

Forest Research Report 2006

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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Introduction

Four research trials exist at Lount Wood, Leicestershire. These are three black walnut, *Juglans nigra*, combined progeny and provenance trials, and a silviculture trial, investigating the effects of nurse species on various walnut species and hybrids. Details of these trials are provided in previous annual reports.

The trials at Lount were visited by staff from the Northmoor Trust and East Malling Research in October 2006. Figure 1 shows the layout of the black walnut trials at Lount and their relationship to each other.

This report summarises progress to date with these trials, and is submitted in fulfilment of the Annual Management Agreement between the National Forest Company and the Northmoor Trust. Details of further work that the National Forest may wish to undertake are included at the end.

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 of black walnut (*Juglans nigra* L.) material from across its natural range for 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. Five year measurements were recorded in 2006.

Trial design

There are four walnut species/hybrids in the trial: common walnut *Juglans regia*, black walnut *J. nigra*, hybrid MJ209 and hybrid NG23. There are two replicates for each walnut type, each with 17 different plot treatments (control (1), tree nurse + no shrub nurse (4), 4 tree nurse × 3 shrub nurse (12)). The total number of plots is therefore 17 × 4 walnut types × 2 replicates = 136 plots.

The nurse species fall into two groups:

Tree nurses comprising Italian alder (*Alnus cordata*), silver birch (*Betula pendula*), Japanese larch (*Larix kaempferi*), wild cherry (*Prunus avium*).

Shrub nurses comprising hazel (*Corylus avellana*), autumn olive (*Elaeagnus umbellata*) and elder (*Sambucus nigra*).

The six internal walnuts of each plot were measured for height and diameter at 60cm. It was noted that several walnuts were not of the type they were labelled as. As the leaves had already fallen, it was difficult to ascertain the true species or hybrid.

Data were analysed using Genstat v9.0 with analysis of variance using plot means. The analysis of variance (Appendix 1) revealed no significant difference for any treatment, although block and walnut were both significant factors (p 0.004 and <0.001 respectively) for height. Black walnut (*Juglans nigra*) were significantly shorter than the other walnuts, but these were also shorter at planting time (Table 1). Height data for the various treatments (non – significant) is given in Appendix 2.

Table 1. Mean height (cm) in 2002 and 2006 for the four walnut species at Lount.

	MJ209		NG23		<i>nigra</i>		<i>regia</i>	
	2002	2006	2002	2006	2002	2006	2002	2006
Block 1	75.0	181.4	84.2	186.8	54.1	122.7	82.2	166.1
Block2	60.1	147.1	70.6	147.1	49.7	137.0	61.7	167.4

