

## International beech provenance trial 1993/95 - site Schädtebek (Bu19-1)

MIRKO LIESEBACH

Thünen Institute of Forest Genetics, Sieker Landstraße 2, 22927 Großhansdorf, Germany ([mirko.liesebach@thuenen.de](mailto:mirko.liesebach@thuenen.de))

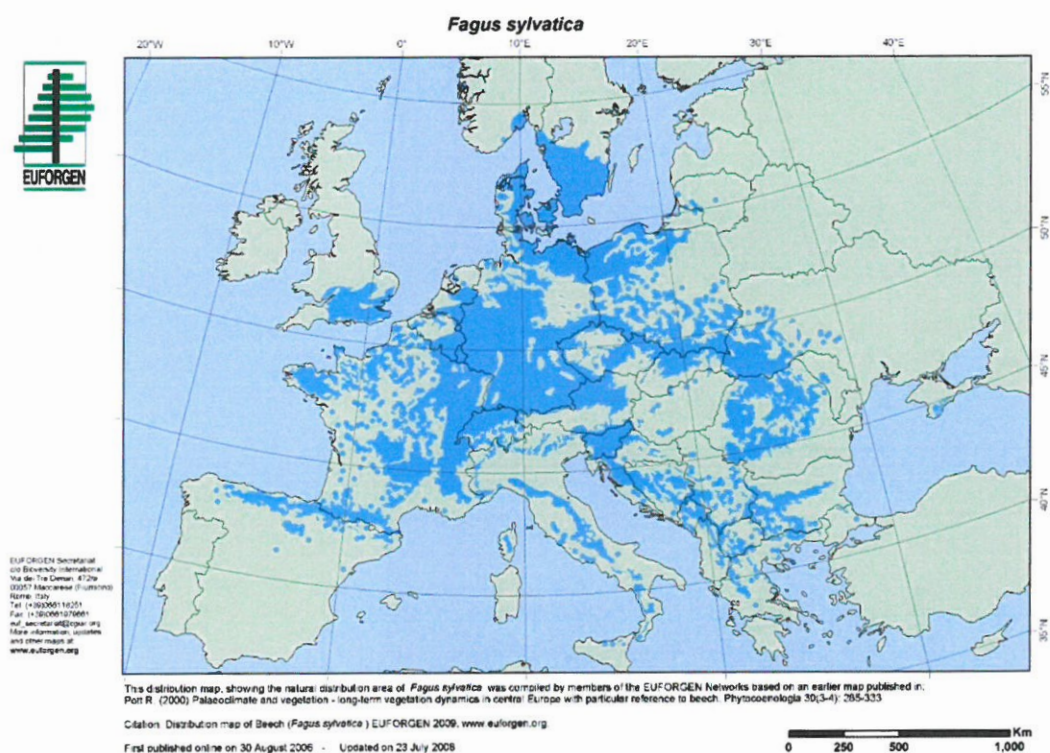
### Abstract

In 1995 an international beech provenance trial was established at 27 sites in Europe. One of the sites is located in Schädtebek / Schleswig-Holstein. At this site 100 provenances are in test. Growth traits were measured and survival and stem form assessed at several times. There is variation between the provenances for all traits. No correlation could be detected between growth and stem form.

**Key words:** *Fagus sylvatica*, field test, growth, stem form

### Background

European beech (*Fagus sylvatica* L.) is a major forest tree species in western and central Europe and covers roughly 12 million ha of forest land. The natural distribution range is shown in Figure 1. The area is increasing due to changes in the forest management currently. Beech is of interest not only for economic but also for ecological reasons. Beech is a species of high silvicultural value with many positive attributes which act to stabilize forest ecosystems.



**Figure 1:** Natural distribution range of *Fagus sylvatica* - European beech (Source: EUFORGEN 2009).

To determine the extent of genetic variation in European beech (*Fagus sylvatica* L.) and to evaluate its genetic resources, it is necessary to know how different populations of the species are able to cope with different environments. Thus, adaptiveness and adaptability of beech populations are to be estimated. This is accomplished by growing a set of provenances in field trials located in the different regions inhabited by the species.

