Forestry Research Report 2009

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

Jo Clark

Forestry Research Manager, 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 in October 2009 to assess the black walnut trials (Phase II and III only) and the stumping of the silviculture trial.

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.

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 (walnut silviculture trial).

2. To evaluate planting mixtures which create, in line with aim one, additional financial and environmental incentives to landowners (walnut silviculture trial).

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 (black walnut progeny and provenance trials, Phases I, II and III).

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 and details can be found in the report for that year.

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 $\times$ 3 shrub nurse (12)). The total number of plots is therefore 17 $\times$ 4 walnut types $\times$ 2 replicates = 136 plots.

The nurse species fall into two groups:
1. Tree nurses comprising Italian alder (*Alnus cordata*), silver birch (*Betula pendula*), Japanese larch (*Larix kaempferi*), and wild cherry (*Prunus avium*).

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

Stumping of walnut

Due to the poor form of many of the walnut, stumping was carried out with two treatments. Block 1 was stumped in July 2007 (summer treatment) and block 2 in November 2007 (winter treatment). Assessments (height of leader, number of competing leaders and number of strong and weak shoots) were carried out in October 2008. Many of the competing shoots were removed by Forestry Commission staff in July 2009, in most cases leaving a single leader. The trees were assessed again in October 2009 and height and competing leaders recorded.

Survival

In 2008, survival in Block 1 was 91% (14 trees dead) and also 91% in block 2 (21 trees dead). Mortality increased during the 2009 growing season with an additional 33 trees dying (Table 1). In the majority of cases, this was due to weak regrowth following stumping which was then unable to compete with vegetation (mainly rank grass) around the base of the walnuts.

Table 1. Numbers of walnut stumped summer 2007 (Block 1) and winter 2007 (Block 2) by species, and survival in October 2008 and 2009.

	Number stumped	Survival 08	Survival 09
Block 1			
regia	30	29	27
nigra	70	63	53
MJ209	26	22	21
NG23	38	36	35
Block 2			
regia	24	24	22
nigra	81	74	62
MJ209	66	63	62
NG23	55	47	43
	390	358	325

The overall mean height of regrowth in 2008 (regardless of species or treatment) was 90cm. All but five of the 33 trees that resprouted in 2008, but died in 2009 were below 50cm in height. Where the regrowth was vigorous, and the shoot well clear of the competing vegetation, survival was excellent. Four trees recorded as dead in 2008 sprouted in 2009: these were two NG23s from Block 2 (winter stumping) and two *nigras* from Block 1.

In both summer and winter treatments mortality of the black walnut (*Juglans nigra*) was highest, as these were the smallest trees, with the poorest form.

Figure 1 shows mean height of walnuts after stumping and a year later, once they had been singled. Table 2 shows the same data including percentage increment for each species by treatment. In some cases, height growth was exceptional, especially within the hybrid NG23. The tallest tree overall was a *J. nigra* at 355cm after the second growing season. It should be pointed out that this particular tree was accompanied by the two nitrogen fixing nurses – Elaeagnus and Italian alder. The tallest *regia* was 214cm, the tallest NG23, 350cm and the tallest MJ209 278cm. Overall mean height across all walnuts and all treatments was 131cm in 2009.