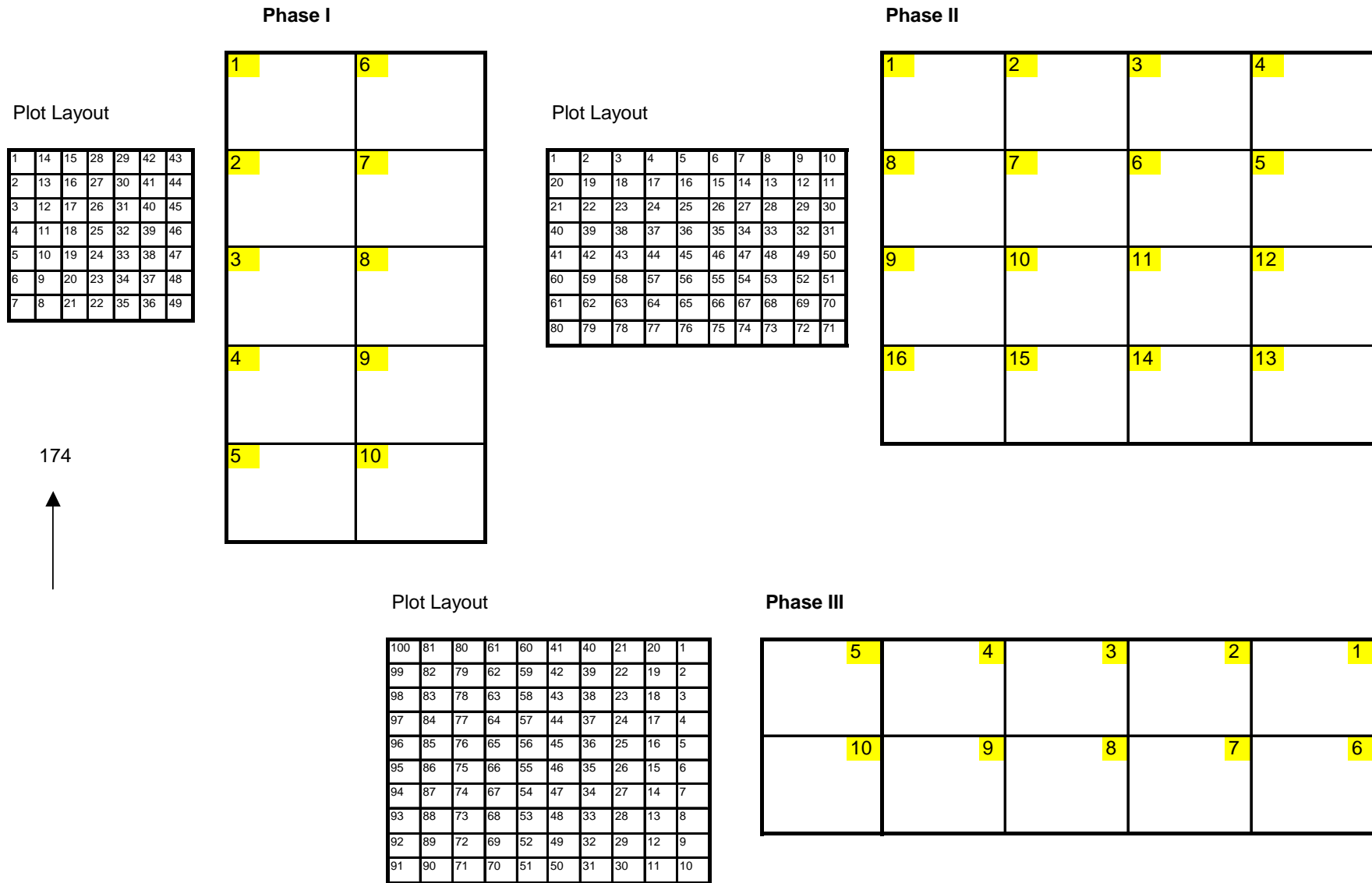


Figure 1. Layout of Black Walnut Trials at Lount Wood.

Black Walnut Progeny/Provenance Trials

The black walnut trials comprise three phases, planted of European and American material in three successive years from 2003 to 2005.

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, 2003).

There were significant differences for height between provenance and sites ($p < 0.001$) and between replicates (Table 2). There were no differences for height between sites at planting time (Hemery and Russell, 2003). Incremental growth at Lount was on average 77% greater than at Little Wittenham (Figure 2).

Table 2. Analysis of variance for Phase I of the black walnut provenance and progeny trial, based on plot means.

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Site	1	6006.86	6006.86	270.24	<0.001
Site * Rep	18	1021.40	56.74	2.55	0.003
Provenance	4	2123.65	530.91	23.89	<0.001
Site * provenance	4	259	64.95	2.92	0.027
Residual	67	1600.39	22.23		
Total	99	11012.11			

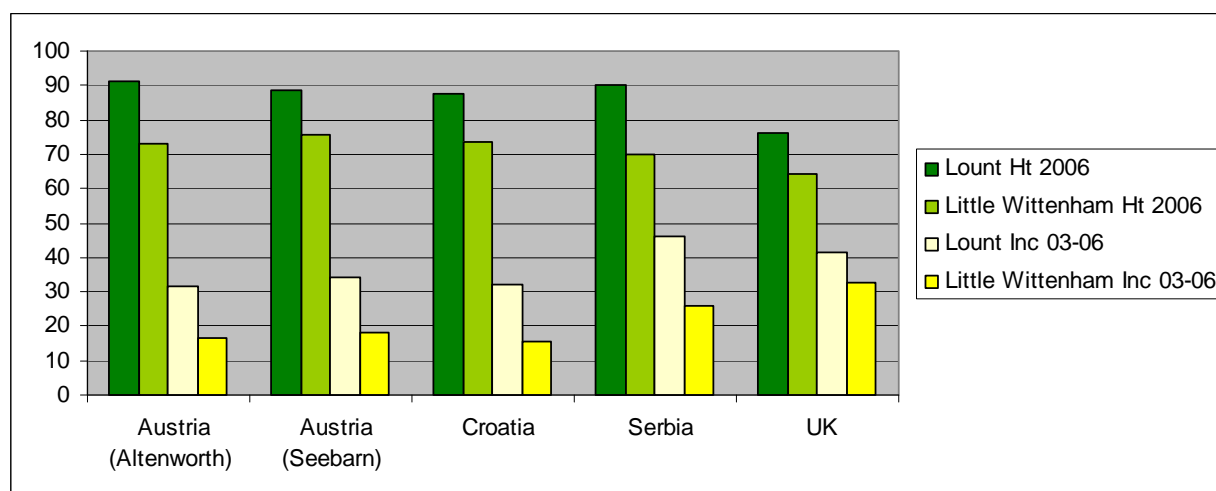


Figure 2. Mean height (cm) of European provenances of black walnut recorded in 2006, and increment since planting.

