

Forest Research Report 2005

WALNUT TRIALS AT LOUNT, NATIONAL FOREST

*Contract report submitted in fulfilment of the
Annual Management Agreement between the
National Forest Company and the Northmoor Trust.*

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Acknowledgements

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Introduction

The Northmoor Trust, East Malling Research and the National Forest have undertaken collaborative research investigating the suitability of black walnut as a timber tree in the UK. To this end, provenance and progeny trials have been established at the Northmoor Trust and at Lount Wood in the National Forest. Furthermore, research in to the best way to produce valuable timber, by investigating different planting mixtures, has also been planted at both sites and replicated on two additional sites.

Combined provenance and progeny trials have been established over three planting years. Phase I, planted in 2003, comprises European material. Material from the USA has been established in two very similar trials in 2004 and 2005 (Phase II and III). Due to complications at the nursery, the majority of the information on the black walnuts from USA is solely at the provenance level. Additional selections for Phase III include progeny data. Full details of this are given in Appendix 1.

Staff visited the trials at Lount from the Northmoor Trust in February 2006. Figure 1 shows the layout of all walnut trials at Lount. All trials were visited by staff from East Malling in May 2006 to score bud break.

This report summarises progress to date with the black walnut (*Juglans nigra*) research trials, and is submitted in fulfilment of the Annual Management Agreement between the National Forest Company and the Northmoor Trust.

Aims

1. To investigate planting mixtures that promote the growth of walnut species and hybrids in terms of stem quality and vigour, leading to a reduction in rotation time.
2. To evaluate planting mixtures which create, in line with aim one, additional financial and environmental incentives to landowners.
3. To test a wide-range collection of black walnut (*Juglans nigra* L.) material for their suitability to produce timber in the UK.