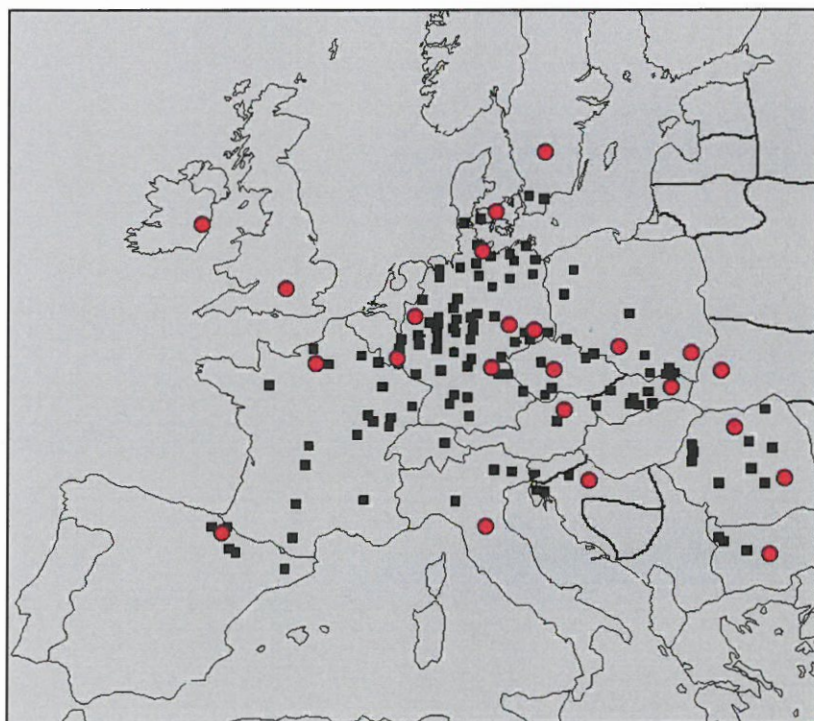
The institute initiated an international beech network of 6 trial series which were established since the mid-1980<sup>th</sup> (VON WÜHLISCH et al. 1998, LIESEBACH 2015). The 6 series comprises together 75 sites which include altogether 465 provenances. The trials contain between 14 and 158 provenances and are located in altogether 23 European countries. On the field trials, traits which best reflect adaptedness and adaptiveness are being assessed.

### International beech trial series 1993/95

The seed samples for the 1993/95 series delivered to the institute differed strongly in many respects: cleanliness, means and duration of transport, collection method, pre-treatments, etc. Generally, seed samples from distant places which had a longer journey were in worse condition than samples from nearby places. The seed were stored and stratified at the Thünen Institute in Großhansdorf.

Seeding was done at the nursery of the institute at Großhansdorf and in a state owned nurserie. The plants were lined out after one year, and transplanted for a further year. All plants were lifted after two years and stored in cooling containers in the institute. During winter plants were prepared for shipment to the trial sites. Planting of the 1+1 seedlings was organized by each joint partner institute. The trial lay-out was designed at the Thünen Institute for all sites.

The series comprised 23 trials in 17 countries and testing a total number of 158 provenances (Figure 2). During the first years a nursery trial existed as well.



**Figure 2:** Provenances and trial sites of the International beech trial series 1993/95 (red dot = trial site, black square = origin of provenance).



The lay-out of the trials is based on a randomized complete block design with three replications. Planting was done in rows with a space of 2 m x 1 m. Each plot was laid out with 50 plants, resulting in a plot size of 10 m x 10 m. Thus a trial with 33 provenances occupies about 1 ha. Plots are considered large enough to maintain the trials for 60 years. There are no bordering rows between the plots. Usually two rows were planted around the trials.

The trials are laid out and planned to serve multiple purposes, and the objectives of the different beech provenance trials include:

1. Tree improvement
  - Testing suitability of provenances for different sites
  - Selection of basic material
  - Setting up recommendations for trade and use of provenances at national and international level
2. Gene conservation
  - Assessment of genetic and phenotypic variation
  - Development of conservation strategies
  - Evaluation methods and ecodistances
3. Evolution biology
  - Adaptiveness, adaptability
  - Research on the impacts of global climate change

### Site Schädtebek (Bu19-1)

The field trial at "Schädtebek" is located near Kiel in Schleswig-Holstein (54° 18' N, 10° 18' E, 40 m a.s.l.) The size of the site is 3 ha (exclusively border rows). The field trial includes 100 provenances which were planted in April 1995 (April 10<sup>th</sup>-13<sup>th</sup> and 24<sup>th</sup>-28<sup>th</sup>). A list of the provenances is given in Table 1.