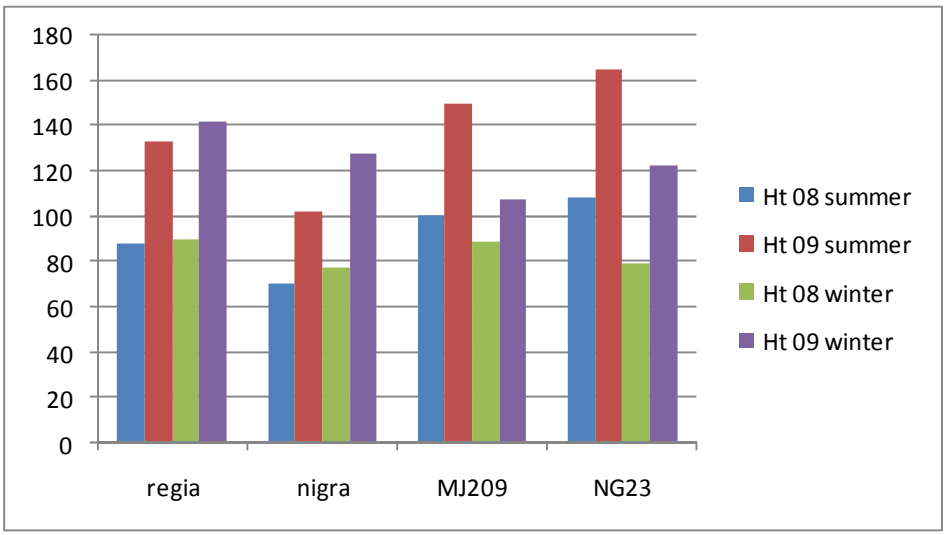

Figure 1. Mean height (cm) of walnut regrowth by species, comparing summer (July 2007) and winter (November 2007) stumping.

Table 2. Mean walnut height by treatment and species in 2008 and 2009, and percent height increment, based on block means by species.

Block	Walnut	Ht 2008	Ht 2009	% Inc
1	ng23	108	165	48
1	mj209	101	150	40
1	nigra	71	102	39
1	regia	88	133	43
2	ng23	80	123	51
2	mj209	89	107	20
2	nigra	77	128	47
2	regia	90	142	43

Overall, the stumping has yielded outstanding results. Only those individuals that exhibited very poor form were stumped. At time of planting, shelter would have been virtually non existent. Six years later, when the walnuts were stumped, the surrounding nurse species were well established and providing shelter, and, in the case of the Italian alder and the Elaeagnus, also providing nitrogen to the walnuts. While leaf samples were not taken from the walnuts at Lount, this was done at other sites where it was found that all walnuts were deficient in nitrogen except those accompanied by the Elaeagnus nurse, and two nitrogen fixing nurses yielded greater levels of nitrogen in the walnuts.

Survival remains high at 83% overall. Additional mortality was almost entirely due to emerging walnut shoots being swamped by competing vegetation – usually a very dense grass sward. As the walnuts in the main are now growing so well, it is unlikely that there will be further mortality due to vegetation.

Most importantly, the form of the walnuts is vastly improved. There remains a small amount of singling to be carried out, but nearly all walnuts were of a single stem with a persistent leader as seen in Figure 2.

Figure 2. Exceptional examples of walnut regrowth.

Above left: Black walnut, *J. nigra*, two years after stumping in winter.

Above right: More typical black walnut, showing excellent form, post singling.

Left: Common walnut, *J. regia*, two years after stumping.

In all pictures, the surveyors hand indicates the extent of the first year's growth.

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. The trials were visited in October 2009 and Phase II and III were measured.

Phase II

Phase II was established in 2004 comprising four European and twenty north American provenances. Details of this trial can be found in the Forestry Research Report for 2004.

Height to the nearest centimeter was recorded and the data analyzed with Genstat 10th Edition using plot means. The model of the variance of analysis used was: *site + site × prov.*

Table 2. Analysis of variance for tree height five years after planting for Phase II of the black walnut provenance and progeny trial, based on plot means.

Source of variation	*d.f.*	*m.s.*	*v.r*	*p*
Site	1	161150.8	482.23	<.001
Prov	23	1548.9	4.63	<.001
Site × Prov	23	733.7	2.20	0.001
Residual	606	334.2		
Total	653			

At time of planting, there were no significant differences between sites, although there were between provenances. By year 5, site as well as provenance, was highly significant (p>0.001, Table 2). Figure 3 shows the mean height by provenance at both sites five years after planting.