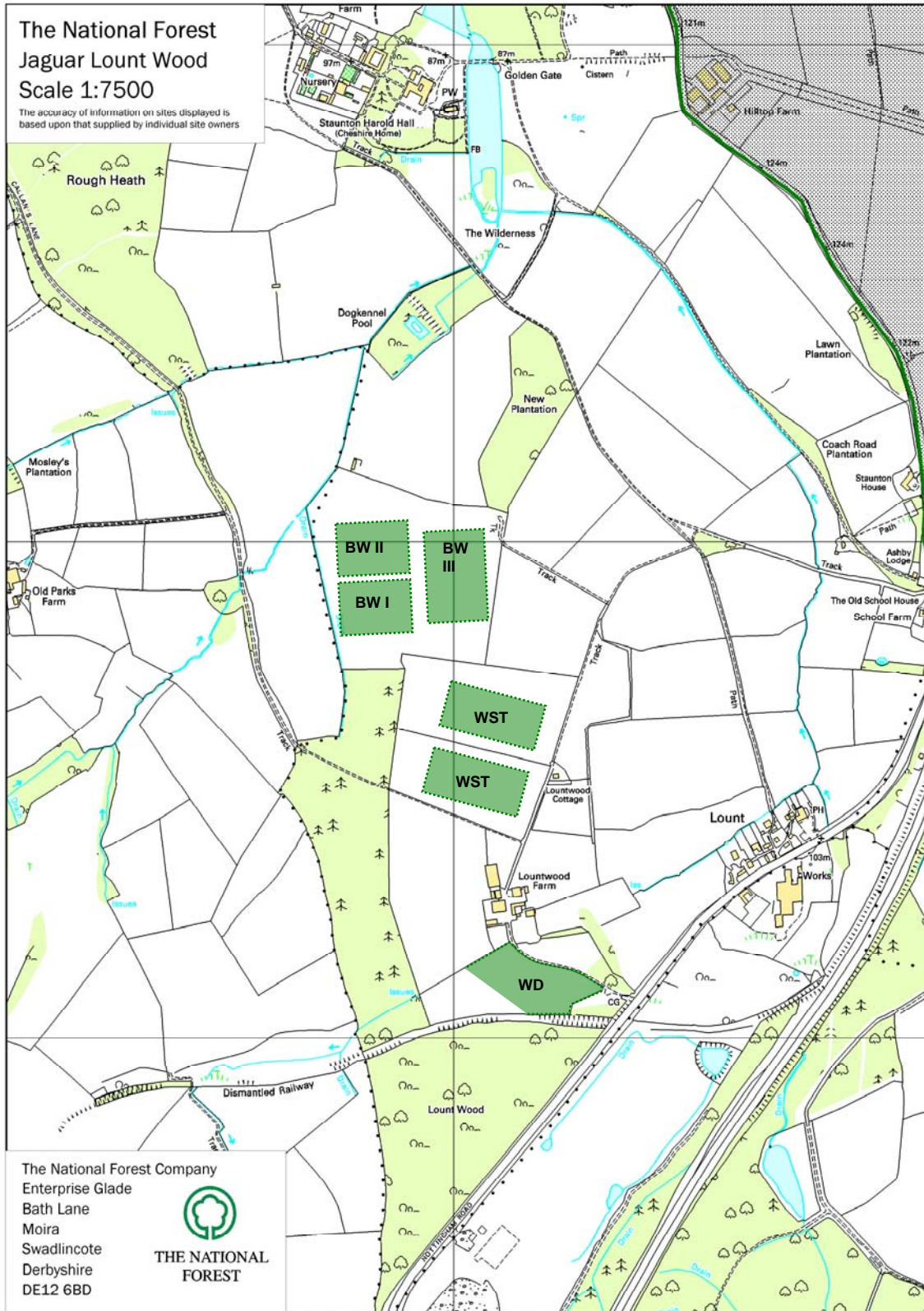
Silviculture Trial

The silviculture trial at Lount was established in 2001. Its height was recorded at planting and at year 1 to measure survival and increment growth. There has been no activity with this trial this year. Five-year data will be recorded 2006/07.

Black Walnut Progeny/Provenance Trials

The first and second phases of the black walnut progeny/provenance trials comprising seedlings from 'plus' trees selected from Europe, UK and USA were maintained at the Northmoor Trust, Oxfordshire and Lount in the National Forest and recorded for survival and seedling height. Survival in Phase II at Lount was 80% and 85% at Northmoor Trust. The replacement trees were planted in January 2006 at the same time as the establishment of the final batch of seedlings comprising the Phase III planting. The new seedlings were recorded for height. In total, 2480 seedlings (490 Phase I, 960 Phase II, 1000 Phase III) have been planted at the Northmoor Trust and 2770 seedlings (490 Phase 1, 1280 Phase 2, 1000 Phase 3) at Lount.

Figure 1. Layout of walnut trials at Lount Wood, the National Forest.



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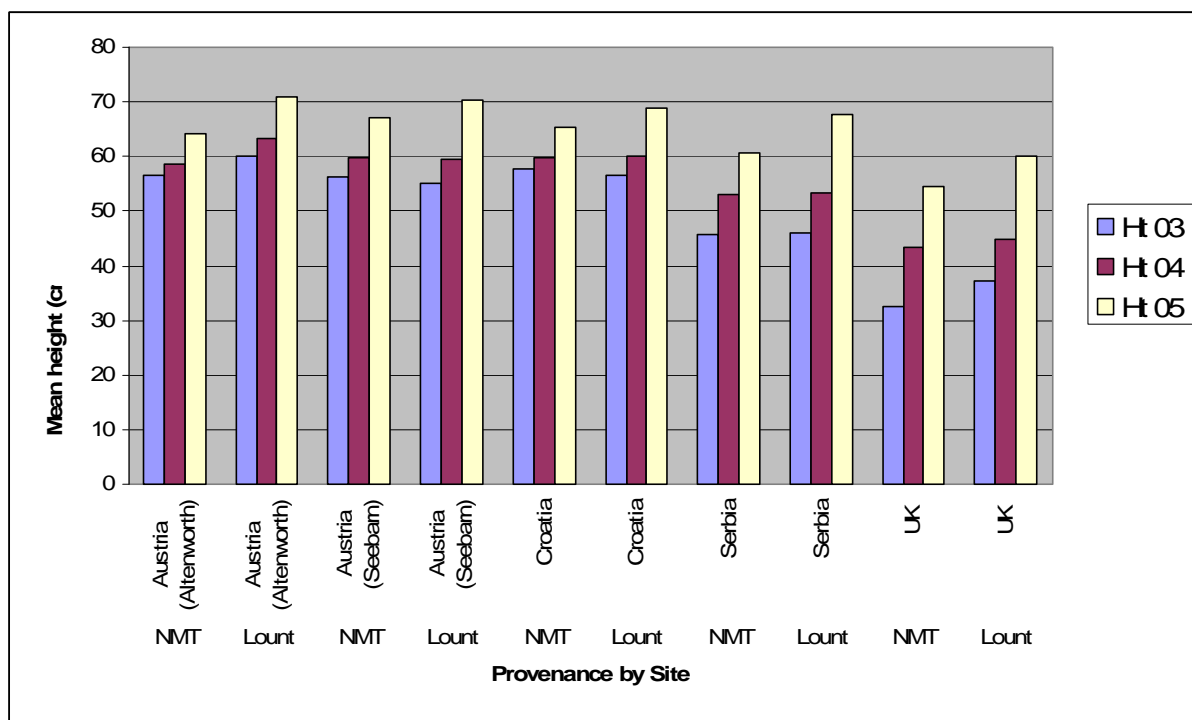
KEY