Together with the planting of beech a mixture of herbs (trefoil [*Trifolium* sp.], lupine [*Lupinus* sp.], fodder radish [*Raphanus* sp.], rape [*Brassica napus*], California blue bell [*Phacelia campanularia*], common buckwheat [*Fagopyrum esculentum*], oat [*Avena sativa*], rye [*Secale cereale*], mallow [*Malva sylvestris*], and others) was sown. There were two reasons for this step: to repress the rising weed and to give the young beech plants shadow. The summer 1995 was very dry and only about 40-50 % of the sown herbs germinated. Most of the site was covered by natural generated camomile (*Tripleurospermum inodorum* and *Matricaria chamomilla*).

During the years 1995 and 1996 the climatic conditions were not the best to establish a field trial in Northern Germany. Both years were very dry, however, only a few plants died.

In September 1995 several beech plants lost their leaves totally and had a second flushing.

The winter 1995/96 was long and cold. On average the year 1996 was not so warm as 1995. In 1996 there were about 100 mm less rain and 200 hours less sunshine than in the year 1995.

In spring 1996 (May 7<sup>th</sup> and 8<sup>th</sup>) there were several nights with a weak late frost, but all plants survived.

The beech is still growing between the sown herbs and the weed. In 1996 natural generated dock (*Rumex* sp.) had a large portion. The weed was not cut.

During the winter (1995/96 and 1996/97) poison against mice was distributed over the whole trial site. Damages could be avoided.

**Table 1:** List of provenances tested at the site Schädtebeck (Bu19-1) German Bundesländer: SH= Schleswig-Holstein, MV= Mecklenburg-West Pomerania, NI= Lower Saxony, BB= Brandenburg, He= Hesse, NW= North Rhine-Westfalia; TH= Thuringia, SN= Saxony, RP= Rhineland-Palatinate, BW= Baden-Württemberg, BY= Bavaria)

No	Provenance	Country	No	Provenance	Country
2	Limitaciones	ES	75	Spangenberg, Rfö. Kaltenbach	DE HE
5	Anguiano	ES	76	Bad Salungen	DE TH
7	F.D des Corbières occid.	FR	77	Eisenach	DE TH
8	F.D de Crécy	FR	80	Ebeleben	DE TH
9	F.D de Fougères	FR	83	Heinzebank	DE SN
10	F.D d'Halatte	FR	84	Tharandt (Pferdestall)	DE SN
11	F.D des Charmettes	FR	87	Osburg	DE RP
12	F.D des Colettes	FR	88	Morbach	DE RP
13	F.D de Planoise	FR	89	Hermeskeil	DE RP
14	F.D de Lagast	FR	90	Kirchheimbolanden	DE RP
18	F.D de Ligny en Barrois	FR	91	Elmstein-Süd, Rfö. Wolfsgrube XIV 1a	DE RP
20	F.D de Verrières du G.	FR	92	Elmstein-Süd, Appenthal. XIV Buch.	DE RP
23	F.D de Villafans	FR	93	Montabaur	DE RP
24	Fyn	DK	94	Ettenheim	DE BW
25	Grasten	DK	95	Münsingen Brente	DE BW
26	Glorup	DK	97	Herrenberg	DE BW
27	Skäralid	SE	98	Giengen I, Abt. 16 (Standard)	DE BW
28	Ryssberget	SE	99	Ehingen	DE BW
29	Lensahn	DE SH	100	Ebrach	DE BY
30	Farchau (Standard)	DE SH	101	Kaufbeuren	DE BY
32	Malchin I'92	DE MV	102	Vohenstrauß	DE BY
36	Osterholz-Scharmbeck	DE NI	103	Vohenstrauß, Rfö. Waishaus	DE BY
37	Deister	DE NI	104	Zwiesel	DE BY
38	Harsefeld	DE NI	108	Veneto	IT
39	Seelzerthurm	DE NI	109	Neuberg-Mürzsteg	AT
40	Bovenden	DE NI	110	Kladská	CZ
43	Busschewald	DE NI	111	Ceský Krumlov	CZ
44	Oderhaus	DE NI	114	Krynica	PL
46	Gransee, Abt. 3082a1	DE BB	115	Stary Sacz	PL
48	Monschau, Abt. 38A	DE NW	116	Bnerko	PL
49	Schleiden, Abt. 403A	DE NW	117	Ladek Zdroj	PL
51	Eitorf 1502/262a	DE NW	118	Henryków	PL
52	Eitorf 1502/209a/b	DE NW	120	Brzeziny	PL
53	Steinfurt	DE NW	124	Zamutov	SK
54	Schmallenberg	DE NW	126	SLP Poruba	SK
55	Glindfeld Vilden, Abt. 19	DE NW	127	Ubla	SK
58	Wünneberg Glashütte, Abt. 15b	DE NW	129	Smolenice	SK
59	Wünneberg Hirse, Abt. 8b	DE NW	130	Trenc in	SK
61	Neuenheerse, Abt. 175	DE NW	132	Muran	SK
66	Dillenburg	DE HE	135	Medzilaborce-Koskovce	SK
67	Hadamar	DE HE	136	Idrija	SL
68	Jesberg	DE HE	137	Postojna	SL
69	Büdingen Abt. 762 (Standard)	DE HE	138	Rogaska Slatina	SL
70	Büdingen Abt. 763 (Standard)	DE HE	139	Opatija	CR
71	Sinntal Abt. 410 (Standard)	DE HE	141	Svaljava Polana	UA
72	Sinntal Abt. 411 (Standard)	DE HE	142	Tura Polana	UA
73	Sinntal Abt. 414 A (Standard)	DE HE	144	Rachiv	UA
74	Schlüchtern	DE HE	145	Belu-Arad	RO