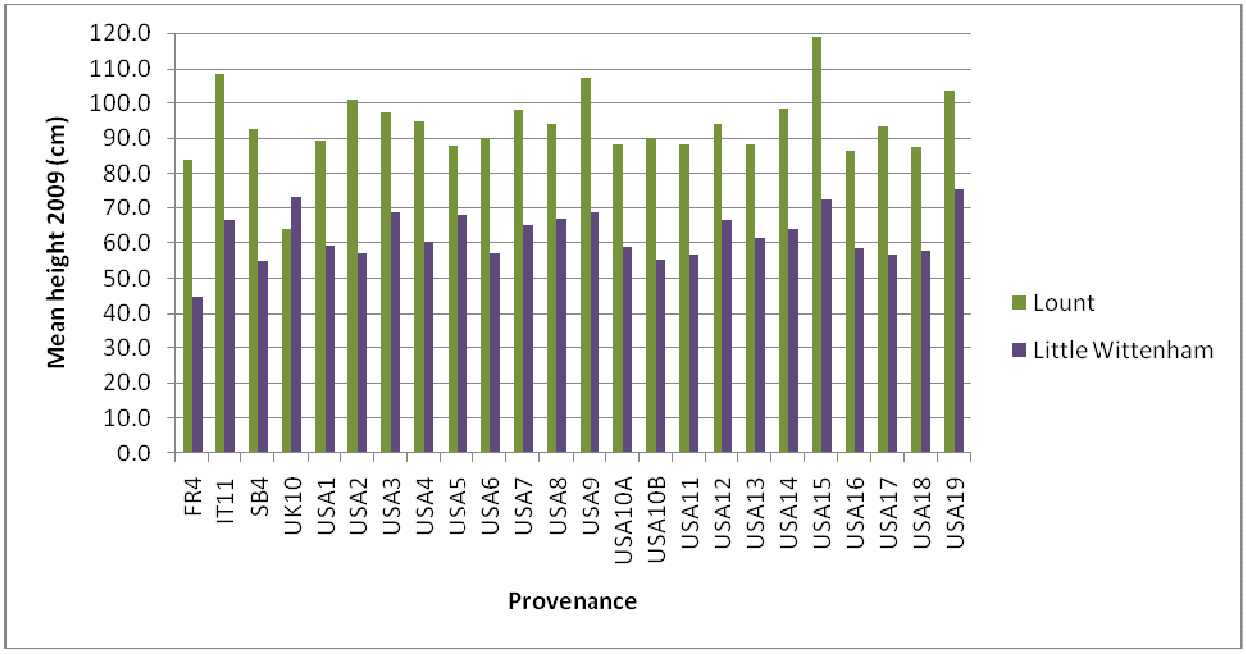

Figure 3. Mean height of black walnut provenances (Phase II) at year 5.

Growth is disappointingly low for five year old trees. Walnut is notorious for not likely to be transplanted. The mean increment for the firth growing season for Phase I, measured in 2008, was 13.1 cm for all walnuts at Lount and 7.3cm for walnuts at Little Wittenham. The increment for fifth growing season for Phase II, measured in 2009, was only 8.3cm for Lount and 2.3cm for Little Wittenham (Figure 4). Three provenances at Little Wittenham (France 4, Serbia 4 and USA 2) and two provenances at Lount (UK 10 and USA 3) have in fact decreased in mean height from the previous year. At little Wittenham, many of the trees were showing signs of chemical damage and much dieback as the trees are in spirals. No such damage was observed at Lount where the trees are in tubes, so it was disappointing to see negative growth for some provenances for no obvious reason. The site is quite exposed. Once all the trees are fully out of the tubes, it will be possible to score flushing data to ascertain which provenances are more prone to frost damage, and thus dieback.

