- *Beech covers a relatively large geographic area of Europe, but only recently has a formal scientific provenance trial been established.*
- *Results after nine growing seasons for survival, height growth and flushing date are presented, with preliminary recommendations for the best seed sources for Ireland.*
- *In recommending suitable beech provenances for Ireland it is important to consider factors other than simply superior height growth. The date of bud break and thus the risk of late spring frost damage can affect survival, growth and stem form.*
- *Based on the results, home-collected material and British sources would be recommended as the first choice.*

Provenances of beech best suited for Ireland

David Thompson[1]

Although beech (*Fagus sylvatica* L.) is not a native broadleaf species in Ireland, it does play an important role in Irish forestry. It was first introduced to Ireland in the late 16th century. Since then it has become naturalised here and currently is the most abundant broadleaf species in the Coillte estate, accounting for 23% of the broadleaf area. It has also been widely planted by the private sector as part of the afforestation schemes since the mid 1980s and early 1990s.

Its natural species range extends from southern Norway in the north to north-eastern Sicily in the south, and from north-western Spain in the west to eastern Bulgaria and Romania in the east (Figure 1). Following the last Ice Age, about 10,000 years ago, beech crossed land bridges from northern France to southern England but did not migrate further north than a line from Bristol in the west to Dover in the east. This range has been greatly expanded by human exploitation of the species.

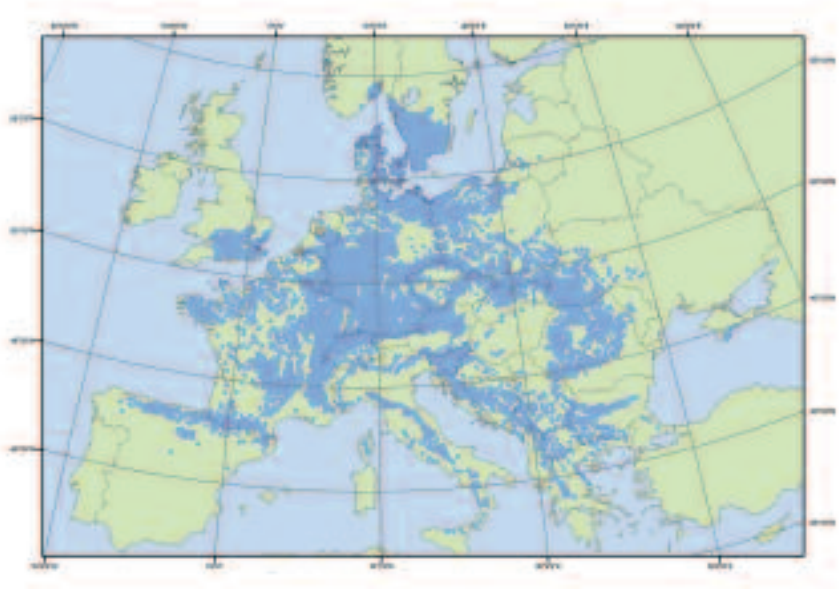

Figure 1: Natural distribution of beech *(Fagus sylvatica* L.*).*
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Because the species covers such a wide geographic area, questions have always arisen about what beech seed sources are best suited to Irish conditions. During the period between 1930 and 1980, for which there are good records of seed usage by the Forest and Wildlife Service, a total of 46,115 kg of beech seed was sown, of which about 30% was imported seed sources including material from 'northern Europe', Italy, Romania, Bulgaria, Denmark, Germany, Czechoslovakia and France. During the 1960s most of the beech planted in Ireland originated from Romania. However, during that time seed imports were usually purchased based on the price and availability of seed rather than any scientific basis.

Despite the lack of knowledge about the best beech sources, no formal provenance trials were planted until the early 1990s. In 1998 an international beech provenance trial was organised by the Institute for Forest Genetics, Grosshandorf, Germany, and one of these trials was planted in Ireland. This trial covered a wide part of the species range and consisted of 34 sources (Table 1). The results from this trial provide the basis for the current preliminary recommendations.

Materials and methods

Seed was collected by partners in the project (no Irish seed was available to include in the trial) and sown in a nursery near Hamburg, Germany. Plants were lifted and sent to Ireland in the spring of 1998 and planted on a site in Ballyboy property in Glenmalure forest, Co Wicklow, which was one of 21 field trials throughout Europe.

The design of the experiment is 34 provenances planted in randomised plots and replicated in three blocks across the site. Each rectangular plot consists of five rows, each with 10 trees at a spacing of 2 m between rows and 1 m between plants within the rows. This design should allow for thinnings to take place without the complete loss of provenances in the trial during its lifetime. The site was deer fenced prior to planting.

A survival and flushing assessment was carried out in early May 2000, after two growing seasons on the site. Flushing was scored on a 1 to 7 scale with a dormant bud scored as 1 and a fully flushed, elongated shoot scored as 7. The trial was cleaned in the summer of 2004 and assessed again for survival and height growth in the spring of 2006.

Results

The results of the 2000 survival and flushing and the 2006 survival and height assessments are presented in Table 1.

Overall survival across all provenances was 77% in 2000 (ranging from 17 to 98% across all provenances), which decreased slightly to 72% in 2006 (ranging from 22 to 92%). While a higher overall survival would have been preferred, the results are satisfactory. Apparently some plants assessed as dead in 2000 had recovered and were growing in 2006. However, some provenances showed a continuing decrease in survival rate between 2000 and 2006. These included Bretagne (number 05) Nizbor (number 64), Homi Plana-Ce (number 51) Eisenerz (number 36), Pyranees Or. (number 08) and Gullmarsberg (number 25).