No	Provenance	Country
46	Beius-Bihor	RO
150	Sovata (25)	RO
158	Ribaritza	BG
161	Fläming	DE ST

Up to now the trial is not thinned. Losses are due to competition. Only upcoming natural regeneration of willow (*Salix caprea*), maple (*Acer pseudoplatanus*) and cherry (*Prunus avium*) were removed.

The following traits were assessed or measured at several ages in the field: Survival was assessed at age 3, 5, 10, 15 and 20. Height growth were measured at age 3, 5, 10 and 15, and diameter (dbh) growth at age 15 and 20. Stem form was recorded using a 4 step scale (1= good to 4= poor).

## Results

On the site Schädtebek only 2 % of the plants died during the first vegetation period or had not took root. In 24 provenances all 150 plants are still alive. These are 2 provenances from France (no. 11, 13), 1 from Sweden (no. 28), 15 from Germany (no. 29, 38, 39, 43, 44, 48, 61, 66, 68, 71, 77, 83, 94, 97, 100), 4 from Slovakia (no. 127, 130, 132, 135), 1 from Slovenia (no. 137), and 1 from the Ukraine (no. 141). The highest plant losses are registered in 5 provenances from Germany (no. 51 [4.6 %], 95 [4.0 %], 40, 84 and 99 [each 3.3 %]). In total, all provenances have a survival rate which is higher than 95 %.

Further results at age 10 are presented by LIESEBACH et al (2011).

The development of the survival over all provenances is listed in Table 2. At age 20 the survival rate is 61 %. Losses can be mainly explained by natural competition between the beech trees. At age 15 the mean height of the trial was 5.3 m (Table 2).

**Table 2:** Development of survival rate and mean height and dbh of beech at the site Schädtebek

Trait	Age 3	Age 5	Age 10	Age 15	Age 20
Survival [%]	98 %	86 %	76 %	69 %	61 %
Height	0.33 m	1.1 m	2.9 m	5.3 m	
Dbh				6.5 cm	9.2 cm
Stem form*					2.6

\*1= good to 4= poor

At age 15 the mean dbh of the trial was 6.5 cm (Table 2). The dbh increased to age 20 up to 9.2 cm (table 2). The mean diameter of the provenances varied between 7.0 cm (No. 138: Rogaska Slatina / Slovenia) and 11.2 cm (No. 130: Trencin / Slovakia) (Figure 3).

An average of 2.6 is calculated over all provenances for the stem form (Table 2) which is not the best. Figure 4 shows the mean stem form for each of the 100 provenances, which varies between 2.2 (No. 74: Schlüchtern / Germany, 104: Zwiesel / Germany, and 109: Neuberg-Mürzsteg / Austria) and 3.1 (No. 14: F.D de Lagast / France). About one third of the provenances (32) have a mean stem form of less than 2.6 (dark green bars in Figure 4). The stem form of only 5 provenance is higher than 2.9. The frequency for each provenance is shown in Figure 5.