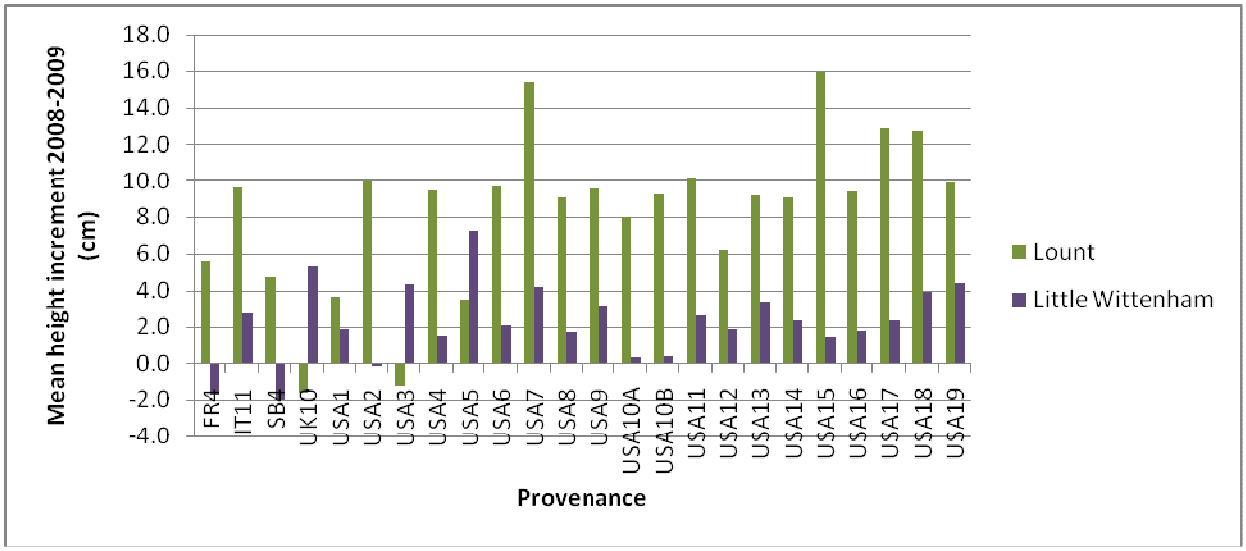

Figure 4. Mean increment for 2008 – 2009 of black walnuts (Phase II) at both Lount and Little Wittenham.

Phase III

Phase III was established in 2005 comprising 28 provenances from north American and 19 from Europe (7 French, 5 Italian, 6 Serbian and 1 British). Details of this trial can be found in the Forestry Research Report for 2005.

Survival and height to the nearest centimeter were recorded and the data analyzed with Genstat 10th Edition using plot means. The model of the variance of analysis used was: *site + site × prov.*

Survival at Lount has deceased from 2008 (97%), when there were 26 trees dead, to 69 trees dead in 2009 (93% survival). Some of the mortality in 2009 is attributable to mowing. There were 36 trees dead at Little Wittenham in 2008 (96% survival), and 49 trees dead in 2009 (95% survival). The increased mortality at Little Wittenham is of those trees that were very poor in 2008, many less than 20cm in height.