Phase II

Phase II was established in 2004 with trees from 20 provenances from the USA, one from France, one British population, and two progeny from Italy and Serbia and Montenegro. Details of these including number of trees in each population or provenance are given in Appendix 3.

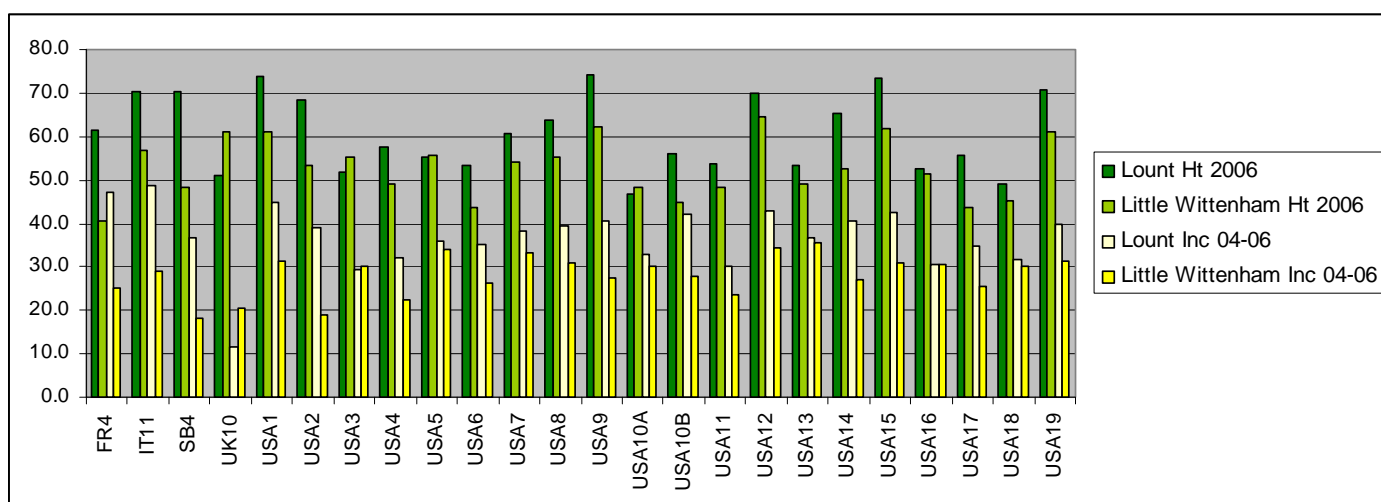


Figure 3. Mean height (cm) of north American provenances of black walnut recorded Phase II in 2006, and increment since planting.

Phase III

Phase III was planted in February 2005 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. Table 3 lists those trees that are additional for the 2004 Phase II planting.

Table 3. Additional accessions in Phase III of the black walnut Progeny and provenance trials.

	Planting year	Provenances <i>n</i>	No. of trees	Progeny <i>n</i>	Populations <i>n</i>
European collections					
SB1	2005		2	*	1
SB2	2005		1	1	
SB3	2005		1	1	
SB6	2005		1	1	
SB7	2005		1	1	
FR6	2005		2	*	1
FR8	2005		2	*	1
FR9	2005		2	*	1
FR11	2005		1	1	
IT1	2005		1	1	
IT6	2005		1	1	
UK23	2005		1	1	
				8	4
US collections					
Oklahoma	2005	1		8	
		1		8	

Eight trees were collected from Oklahoma, a year after all other US collections. These were not bulked and so progeny identity is retained for these accessions. Labelled NMT 1-8 by the nursery, these are labelled USA 20-27 for trial purposes and only appear in Phase III. Where seed from more than one tree are included in an accession, but less than ten, this has been termed a population. More than ten individuals, is termed a provenance.

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.

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.

Required Work Programme for 2007

Walnut Silviculture Trial

1. Remove guards from all trees
2. Prune walnut trees for formative pruning.
3. Carry out form assessment prior to pruning
4. Identify each walnut as many are not the species labelled and spray paint incorrect trees.

