

Forestry Research Report

2008/9

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 in October 2008 to assess the black walnut trials (Phase I 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. 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 (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 17×4 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 summer 2007 and assessed in November 2007. Details of this can be found in the National Forest Research Report for 2007. Block 2 was stumped in November 2007 and assessed the following winter in October 2008. Block 1 was reassessed at the same time.

Survival in Block 1 was 91% with 14 trees dead. Eight of these had simply died, but four had been mown and 2 had died due to swamping by the *Elaeagnus*. In block 2, survival was also 91% with 21 dead, with 16 not resprouting, and five being mown. Other walnuts in both blocks had suffered mower

damage, but not been killed by this. It was noted that many of the *Elaeagnus* had been badly damaged, presumably by machinery forcing its way through the rows. *Elaeagnus* branches are quite brittle.

Table 1. Numbers of walnut stumped summer 2007 (Block 1) and winter 2007 (Block 2) by species. Numbers differ slightly from those stated in the Research Report for 2007.

	Number stumped
Block 1	
regia	30
nigra	70
MJ209	26
NG23	38
Block 2	
regia	24
nigra	81
MJ209	66
NG23	55

Block 1 was initially assessed May 2008 (see the report for 2007) and although regrowth was good, there had been much damage from browsing and frost. All walnuts in both blocks were assessed in October 2008. Data recorded were height of the tallest shoot to the nearest centimetre, the number of strong (> 20cm) and weak (< 20cm) shoots, and the number of competing leaders.

It was observed while assessing Block 1 that although stumps had sprouted the same summer trees were stumped, these new shoots suffered much manage before the commencement of the next growing season. In spring 2008, entirely new shoots were produced by the stump, and had quickly overtaken any remaining growth from the previous year. This would suggest that it is not beneficial to the tree to stump in the summer.

Figure 1 shows the mean height, by species and treatment of the stumped walnuts. Interestingly, although having a shorter growing period, the regia and nigra both put on more growth with the winter treatment. The two hybrids, MJ209 and NG23 put on more growth (new growth, from the base) with the summer treatment. Both hybrids also grew more than either of the true species, although the regia also showed good vigour. The poorest performer was always the nigra, but it should be pointed out that these were much the poorest trees before stumping, and had many more individuals stumped, and diameter of the stump (not measured) was substantially less than either of the hybrids or the regia.

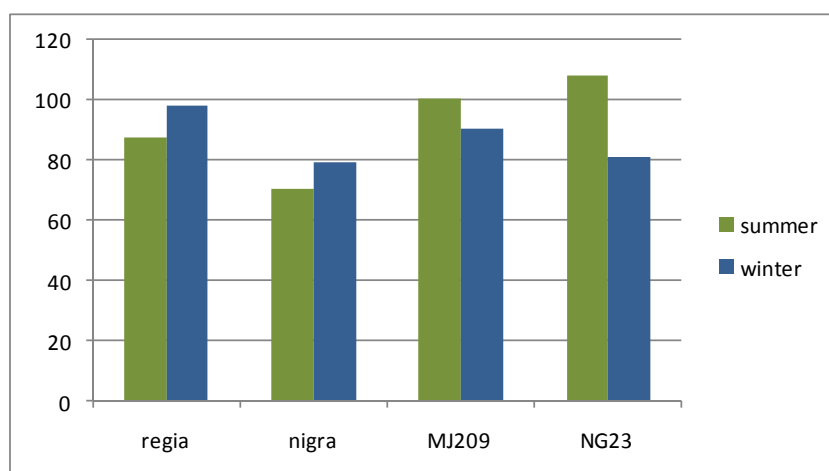


Figure 1. Mean height (cm) of walnut regrowth by species, October 2008, comparing summer (July 2007) and winter (November 2007) stumping.

The number and strength of all the shoots was also recorded, as was the number that were competing with the leader. Figure 2 shows the mean number of shoots by species and treatment. It is evident that a summer treatment produces fewer shoots in total, and fewer competing leaders in all species with the exception of MJ209 where fewer shoots were produced by those walnuts receiving the winter treatment. Where fewer shoots were produced, the height in of the individual shoots was much greater.

