment Ohridski Blvd. 132. 1756 Sofia, Bulgaria. ***e-mail:*** **forestin@bas.bg**
Alía¸ Ricardo	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. ***e-mail:*** **alia@inia.es**
Aranda¸ Ismael	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. ***e-mail:*** **aranda@inia.es**
Ballian¸ Dalibor	Faculty of Forestry. Zagrebacka 20, 71000 Sarajevo, Bosnia and Herzegovina. ***e-mail:*** **ballian_dalibor@hotmail.com, balliand@bih.net.ba**
Barba¸ Diana	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. ***e-mail:*** **dbarba@inia.es**
Barba¸ Rebeca	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain.
Bayarri, Elías	Gobierno de Cantabria, Spain.
Bodgan¸ Sasa	Faculty of Forestry. Svetosimunska 25; 10002. Zagreb. Croatia. ***e-mail:*** **sasa.bogdan@zg.htnet.hr**
Bozic, Gregor	Slovenian Forestry Institute. Vecna pot 2, 1000 Ljubljana, Slovenia. ***e-mail:*** **gregor.bozic@gozdis.si**
Cano¸ Javier	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. ***e-mail:*** **fjcanomartin@gmail.com**
de la Cruz Moreno¸ Julio	Dirección General del Medio Natural. Gobierno de la Rioja. C/ Prado Viejo, 62 bis. 26071. Logroño. La Rioja. Spain.
de Vries¸ Sven M.G.	Alterra. PO BOX 47, 6700 AA Wageningen, The Netherlands. ***e-mail:*** **sven.devries@wur.nl**
del Caño¸ Fernando	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. ***e-mail:*** **umgf@inia.es**
Davkov, Alyosha	Forest Research Institute, Climent Ohridski Blvd.. 132, 1756 Sofia, Bulgaria, **e-mail: adakov@abv.bg**
Delehan, Ivan	Ukrainian National Forestry University. Gen. Chuprynky st. 103, Lviv, Ukraine, 79057. ***e-mail:*** **delehan@lviv.farlep.net**
Díaz-Maroto¸ Ignacio J.	University of Santiago. High School Polytechnic; Campus Univesitario s/n 27002 Lugo. Spain. ***e-mail:*** **ignacio.diazmaroto@usc.es**
Ducousso¸ Alexis	INRA. UMR BIOGECO, INRA, 69 route d´Arcachon, F 33612 Cestas, France. ***e-mail:*** **alexis.ducousso@pierroton.inra.fr**
Ernst¸ Dieter	Helmholtz Zentrum München, Institute of Biochemical Plant Pathology. Ingolstädter Landstr. 1, 85764 Neuherberg, Germany, ***e-mail:*** **ernst@helmholtz-muenchen.de**
Fennessy¸ John	***e-mail:*** **john.fennessy@coford.ie**

Name	**Center - email**
Forstreuter¸ Manfred	Freie Universität Berlin - Institut für Biologie - AG Ökologie der Pflanzen- Altensteinstr. 6 D-14195 BERLIN Germany **_e-mail:_ mforst@zedat.fu-berlin.de**
Frydl¸ Josef	Forestry and Game Management Research Institute. Strnady 136 252 02 Jíloviště, Czech Republic, **_e-mail:_ frydl@vulhm.cz**
García del Barrio¸ Jose Manuel	CIFOR-INIA. Ctra de la Coruña k.m. 7.5- 28040. Madrid. Spain. **_e-mail:_ jmgarcia@inia.es**
García Güemes¸ Carlos	JCYL. Servicio Provincial de Burgos. **_e-mail:_ GarGueCa@jcyl.es**
Giannini¸ Raffaello	Department of Agricultural and Forest Economics, Engineering, Sciences and Technologies, University of Florence, Via San Bonaventura 13, 50145 Florence, Italy. **_e-mail:_ raffaello.giannini@unifi.it**
Goetz¸ Bernhard	Univesity of Applied Sciences Eberswalde, Forest Botanical Gardens. Am Zainhammer 5, D-16225. Eberswalde. **_email:_ bgoetz@fh-eberswalde.de**
Gömöry¸ Dušan	Technical University in Zvolen. TG Masaryka 24, SK-96053 Zvolen, Slovakia. **_e-mail:_ gomory@vsld.tuzvo.sk**
Huber¸ Gerhard	Bavarian Offic for Forest Seeding and Planting. Forstamtsplatz 1, 83317 Teisendorf. Germany. **_e-mail:_ gerhard.huber@asp.bayern.de**
Ibáñez, J. Ignacio	Dirección General del Medio Natural. Gobierno de la Rioja. C/ Prado Viejo, 62 bis. 26071. Logroño. La Rioja. Spain.