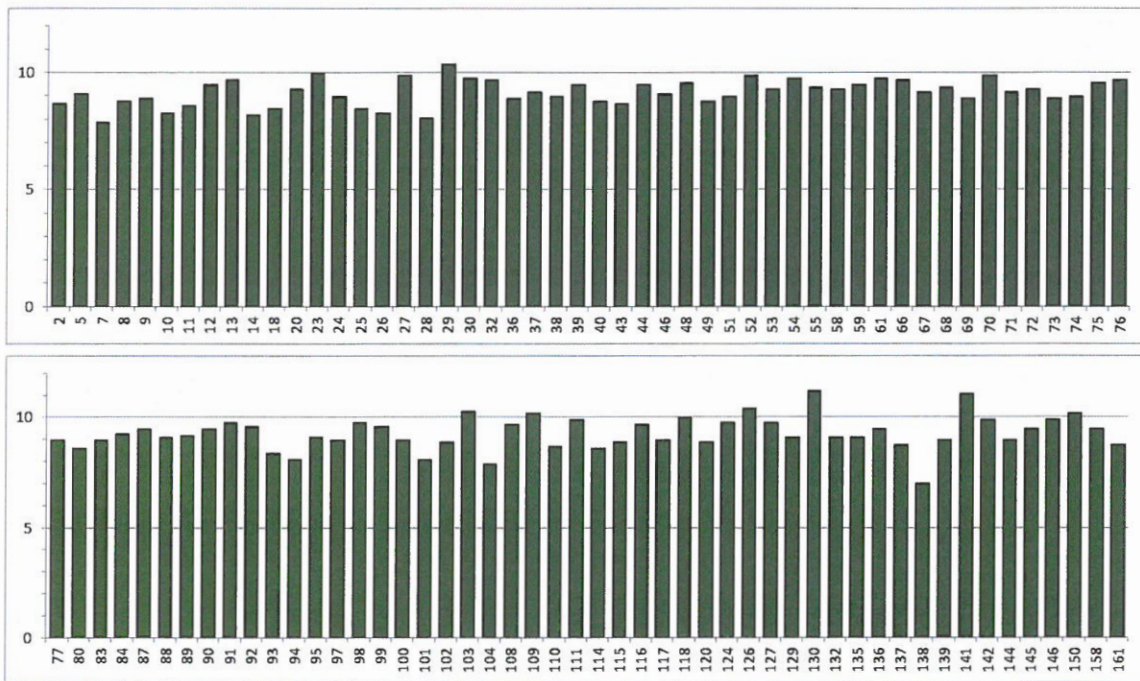


Figure 3: Mean dbh at age 20 of the 100 provenances tested at the site Schädtebek (Bu19-1).