The provenance with the highest survival rate in 2006 was the Italian provenance (Val di Sella, number 37), which

Table 1. Performance of 34 beech provenances at the Glenmalure site.

Provenance Number	Country	Provenance Name	Survival % 2000	Survival % 2006	Flushing 2000 (1 to 7)	Height (m) 2006
01	F	Perche	85	85	3.7	2.1
02	F	Bordure Man.	47	41	5.2	1.2
03	F	Picardie	65	65	5.0	1.7
05	F	Bretagne	91	64	4.4	1.9
06	F	Plateaux du	48	40	5.2	1.5
08	F	Pyrenees Or.	85	72	5.3	1.4
11	LUX	Heinerscheid	75	69	4.4	1.7
13	B	Soignes	48	56	3.9	1.8
14	NL	Aarnink	17	22	5.3	1.8
15	NL	Elspeet	67	77	2.1	1.5
16	BUL	Gotze Delchev	87	79	6.2	1.8
17	GB	Westfield	73	65	4.3	1.5
18	GB	Bathurst	88	83	4.6	2.0
19	GB	Down/Chilt.	88	85	4.3	1.9
20	GB	Lowther	65	68	3.9	1.8
21	DK	Grasten	80	81	5.8	1.7
23	S	Torup	58	55	5.6	1.3
25	S	Gullmarsberg	72	61	4.8	1.4
26	D	Farchau	72	75	5.5	1.7
28	D	Schluecht.	92	89	6.0	1.7
31	D	Urach	87	87	3.9	2.0
34	CH	Oberwil	90	85	6.1	2.0
35	A	Hinterstoder	87	77	5.9	1.8
36	A	Eisenerz	93	79	6.0	1.7
37	I	Val di Sella	98	92	6.3	2.0
39	PL	Jaworze	87	85	6.1	2.0
46	CZ	Domazlice-Vyhl.	87	84	6.1	1.5
48	CZ	Jablonec	77	87	6.1	1.5
49	CZ	Brumov-Sidonie	73	75	6.2	1.8
51	CZ	Homi Plana-Ce.	88	75	6.1	1.4
53	SLO	Postojna Masun.	92	85	6.2	1.8
60	PL	Sekowiec	85	77	6.0	1.4
64	CZ	Nizbor	83	65	6.0	1.4
67	PL	Bilowo	77	69	5.1	1.4
		Trial Means	77	72	5.2	1.7

also had the highest survival rate in 2000. The poorest survival was in the Dutch source Aarnink (number 14), but again this reflected a poor survival rate seen in the 2000 survival figures. This may have been the result of poor plant quality and not due to poor genetics, but this affected only one of the 34 provenances.

A flushing assessment was carried out in early May 2000 when the average flushing stage across all provenances was 5.2. Flushing stages ranged from 2.1 (Elspeet, a Dutch source, provenance 15, least flushed) to 6.3 (Val di Sella, Italian source, provenance 37, most flushed). Most of the western provenances were not as flushed as most of the southern and eastern provenances, which supports previous results reported for the effect of provenance on beech flushing (von Wuehelisch et al. 1995).

The results in Table 1 show that a significant number of the provenances from the eastern and southeastern part of the species range (Italy, Bulgaria, Romania, Poland, Czech Republic and Slovakia), while producing rapidly growing plants were also the most well developed, meaning they

were the first to flush. Thus these fast growing provenances would be at the greatest risk of late spring frost damage, which could affect survival, height growth and perhaps most importantly stem form. While there has not been any serious damage at the trial site from frost, it would not be prudent to recommend these fast growing sources from eastern Europe for use in Ireland.

It is interesting to note that one of the best known beech sources, the Foret de Soignes outside of Brussels (provenance number 13), noted for its very good stem form, is not particularly outstanding at this time in this trial.

Conclusions

In recommending suitable beech provenances for Ireland it is important to consider factors other than simply superior height growth. The date of bud break and thus the risk of late spring frost damage can affect survival, growth and, perhaps more importantly, stem form. Because beech covers such a wide species range, provenance selection is important. Trials like this have shown that eastern sources tend to break bud earlier, while western sources are later flushing and thus less at risk to late spring frost damage (von Wuehlisch et al. 1995). They also found that provenances from higher elevations tended to break bud earlier than those from lower elevations.

In a survey of commercial beech stands established during the period 1930 to 1980, J. Neilan (unpublished results) found that in 82 Irish beech stands for which the provenance could be traced, when assessed for superior stem form, only home-collected sources and seed importations from Britain produced good quality stem form stands. Stands established with Romanian, Bulgarian or Czechoslovakian seed could not be located, suggesting that this material has proven to be unsuitable for this country.

The results suggest that either home-collected material (based on previous experience, not based on results from this trial) and the use of British sources would be recommended. Certainly eastern European sources and those from high elevations in western Europe should be avoided because of the risk of late spring frost damage. Some low elevation French (Perche) and German (Urach) material may also produce good quality beech in Irish conditions. However, stem form has not yet been assessed and could have a significant effect on later recommendations.

In general, it takes a quarter to a third of the full rotation length of a species to show its full genetic expression including growth and stem form potential. Truly meaningful results from this trial will take 25 to 40 years to manifest themselves, but the current results after only nine years offer a ‘first look’. More time is required to provide reliable information on the growth and especially the stem form of the different provenances. Nevertheless, the data on flushing will not change over time.

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