Ionita¸ Lucia	Forest Reseach and Management Institute. B-dul Eroilor nr. 128., Voluntari, jud. Ilfov, ROMANIA. **_e-mail:_luciaionita1@yahoo.com**
Ivancovic¸ Mladen	Croatian Forestry Institute. Cvjetno naselje 41. 10450 Jastrebarsko. Croatia. **_e-mail:_ mladeni@sumins.hr**
Koskela¸ Jarkko	Bioversity International. Regional Office for Europe. Via dei Tre Denari 472/a. 00057 Maccarese (Fiumicino). Rome, Italy. **_e-mail:_ j.koskela@cgiar.org**
Kraigher, Hojka	Slovenian Forestry Institute. Vecna pot 2, 1000 Ljubljana, Slovenia. **_e-mail:_ hojka.kraigher@gozdis.si**
Kramer¸ Koen	Vegetation and Landscape Ecology. Alterra. P.O.Box 47. 6700 AA Wageningen. The Netherlands. **_e-mail:_ koen.kramer@wur**
Krynytskyy, Hryhoriy	Ukrainian National Forestry University. Gen. Chuprynky st. 103, Lviv, Ukraine, 79057. **_e-mail:_ krynytsk@ukr.net**
Lalague¸ Hadrien	INRA. URFM, domaine St Paul, site Agroparc, 84914 Avignon, France. **_e-mail:_ hadrien.lalague@avignon.inra.fr**

Name	**Center - email**
Liesebach¸ Mirko	VTI- Institute of Forest Genetics. Sieker Landstr. 2. 22927. Grosshansdorf. Germany. ***e-mail:*** **mirko.liesebach@vti.bund.de**
López de Heredia¸ Unai	Ud. Anatomía, Fisiología y Genética Vegetal. ETSI Montes. UPM. Ciudad Universitaria s/n. 28040. Madrid, Spain. ***e-mail:*** **unai.lopezdeheredia@upm.es**
Mátyás¸ Csaba	University of West Hungary, Faculty of Forestry. Institute of Environment and Earth Sciences. H 9401 Sopron POB 132. Hungary. ***e-mail:*** **cm@emk.nyme.hu**
Mertens¸ Patrick	DEMNA-DMF. Av. Maréchal Juin, 23. B-5030. Gembloux. Belgium. ***e-mail:*** **Patrick.MERTENS@spw.wallonie.be**
Mészáros¸ Ilona	University of Debrecen. Debrecen Egyetem tér 1. Hungary, H-4032. ***e-mail:*** **immeszaros@puma.unideb.hu**
Millerón¸ Matías	Ud. Anatomía, Fisiología y Genética Vegetal. E.T.S.I. Montes. Universidad Politécnica de Madrid. Ciudad Universitaria s/n. 28040. Madrid, Spain. ***e-mail:*** **matitomille@gmail.com**
Mohren¸ Frits	Wageninigen University. Chairgroup Forest Ecology and Forest Management. P.O. Box 47, 6700 AA Wageningen. The Netherlands. ***e-mail:*** **frits.mohren@wur.nl**
Muehlethaler¸ Urs	Bern University os Applied Sciences SHL. Laenggasse 85. CH-3053 Zollikofen. ***e-mail:*** **Urs.Muehlethaler@shl.bfh.ch**
Muhs¸ Hans	***e-mail*****:** **hans.muhs@arcor.de**
Novotny¸ Petr	Forestry and Game Management Research Institute. Strnady 136 252 02 Jíloviště, Check Republic***, e-mail:*** **pnovotny@vulhm.cz**
Orlovic¸ Sasa	Institute of Lowland Forestry and Environment. Antona Cehova 13, 21000 Novi Sad, Serbia. ***e-mail:*** **sasao@uns.ac.rs**
Parnuta¸ Gheorghe	Forest Research and Management Institute. Bd Eroilor, 128 RO-077190. Voluntari-ILFOV. Romania. ***e-mail:*** **gh-parnuta@icas.ro; gparnuta@yahoo.com**
Pastorino¸ Mario	CONICET-INTA. CC 277 (INTA) 8400 San Carlos de Bariloche, Argentina. ***e-mail:*** **mpastorino@bariloche.inta.gov.ar**
Paule¸ Ladislav	Faculty of Forestry, Technical University, SK-96053 Zvolen, Slovakia. ***e-mail:*** **paule@vsld.tuzvo.sk**
Pilipovic¸ Andrej	Institute of Lowland Forestry and Environment. Antona Cehova 13, 21000 Novi Sad, Serbia. ***e-mail:*** **andrejpilipovic@yahoo.com**
Pinto¸ Miguel A.	Aula de Medio Ambiente. Caja de Burgos. Spain. ***e-mail:*** **pinto@medioambientecajadeburgos.com**

Name	**Center - email**
Pluess¸ Andrea	ETH Zurich, ITES, Ecosystem Management. Universitaetstrasse 16. CH-8092 Zurich. ***e-mail: andrea.pluess@env.ethz.ch***
Prada¸ Arancha	Banco de Llavors. Generalitat Valenciana. ***e-mail:*** **gis_banco@gva.es**
Prieto Lezaun¸ Esther	Dirección General del Medio Natural. Gobierno de la Rioja. C/ Prado Viejo, 62 bis. 26071. Logroño. La Rioja. Spain.