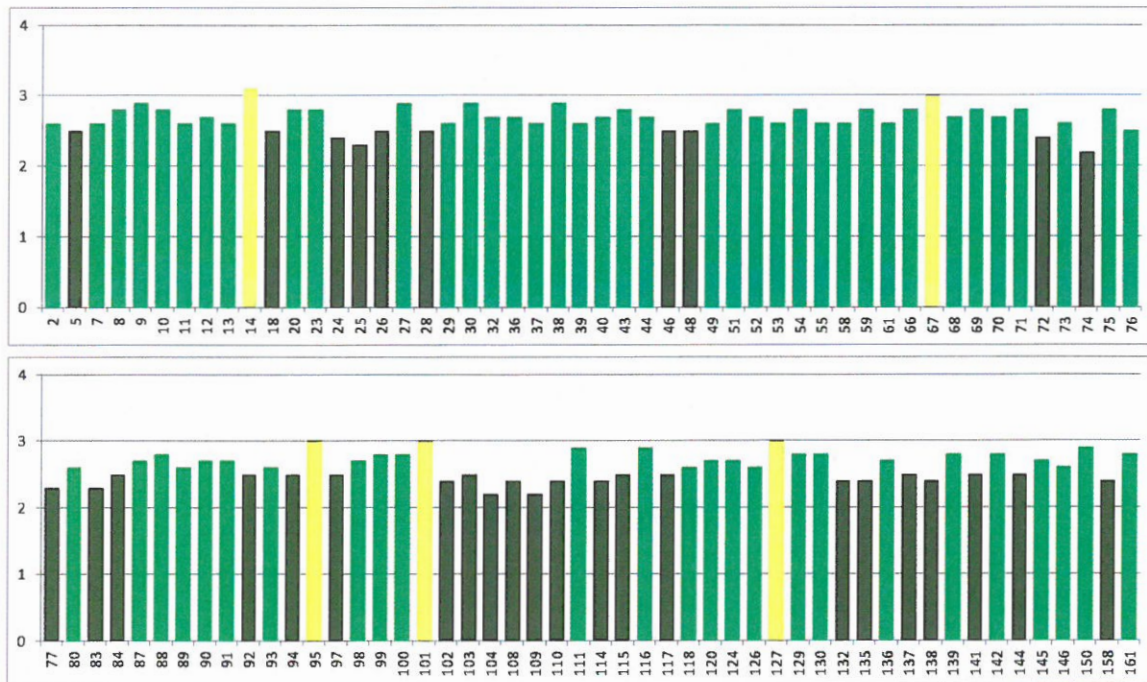
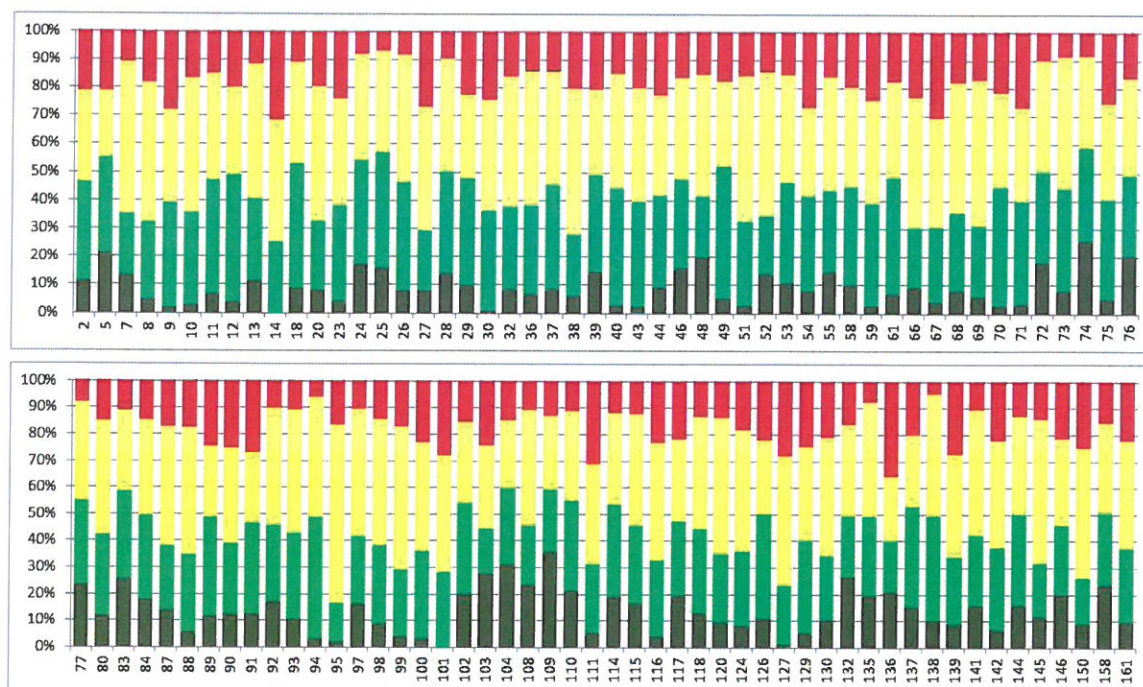


Figure 4: Mean stem form at age 20 of the 100 provenances tested at the site Schädtebek (Bu19-1).





**Figure 5:** Frequency of stem form (4 step scale: good [dark green] to red [poor]) at age 20 of the 100 provenances tested at the site Schädtebek (Bu19-1).

### Correlation between traits

At all ages height and diameter growth are correlated (Table 3). However, there is no correlation between the mean stem form and the growth traits height and dbh. The results of the correlation analysis are summarized in Table 3.

**Table 3:** PEARSON's correlation coefficient for the growth traits height (H..) and dbh (D..), and stem form respectively. (\*significant  $\alpha < 0.05$ )

Trait age	Height 5	Height 10	Height 15	Dbh 15	Dbh 20	Form 20
Height 5	-					
Height 10	0.90494*	-				
Height 15	0.58069*	0.68881*	-			
Dbh 15	0.70594*	0.80749*	0.63085*	-		
Dbh 20	0.63085*	0.48717*	0.37263*	0.78120*	-	
Form 20	-0.01073	-0.04759	-0.04165	0.10056	0.16546	-

### Conclusions

Due to the high number of provenances originated over whole Europe it is not surprising that is variation between the provenances regarding growth and stem form. However, the variation is lower than expected compared with other forest tree species. Of specific interest is the result that growth and stem form are not correlated.

## Acknowledgements

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