



Forestry Research Report 2010

Walnut Trials at Lount Wood, National Forest

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Northmoor Trust

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This report is submitted to fulfil the Annual Management Agreement between the National Forestry Company and the Northmoor Trust for financial year 2010 – 2011. This comprised data collection and analysis of Phase III of the black walnut progeny and provenance trial located at Lount Wood in the National Forest.

Introduction

The walnut research carried out at Lount Wood in the National Forest has been running for a number of years and is concerned with the genetics and silviculture of growing quality walnut for timber. The oldest trial, planted in 2001 to investigate a silvicultural system, utilises two species (*Juglans regia* and *J. nigra*) and two hybrids of walnut (MJ209 and NG23), established with various nurse combinations to help optimise growth and form. A series of black walnut (*J. nigra*) progeny and provenance trials was established from 2003-2005 to ascertain which provenances are most suited to growing in British conditions.

Phase III is a combined progeny and provenance trial, comprised of 10 reps (each of 100 trees) of material largely from the USA, but also includes progeny from European sources. The trial is an incomplete randomised block design with single tree plots.

USA 1-19 are bulked provenances, whereas USA 20-27 are all from single selected plus trees from Oklahoma. These eight progeny can be combined to provide provenance data for Oklahoma, and bring the total to twenty US provenances. The European material in the trial also comprises individual progeny and some provenance data. Details are given in appendix 1.

Data collection and analysis

During winter 2010, the third phase of the black walnut trial (p2005) was measured by staff from the Northmoor Trust for survival, growth, and form. Growth was measured to the nearest centimetre. Form was assessed using a four point score, where 1 was a perfect tree and 4 a very poor tree. A perfect tree retains its apical dominance and shows no dieback. A tree with a score of 2 shows some dieback but the general growth pattern is still vertical (apical dominance is retained). A tree with a score of 3 has significant dieback and it is not clear which shoot is the leader. The leader is often no longer central. A tree with a score of 4 shows multiple leaders and shows no apical dominance. Such trees have a 'toffee apple' appearance

Those trees that still had green leaves firmly attached were also recorded to give an indication of growth cessation for the year and hence overall tree growth.

Although the trial is replicated at Little Wittenham, south Oxfordshire (and data were collected also), only data from Lount are presented here as chemical damage to the trial at Little Wittenham resulted in significant dieback. Data were analysed with Genstat 10th edition and the analysis of variance used was rep*prov.

Results

Survival remained high at 92.4% with 76 trees dead. This shows a slight decrease from 2009, where survival was 93.1% (69 dead). After the mortality seen during the establishment stage, survival should remain at this level now.

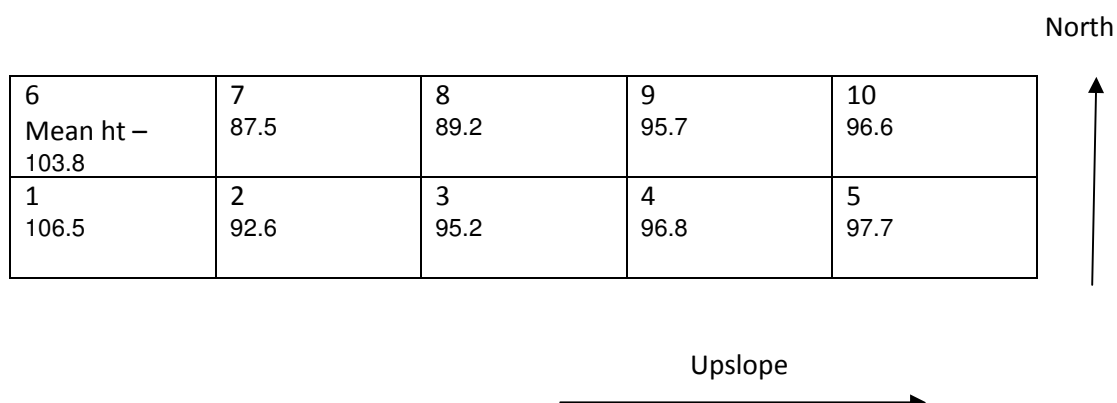
For height growth, both rep and provenance were highly significant at the $p < 0.001$ level, but there was no interaction (Table 1).