- BW I: Black walnut provenance progeny trial - European material Phase I (planted 2003)
- BWII: Black walnut provenance progeny trial - USA material Phase II (planted 2004)
- BWIII: Black walnut provenance progeny trial - USA material Phase III (planted 2005)
- WST: Walnut silviculture trial (planted 2002)
- WD: Walnut demonstration

Phase I

Phase I was established in 2003 comprising five European provenances and 43 progeny. Details of this trial can be found in the Forestry Research Report for 2003 (Hemery and Russell). Stock at time of planting was excellent, and only one tree died over both sites in 2004. However, somewhat disappointingly, 19 trees died at Northmoor in 2005. Survival remains excellent at Lount at 99.5% (two dead trees). There was no apparent cause for this mortality of trees at Northmoor.

Figure 2. Mean height by year for each provenance in Phase I of the black walnut trials.



Phase II

Phase II comprises 20 provenances from the USA, one from France, one British population and two progeny, one from Italy and one from Serbia and Montenegro. At the time of planting (2004) it was noted that several of the trees were almost certainly dead, but were nevertheless planted, as numbers were limited. Survival recorded the following summer indicated 15% mortality (145 trees) at Northmoor and 20% mortality (261 trees) at Lount. Provenance USA 4 and USA 6 had particularly high mortality (32% and 40% respectively).

All seed were resown and better numbers of seedlings were available for Phase III, an almost identical trial, planted a year later in 2005. All dead trees from Phase II were beaten up.

Each trial was measured for survival and height growth.

Figure 3. Walnut research trials at Lount.



Phase III

Phase III was planted in February 2006 and comprises 10 reps of 100 trees, and replicated at Northmoor Trust. Provenances are distributed in non-contiguous multiple-tree plots. Tree positions were assigned randomly at planting time and recorded.

While most tree identities are the same as in Phase II, the European material (SB4, IT11, FR4 and UK10, the control) are missing. Additional selections included in Phase III are eight new progeny from Oklahoma, eight new progeny from Europe and four new populations from Europe. Details of these are given in Appendix 2.

It is worth noting, that stock delivered to Northmoor was excellent, and talking with FE staff, it was confirmed that stock delivered to Lount was also excellent. Height and tree code were checked after planting.

Mean height at both sites was 27.5cm at planting.

All Phases were recorded for budbreak in 2006 by staff from East Malling, as bad frost damage hindered recording in 2005.

Collection of 'plus' trees

Graftwood was collected in February 2006 from three superior UK *Juglans nigra* that provided seed for the black walnut provenance trials but had yet to be propagated. The newly grafted plants are now growing in the glasshouse at EMR. The total number of superior UK plus trees of black walnut at EMR now stands at 24.

Genetic diversity study

A small study to quantify the genetic diversity of black walnut germplasm in a subset of the European and American germplasm was undertaken using 11 nuclear microsatellites arranged in two multiplexes. In total 186 individuals comprising plus trees from EMR and seedlings from trials were screened: 94 European trees and seedlings from UK, France, Austria, Czech Republic and Slovakia, and 92 seedlings from four USA provenances (Alabama, Florida, North Carolina and Pennsylvania). The overall observed heterozygosity for the European and USA subsets was 0.67 in both cases indicating that there are high levels of genetic diversity in black walnut not only in the USA, but also in Europe. The F_{st} value (the proportion of the genetic variance explained by differences among populations) for the European subset (0.249) was similar to that for the USA subset (0.297) suggesting that the genetic differentiation between the two continents is almost the same.

General Comments

The site appears excellent, with survival, in general being very good.

Each trial had rep markers, although none of these were numbered. Tags for phase III were given to Forest Enterprise staff on site at the time of the visit. The site was very wet in places and several of the stakes were on the ground and the holes waterlogged. If tags have not already been supplied, or have been lost, for Phases I and II, tags can be supplied by Northmoor Trust.

Phase III was excellent; perfectly laid out and planted. Phase II was measured after beat ups had been planted. These were not planted quite so well as Phase III. Many were barely in the ground, and several were tied into the tube with the cable tie. As trees were measured, all these were released. It was noted that a few of the tubes had also not been secured around the tree. All tubes and ties were correctly replaced. A few trees had snapped tops, but this was likely due to nursery handling and delivery as this was also observed at Northmoor.

Technology Transfer

Papers

Clark, J. R. and Hemery, G.E. (2005). Better Tree, Better Profits. *Woodland Heritage Journal* **10**, p22.

Clark, J. R., Hemery, G.E., Russell, K. and Williams, H. (2005). The Future of black walnut (*Juglans nigra*) in Britain. *Quarterly Journal of Forestry*, **99**(3)

Hemery, G.E., Russell, K. (2005). Advances in walnut breeding and culture in the United Kingdom. *Acta Horticulturae*.