Puertas¸ Fernando	Gobierno de Navarra, Spain.
Rasztovits¸ Ervin	UWH. 9400, Spron, Bajcsy Zs. U. 4., Hungary. ***e-mail:*** **raszto@emk.nyme.hu**
Reque¸ Jose A.	Universidad de Valladolid. Spain. ***e-mail:*** **requekch@pvs.uva.es**
Robson¸ Matt	Dept. Biosciences, Plant Biology, PO Box 65, University of Helsinki, 00014, Finland. ***e-mail:*** **mrobson04@googlemail.com**
Sevilla¸ Froilan	Junta de Castilla y Leon. Anv/ Peregrinos s/n 5ª planta. 24071. León. ***e-mail:*** **sevmarfr@jcyl.es**
Sijacic-Nikolic¸ Mirjana	Faculty of Forestry University in Belgarde. Kneza Viseslava 1, 11070 Belgrade, Serbia. ***e-mail:*** **sijacic68@nadlanu.com**
Spanos¸ Konstantinos	NAGREF- Forest Research Institute. 56006- Vassilika, Thessaloniki, Greece. ***e-mail:*****kspanos@fri.gr; kaspako@otenet.gr**
Stojnic¸ Srdjan	University of Novi Sad. Institute of Lowland Forestry and Environment Novi Sad. Antona Cehova 13, P.O.Box 117, 21000 Novi Sad, Serbia. ***e-mail:*** **stojnics@uns.ac.rs**
Sulkowska¸ Malgorzata	Forest Research Institute. Braci Lesheis 3, St 05-090 Rasryn, Poland. ***e-mail:*** **M.Sulkowska@ibles.waw.pl**
Tejedor¸ Ignacio	Dirección General del Medio Natural. Gobierno de la Rioja. C/ Prado Viejo, 62 bis. 26071. Logroño. La Rioja. Spain.
Thiel¸ Daniel	University of Bayreuth,Departament of Biogeography 95440. Germany. ***e-mail:*** **daniel.thiel@uni-bayreuth.de**
Traver¸ Carmen	***GAVRN Gobierno de Navarra, Spain.*** ***e-mail:*** **carmen.traver@gavrn.com**
Verheyen¸ Kris	Ghent University. Laboratory of Forestry. Department of Forest and Water Management. Geraardsbergsesteenweg 267. B-9090 Melle- Gontrode. Belgium. ***e-mail:*** **kris.verheyen@ugent.be**
Vettori¸ Cristina	Plant Genetics Institute, Division of Florence. Polo Scientifico CNR, Via Madonna del Piano 10. 50019 Sesto Fiorentino (FI), Italia. ***e-mail: cristina.vettori@igv.cnr.it***

Name	**Center - email**
Vendramin¸ Giovanni G.	Plant Genetics Institute, Division of Florence. Polo Scientifico CNR, Via Madonna del Piano 10. 50019 Sesto Fiorentino (FI), Italia. ***e-mail:*** **gg.vendramin@gmail.com**
Vila-Lameiro, Pablo	University of Santiago. High School Polytechnic; Campus Univesitario s/n 27002 Lugo. Spain. ***e-mail: pablo.vila.lameiro*@usc.es**
von Wühlisch¸ Georg	VTI- Institute of Forest Genetics. Sieker Landstr. 2. 22927. Grosshansdorf. Germany. ***e-mail:*** **georg.wuehlisch@vti.bund.de**
Wesoly¸ Wojciech	University of Life Sciences. Wojska Polskiego 69 Pl 60-625 Poznan, Poland. ***e-mail:*** **wesoly@au.pozman.pl**
Övergaard, Rolf	Southern Swedish Forest Research Centre. Swedish University of Agricultural Sciences. Sweden. ***e-mail:*** **Rolf.Overgaard@ess.slu.se**