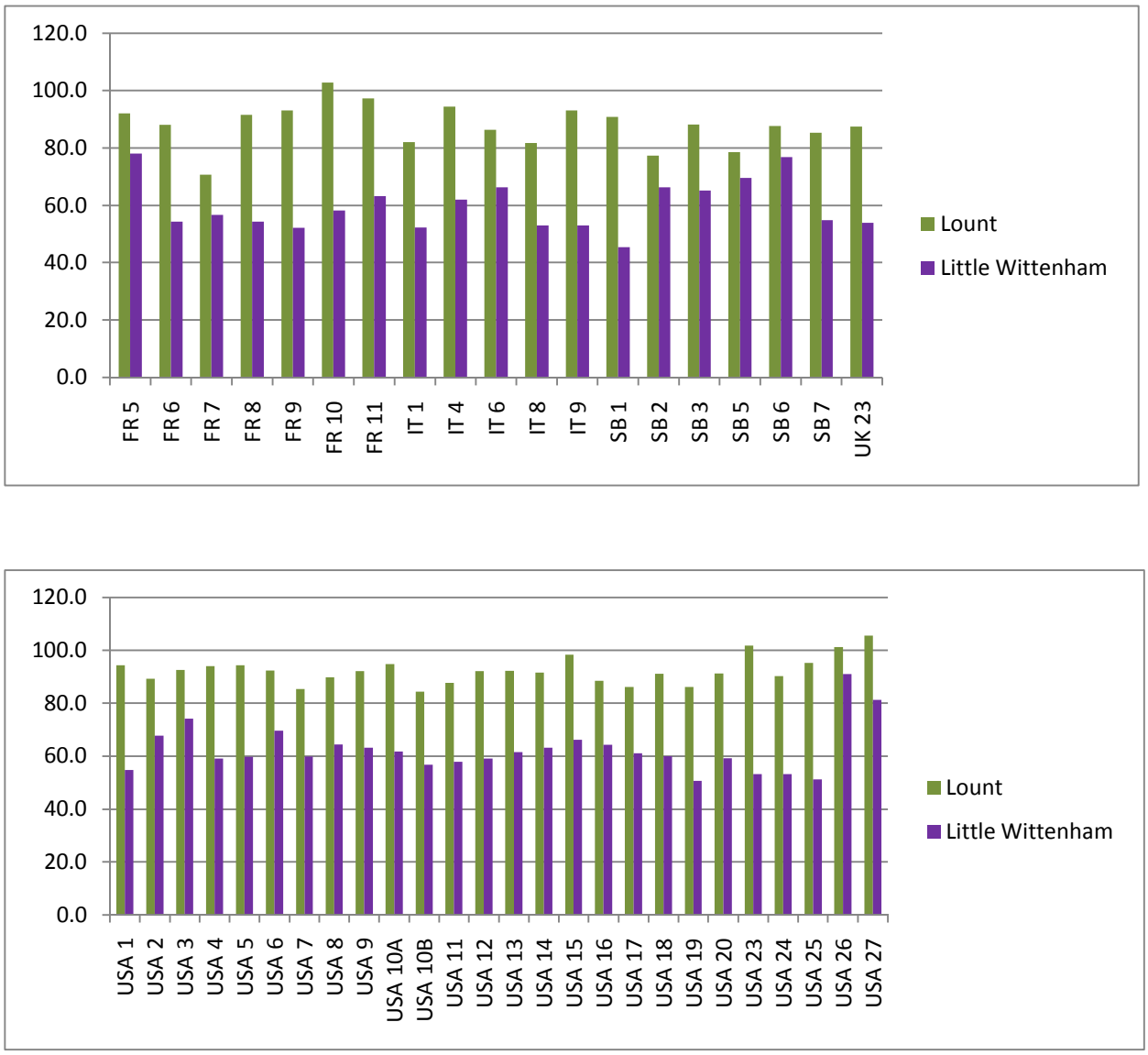

Figure 5. Mean height of black walnuts provenances (Phase III) at year 4.

Both site and provenance are significant factors affecting height growth, although there is no significant interaction (Table3). Phase III appears to be growing well in comparison to Phase II which is a year older. Trees at Lount consistently outperform those at Little Wittenham for all Phases of planting.

Table 3. Analysis of variance for tree height four years after planting for Phase III of the black walnut provenance and progeny trial, based on plot means.

Source of variation	*d.f.*	*m.s.*	*v.r*	*p*
Site	1	138065.2	570.24	<.001
Prov	46	612.7	2.53	<.001
Site × Prov	46	340.0	1.40	0.044
Residual	599	242.1		
Total	692			

General Comments

The black walnut trials are looking excellent. Phase III will be 5 years old in 2010 when a more detailed assessment will be carried out. Phase I will not now be re-measured until year 10 in 2013 and Phase II in 2014. There will be no work required on the black walnut trials in 2012. It would be useful to carry out flushing assessments of all black walnuts and this would be easiest once the trees are completely out of the tubes: 2013 or 2014 would be appropriate.

The silviculture trial was also looking excellent, and the regrowth showed superb form. The stumping has proved to be very beneficial and the results justify the additional work involved. There is a small amount of singling required.

Required Work Programme for 2010/2011.

Walnut Silviculture Trial

1. Singling of the remaining walnuts to be carried out by FC staff.

Black Walnut Trials

1. Year 5 assessments for Phase III.