Valuable Broadleaves – Resources and Research in Germany

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1. Valuable Broadleaves in Germany

Forest area in Germany covers about 11.076 Mio ha in total and Forests represent 31.03 % of the total surface (BMVEL 2004). Forest area in Germany has increased significantly in the last 200 years due to reforestation of former wasteland and abandoned agricultural area. In the 15-year period between 1987 and 2002, annual forest area increased in the western states of the country by about 54000 ha or 0.7 % of total amount.

In comparison to the most common tree species in Germany, which are Norway spruce (28.2 %), Scots pine (23.3 %) and European beech (14.8 %) the area of tree species targeted by COST E42 (noble hardwoods, birch-species, red alder) is rather low and accounts for about 10 % of the total forest area. This means that their relevance is similar to that of indigenous oak-species (*Quercus petraea*, *Q. robur*; 9.6 %), which are traditionally well known for high value timber production. Due to the actual state of analysis of the national inventory BWI 2, absolute and relative amount of these target species, which are mixed in different species groups, can only be indicated approximately. The basis of the following table (Tab. 1) is formed by the inventory results to the actual forest types by dominant species and their accordance to the natural tree species composition under the sample-plot specific site conditions (Table 1).

Forest-Type	**(very) Close-to-nature species composition [ha]**	**Semi close-to-nature [ha]**	**Anthropogenically influenced [ha]**	**Total [ha]**
Ash-type	78894	67798	15745	162437
Birch-type	94933	195799	20522	311254
Alder-type	86699	52600	63154	202454
Other broadleaved types (high lifespan)[1]	116461	173921	71170	361552

[1] This type also includes other than COST E42 target tree species.

Other broadleaved types (low lifespan)[1]	19272	82127	84693	186092

Table 1: Area of forest types containing target tree-species of COST E42 differentiated on the degree of convergence to the natural tree species composition. (BMVEL 2004, p. 30)

The relevance of valuable broadleaved tree species in Germany in contrast to the actual state is expected to increase due to the following facts:

- Regarding total area and age class structure of the German forests, valuable broadleaved species showed the highest positive change dynamics: The area covered by broadleaves with long lifespan increased by 1.6 % of the total area which is the second highest behind the increase of common beech (+ 1.9 %). In the youngest age class (1-20 years) broadleaved species other than oak and beech represent even more than 2/3 of the area of all broadleaves and 1/3 of the total forest area respectively. As forest management strategies are not expected to change significantly their area will continue to rise.
- Appropriate site conditions allow for an increase in the area for growing one or more of the target tree species significantly. Aiming at the development of mixed-stands, which is an important aim of close-to-nature forest management strategies in Germany, expansion of the area of valuable broadleaved can be expected in general. *Betula*-species may become more important because of changing management strategies in young stands, particularly those established on storm damaged areas
- As mentioned above, afforestation of formerly agricultural used area is a permanent phenomenon which is estimated to have at least the same importance in the near future as it has today. If adoption of the species established is warranted, growth and quality of valuable broadleaved trees (ash, sycamore, Scots maple, birch) in many cases is more satirfying than that of European Beech or other shade tolerant species of late successional status.
- Last but not least a lot of valuable broadleaved species require medium range production times due to their length of life, of phytopathogenic risks or modification of the wood properties at higher age. Examples are root rot of the wild cherry (Spiecker 1994), the facultative formation of coloured heart of ash and others. Growing valuable

broadleaves under these conditions is thus attractive under an economical point of view, because return of investments occurs much earlier than usually seen in other forest tree species.

2. Completed research

a) Forest Growth research

First recommendations of growing valuable broadleaves can be found in the famous book of von Carlowitz 1713 “Die Baumzucht”, which incidentally is known as one of the first folio dealing with the question of sustainable forest management. He recommends emphasizing the planting and tending of valuable broadleaves as they produce high value timber and grow fast.