Russell, K. (2006?). Walnut Research at East Malling. *NUCIS Newsletter* **13**. (submitted).

Taylor, D. (2005). A Countryside in Trust. *Forestry and British Timber*, November, p16.

Leaflet

Contribution to Alistair's, Bignall's and Jaguar Lount Woods leaflet, produced by the Forestry Commission and National Forest.

Presentations

Russell, K. UK highlights on national activities on gene conservation and research of Noble Hardwoods - Country: United Kingdom. Presentation at 8th EUFORGEN Noble Hardwoods Network, Copenhagen, Denmark, May 2005.

Russell, K. Selection and Improvement of broadleaved trees. Presentation to Forestry & Timber Association's Technical Day at Rhydcilgwyn Estate, Ruthin, Wales, 6th May 2005.

Posters

Russell, K., & Tobutt, K.R. Forestry and Landscape Research at EMR: Conserving and utilizing the best UK trees. East Malling Open Day, 22nd September 2005.

Russell, K., Nier, S., & Sutherland, B. Forestry and Landscape Research at EMR: Trees for the future. East Malling Open Day, 22nd September 2005.

Russell, K., Nier, S., Sutherland, B., & Hubert, J. Molecular and adaptive trait diversity in UK native woodland tree species. British Ecological Society Annual General Meeting, University of Hertfordshire, 5-7th September 2005.

Sutherland, B. G., Nier, S. & Russell, K. Improving UK broadleaved trees by assessing genetic and adaptive variation. Biodiversity for Breeding Symposium, NIAB Cambridge, December 13-14th December 2005.

Russell, K. The Walnut Club and Growing Walnut. National Fruit Show, 19-20th October 2005.

Website

Contribution the BIHIP walnut web page.

Several tours of Paradise Wood, the Northmoor Trust's research woodland, including the South West Forest, a delegation from Westonbirt arboretum, the Royal Forestry Society, Gloucestershire division, the Oxfordshire Woodlands Group, several private individuals and student groups.

Appendix 1. Phase I data by year and increment growth.

Site	Provenance	Ht 03	Ht 04	Inc 03-034	Ht 05	Inc 04-05
NMT	AU Altenworth	56.4	58.7	2.2	64.2	5.5
NMT	AU Seebarn	56.3	59.9	3.6	67.1	7.2
NMT	CR Bulk	57.7	59.6	1.9	65.5	5.8
NMT	SR Bulk	45.8	53.1	7.3	60.7	7.7
NMT	UK Bulk	32.7	43.5	10.8	54.6	11.2
No. Dead			1		19	
Site Mean		49.8	55.0	5.2	62.4	7.5
Lount	AU Altenworth	60.1	63.4	3.3	70.9	7.4
Lount	AU Seebarn	55.2	59.5	4.3	70.4	10.9
Lount	CR Bulk	56.6	60.1	3.5	68.7	8.6
Lount	SR Bulk	46.0	53.3	7.2	67.8	14.5
Lount	UK Bulk	37.3	44.8	7.5	60.1	15.3
No. Dead			2		2	
Site Mean		51.1	56.2	5.2	67.6	11.3

Appendix 2. Existing collections, planted in Phase I and II.

	Planting year	Provenances <i>n</i>	Progeny <i>n</i>	Populations <i>n</i>
European collections				
Austria	2003	2	15	
Czech Republic	2003	1	15	
France	2004	1	*	
Great Britain	2003 + 2004		8	1
Italy	2004		1	
Serbia and Montenegro	2004		1	
Slovak Republic	2003	1	3	
		5	43	1
US collections				
Alabama	2004	1	*	
Illinois	2004	2	*	
Indiana	2004	3	*	
Iowa	2004	1	*	
Kentucky	2004	2	*	
Maryland	2004	2	*	
Minnesota	2004	1	*	
Missouri	2004	1	*	
North Carolina	2004	1	*	
Ohio	2004	1	*	
Pennsylvania	2004	1	*	
Tennessee	2004	1	*	
Wisconsin	2004	3	*	
		20	0	

New selections, included in Phase III provenance and progeny trial

	Planting year	Provenances <i>n</i>	Progeny <i>n</i>	Populations <i>n</i>
European collections				
SB1	2005		*	1
SB2	2005		1	
SB3	2005		1	
SB6	2005		1	
SB7	2005		1	
FR6	2005		*	1
FR8	2005		*	1
FR9	2005		*	1
FR11	2005		1	
IT1	2005		1	
IT6	2005		1	
UK23	2005		1	
			8	4
US collections				
Oklahoma	2005	1	8	
		1	8	