Black Walnut Trials

1. Ensure all tags are present and correct
2. Measure Phase I and III

Other Work Proposals to Discuss

1. Black walnut form is very poor in the silviculture trial. Stump the non-test trees as an investigation in to stumping of walnut
2. Walnut species and hybrids demonstration area with information board.
3. Walnut trees for nut production demonstrations.
4. Phenology work – spring and autumn.
5. The establishment of quality trees in small blocks in failed farm woodland plantings as demonstration.
6. Walnut Day in the National Forest.

Technology Transfer

Papers

Russell, K. (2006). Walnut Research at East Malling Research. *FAO-CIHEAM - NUCIS Newsletter 13*, December 2006, p59.

Clark, J.R. & Russell, K. (2006). Forest Research Report 2005: Walnut Trials at Lount, National Forest. Annual Management Agreement Contract Report, pp10.

A cracking nut. Countryman, October 2006, p68-70.

Cracking Tree Growth. The Oxford Times, 7th April 2006, p14.

Visits and networking

1. Canadian Grower Neil Thomas, tour of Paradise Wood
2. Wallace Weir – growth models for walnut
3. Henry D'abo – Estate in Cambridgeshire, tour of Paradise Wood
4. Clive Simms – e mailed from Hugh.

Presentations

Karen Russell gave an invited presentation at the International Seed Federation Tree and Shrub Group conference, Stratford, 28th August on tree improvement at EMR and the British & Irish Hardwoods Improvement Programme.

Events

Karen Russell attending the National Fruit Show, Detling, Kent, 18-19th October 2006 and judged the first UK walnut competition to be held since the 1930s. Various small articles appeared in Show literature and national press.

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.

Walnut Silviculture Trial

Appendix 1. Analysis of variance for walnut height 2006 based on plot means for the walnut silvicultural trial.

Source of variation	d.f.	s.s.	m.s.	v.r	F pr.
Block	1	9110	9110	8.78	0.004
Walnut	3	35000	11667	11.25	<0.001
Treatment	1	947	947	0.91	0.343
Walnut × Treatment	3	651	217	0.21	0.890
Treatment / tree nurse	3	1760	587	0.57	0.640
Treatment / shrub nurse	3	3412	1137	1.10	0.357
Walnut × treatment / tree nurse	9	5113	568	0.55	0.834
Walnut × treatment / shrub nurse	9	10031	1115	1.07	0.393
Treatment / (tree nurse × Shrub nurse)	9	1341	149	0.14	0.998
Walnut × treatment / (tree nurse × shrub nurse)	27	16898	626	0.60	0.927
Residual	67	69501	1037		
Total	135	153764			

Appendix 2. Mean height (cm) of walnuts in 2006 with various tree nurse and shrub nurse treatments.

		elaeagnus	elder	hazel	none
MJ209	alder	178.8	152.1	128.7	192.5
	birch	190.5	120.2	161.0	166.8
	cherry	182.1	149.8	148.2	155.5
	larix	179.4	174.0	170.9	164.2
	none	*	*	*	167.6
NG23	alder	188.5	187.0	183.1	149.3
	birch	179.2	144.1	159.0	180.2
	cherry	161.8	141.5	163.3	179.4
	larix	180.6	127.9	173.2	170.9
	none	*	*	*	147.4
nigra	alder	148.3	124.0	121.7	148.3
	birch	132.0	151.0	111.9	129.4
	cherry	124.0	138.5	116.3	110.4
	larix	138.6	123.1	114.0	133.8
	none	*	*	*	117.2
regia	alder	158.0	173.6	211.7	162.8
	birch	146.1	179.3	164.1	168.6
	cherry	191.9	178.0	181.4	165.3
	larix	145.6	133.8	169.9	153.7
	none	*	*	*	150.0

Appendix 3. Details of the north American original accessions as planted in Phase II.

Code	State	County	No. of Trees
USA1	Alabama	Tallapoosa	15
USA2	Illinois	Vermillion	15
USA3	Illinois	Sangamon	11
USA4	Indiana	Tippecanoe	30
USA5	Indiana	Sullivan	15
USA6	Indiana	Marshall	18
USA7	Iowa	Boone	10
USA8	Kentucky	Fayette	15
USA9	Kentucky	Hardin	15
USA10a	Maryland	Howard	15
USA10b	Maryland	Washington	10
USA11	Minnesota	Olmsted	10
USA12	North Carolina	Burke	11
USA13	Ohio	Delaware	15
USA14	Pennsylvania	Mifflin	15
USA15	Tennessee	Greene	15
USA16	Wisconsin	Grant	14
USA17	Wisconsin	La Crosse	15
USA18	Wisconsin	Rock	15
USA19	Missouri	Howard	15