Table 1. Analysis of variance for tree height of the black walnut Phase III provenance and progeny trial, five years after planting.

Source	<i>d.f.</i>	<i>m.s.</i>	<i>v.r.</i>	<i>p</i>
Provenance	24	563.1	2.28	< 0.001
Rep	9	3214.1	13.02	< 0.001
Provenance x Rep	209	230.2	0.93	0.726
Residual	681	246.9		
Total	923	280.3		

When looking at mean walnut height by rep, the site effect becomes apparent, making rep a significant factor. Height increased with the increase in slope, with the anomaly of the two best reps (in terms of height growth) being at the bottom (Figure 1).

Figure 1. Trial layout of the black walnut progeny and provenance trial Phase III at Lount Wood, showing mean height (cm) for each rep.



Growth data were analysed at both the progeny and provenance level. Both were highly significant ($p > 0.005$ and $p > 0.002$ respectively). Although differences in form were apparent, these data were not significant. Details of growth and form are given in table 2.

Table 2. Mean height (cm), incremental growth and form for progeny and provenances of the black walnut Phase III trial, at Lount Wood. The four best and four worst performing progeny/provenances are highlighted in green (best) are red (worst). Data are ranked by mean height.

Code	mean height (cm)	% increment (2009-2010)	mean form (1-4)
USA 27	113.7	8.0	2.6
FR 10	113.3	10.5	3.0
USA 26	109.0	7.3	3.3
USA 23	105.3	3.7	2.3
FR 11	105.2	8.6	2.8
USA 15	104.2	5.3	2.6
IT 4	103.3	9.1	2.3
USA 25	102.5	7.9	3.3
USA 4	101.6	7.9	2.8
IT 9	101.3	9.4	2.0
FR 8	101.0	10.7	2.3
USA 5	100.6	7.0	2.7
FR 9	100.0	7.2	3.8
USA 10A	99.5	5.3	2.6
USA 12	99.4	8.0	2.7
USA 21	98.8	4.5	3.0
USA 1	98.5	4.8	2.8
USA 6	98.1	6.7	2.7
USA 24	97.9	9.4	3.1
USA 18	97.7	9.1	2.6
USA 3	97.6	5.1	2.7
USA 9	97.2	5.1	2.7
USA 13	97.0	4.8	2.5
USA 20	97.0	6.6	2.9
USA 14	96.8	5.7	2.8
USA 2	96.5	7.4	2.5
USA 19	96.2	0.5	2.6
USA 8	95.4	4.2	2.7
FR 6	94.9	8.2	3.0
USA 22	94.8	8.9	2.7
SB 1	94.2	3.8	2.6
FR 5	94.0	4.9	3.0
USA 16	93.8	11.0	2.4
SB 6	92.6	5.9	2.4
UK 23	92.3	5.9	2.5
IT 6	92.2	7.1	2.5
SB 3	92.0	5.1	2.8
USA 7	91.6	10.2	2.5
USA 11	91.0	4.0	2.6
USA 17	90.5	7.3	2.5
SB 7	90.3	5.7	2.3
IT 1	90.2	10.0	2.7
USA 10B	88.8	8.1	2.7
IT 8	86.0	7.1	2.3
SB 5	83.0	5.7	2.0
SB 2	80.4	14.1	2.0
FR 7	72.3	2.1	3.7