First scientific investigations on the Growth of valuable broadleaved species in Germany have been carried out in the early 20th century, establishing yield tables for ash (Wimmenauer 1919a+b, Zimmerle 1942). Later on yield tables for Scots maple (Vollquardts 1958, Nagel 1985) and small leaved lime (Böckmann 1990) followed. As an advancement of the yield table concept productions programmes with appropriated target diameter and production time were developed. Nowadays tending selected future crop trees becomes more important thus the yield table concept becomes less relevant for single-tree-oriented decision support.

In accordance with the results of Spiecker (1991), controlling crown dimension and crown development is estimated as a key factor in controlling growth of valuable broadleaves. Studies on wild cherry (Spiecker et al. 1988,1994) as well as on ash and sycamore (Hein 2004, Thies in prep.) have been carried out.

b) Research on Genetics

In order to obtain seed from broadleaves numerous seed stands have been registered in Germany along with the establishment of seed orchards. The selection of the seed trees took place predominately using the criteria of growth and quality. In accordance with the law regarding the use of forest seed (FoVG), the clones are segregated by provenance. The following table depicts the existing seed orchards:

	Selected seed			
	Stands		**Seed orchards**	
Tree species	**Number**	**Reduced area in**	**Number**	**Area in ha.**

		ha.		
Sycamore	874	980	8	11.4
Common alder	537	1372	11	17.7
Ash	1425	2860	5	8.8
Sessile oak	8471	32317	2	4
Pedunculate oak	2243	9151	1	2.0
Small-leaved lime	544	794	7	11.5

Table 1 (updated: 01.10.1997)

The progeny from these seed orchards were and still are being tested. Certified seed orchards are:

	Certified seed						
	Stands		Seed orchards		Clones	Clone mixtures	
Tree species	Number	Reduced area in ha.	Number	Area in ha.	Number	Number of clone mixtures	Number of contained clones
Common alder	5	6.8	4	11.3	22		
Sessile oak	48	231.8	5	29	341		
Pedunculate oak	8	42.5	16	251	76		
Small-leaved lime	439	827	1	2.0	995		

Table 2 (updated: 01.10.1997)

Genetic examinations of broadleaves have taken place for decades using isoenzyme analysis. The main focus was examinations into:

- Species and race identification: *Prunus avium, Juglans regia, J. nigra* and *J. intermedia, Fraxinus excelsior*
- Genetic variation of the tree species: *Acer pseudoplatanus, Tilia platyphyllos, T. cordata, Fraxinus excelsior, Ulmus laevis, U. glabra*
- Clone identification of the tree species *Tilia platyphyllos, T. cordata, Acer pseudoplatanus, Sorbus domestica*

The effects of seed storage on the genetic diversity were examined for *Betula pendula, Alnus glutinosa, Acer pseudoplatanus* and *Fraxinus excelsior*.

The correlation between seed and plant material can be assessed using genetic comparisons in reference samples. This system has been put into practice and is possible with the following tree species: *Acer pseudoplatanus*, *Tilia* spp., *Fraxinus* spp. and *Juglans* spp.

Investigations into the genetic effects of diverse thinning regimes in beech and oak stands have shown that a dramatic reduction in the stocking levels leads to a loss of rare alleles and thus to a reduced genetic variety.

3. Recent research

Recent research activities on valuable broadleaved tree species in Germany are dealing with:

a) Forest Growth

- Development of agro-forestry-systems with valuable broadleaves (ash, sycamore, wild cherry, birch, red alder, walnut) as an alternative to the common form of afforestation (funded by the German Federal Ministry of Education and Research. 04/2005 – 03/2007)

b) Genetics

In order to uphold the provisions of the FoVG law, work is continuing on the identification of provenances especially for *Prunus avium*. As well as the traditional isoenzyme analysis, DNA and isotope analyses are also becoming more widely applied. The DNA identification of fast growing poplar clones will become a new focus since the interest in poplar timber for the energy and paper industries is currently increasing rapidly.

A further emphasis is that of investigations into the genetic variation on a larger geographical scale and the effects of silvicultural measures on the genetic structure of forest stands. An emphasis will be placed on investigations into beech (and fir) forests, in which valuable broadleaves still play only a minor role. Furthermore, there exists great interest in the understanding of natural pollination and the distribution of dispersed tree species, especially of *Prunus avium* and *Acer platanoides*.

4. Literature

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