Discussion

Table 2 indicates which progeny/provenances are performing well for any given criterion. Ranked by height 2010, it shows that progeny USA 23, 26, 27 and FR 10 are the tallest. Progeny FR 10 has also shown the greatest height growth increment. USA 23, 26 and 27 are all single tree selections from Oklahoma, showing that this material is currently outperforming all other material from any other US state. However, four of the eight progeny from Oklahoma are also in the bottom six ranked for form (USA 21, 24, 25, and 26). Conversely, material from Serbia showed some of the poorest growth rates (SB 2 and 5) although both rank high for form as did SB 7. Thus, progeny from trees selected from Oklahoma exhibit good growth rates but poor form (apical dominance). This could be due to early flushing, enabling the tree to capture more resources, but potentially suffering from late spring frosts resulting in the observed poor form and lack of apical dominance, whereas trees from Serbia could be late flushing and therefore escape any spring frosts.

Data were collected in mid October 2010, when it was possible to see which trees still had green leaves firmly attached. Exactly half (29 out of 58, data not presented) trees from Oklahoma still had leaves on compared to the next highest US provenance (USA15, Tennessee) which had 7 out of 24 trees still with green leaves. No tree from the UK had green leaves still present (ranked joint 11th out of 48 for form). It would be interesting to score spring phenology to see if early flushing individuals exhibit a) poorer form due to frost damage and b) increased growth rate due to increase resource capture.

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Appendix 1. Details of the material planted in Phase III (2005) of the black walnut progeny and provenance trial, at Lount Wood in the National Forest.

Code	Progeny/ State	Prov/ County	no. of trees	Provenance
FR 5	NG241	Castillon area (near Bordeaux)	2	France
FR 6	NG242	Branne (near Bordeaux)	2	France
FR 7	NG243		1	France
FR 8	NG244		2	France
FR 9	NG245		3	France
FR 10	NG E 74010		1	France
FR 11	NG E 74015		1	France
IT 1	ISP1		1	Italy
IT 4	ISP4		1	Italy
IT 6	ISP6		1	Italy
IT 8	ISP8		1	Italy
IT 9	ISP9		1	Italy
SB 1	Belgrade		2	Serbia
SB 2	CA1		1	Serbia
SB 3	SK		1	Serbia
SB 5	IT1		1	Serbia
SB 6	IT2		1	Serbia
SB 7	IT3		1	Serbia
UK 23	Battersea Park	London	1	UK
USA 1	Alabama	Tallapoosa	15	Tallapoosa
USA 2	Illinois	Vermillion	15	Vermillion
USA 3	Illinois	Sangamon	11	Sangamon
USA 4	Indiana	Tippecanoe	30	Tippecanoe
USA 5	Indiana	Sullivan	15	Sullivan
USA 6	Indiana	Marshall	18	Marshall
USA 7	Iowa	Boone	10	Boone
USA 8	Kentucky	Fayette	15	Fayette
USA 9	Kentucky	Hardin	15	Hardin
USA 10A	Maryland	Howard MA	15	Howard
USA 10B	Maryland	Washington	10	Washington
USA 11	Minnesota	Olmsted	10	Olmsted
USA 12	North Carolina	Burke	11	Burke
USA 13	Ohio	Delaware	15	Delaware
USA 14	Pennsylvania	Mifflin	15	Mifflin
USA 15	Tennessee	Greene	15	Greene
USA 16	Wisconsin	Grant	14	Grant
USA 17	Wisconsin	La Crosse	15	La Crosse
USA 18	Wisconsin	Rock	15	Rock
USA 19	Wisconsin	Howard MI	15	Howard
USA 20	OK1	Oklahoma	1	Oklahoma
USA 21	OK2	Oklahoma	1	Oklahoma
USA 22	OK3	Oklahoma	1	Oklahoma
USA 23	OK4	Oklahoma	1	Oklahoma
USA 24	OK5	Oklahoma	1	Oklahoma
USA 25	OK6	Oklahoma	1	Oklahoma
USA 26	OK7	Oklahoma	1	Oklahoma
USA 27	OK8	Oklahoma	1	Oklahoma