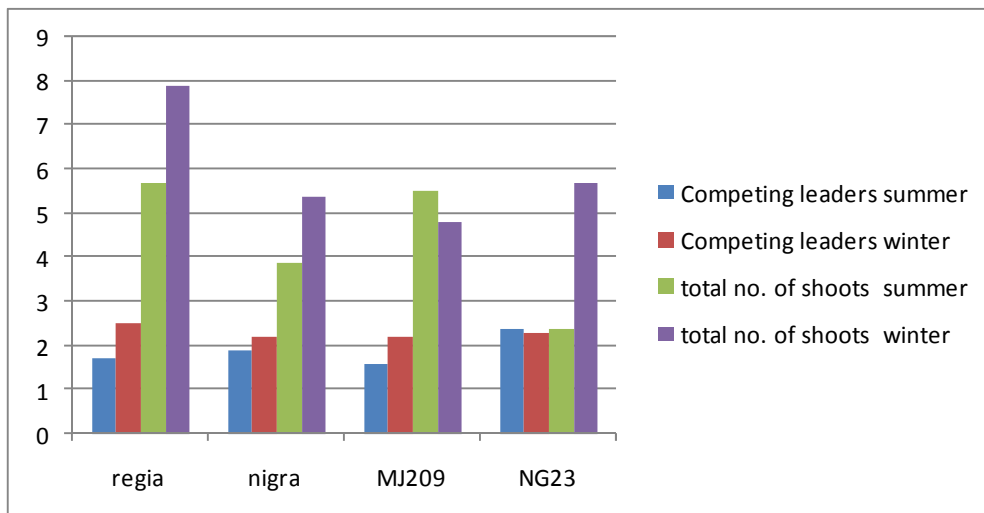


Figure 2. Comparison of mean number of competing leaders and total number of shoots between summer and winter stumping by species.

Thus, in summery, survival of walnuts after stumping is very high (91%) and given the resulting strength and form of shoots in one year, worth carrying out. Walnuts initially respond well to a summer treatment, but the shoots would appear to not have long enough to harden off properly and frost damage is therefore high. Shoots the following spring arise from the rootstock and the existing shoots do not put on much growth, if at all, and are overtaken by new shoots, indicating a winter treatment more successful in producing a stronger tree. However, substantially more shoots are produced by a winter treatment, and more of these compete with the leader.

If the objective is still to produce quality timber, the walnuts will need to be singled. A second assessment would be very interesting to investigate to what extent the walnuts single themselves. Figure 3 illustrates the range of results of stumping from producing virtual bushes to trees with two or three superb stems.



Figure 3. Walnut with many new shoots, and only moderate height. All stems competing equally.



Figure 4.

Left: slightly better, as although there are still multiple new shoots, they are not competing equally.

Below left: a very good walnut, with 3 competing leaders. Singling here would be very beneficial.

Below right: an exceptional walnut, responding superbly to stumping, sending up a single very strong shoot, almost 2m in height in a one season.



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 only was assessed winter 2008 as this comprises 5 year data.

As these trees are being investigated as quality timber producers, form is an essential characteristic to look at. A quality timber tree requires a clean straight bole, light branching, horizontal in nature to reduce the resulting knot, and be free from forks, kinks, sweeps. All these factors can be assessed, and this is very time consuming to be accurate, but research indicates that a quick visual assessment by the practiced forester is as valid as the detailed assessment. Termed 'wow' here, this assessment incorporates general vigour of the tree and its form. This is a 1 - 4 score with 1 being perfect, 2 is better than average, requiring some pruning (in a timber tree, but obviously not in a research tree), 3 is below average, requiring much cultural work and 4 is a very poor tree that would be removed at first thinning.

A second critical factor is apical dominance (leader persistence). Again, this is a 1 - 4 score, but takes into account two factors - the clear height of the leader (the dominant shoot) above competitors, and the degree from vertical that this is. For example, a tree may lose its central leader and another takes over. This could be almost vertical, in which case the tree would score highly for apical dominance, but often, a side branch takes over and this can be significantly off centre. So, even though it may be clearly the dominant shoot, the tree would score poorly for apical dominance due to the pronounced kink formed by the side branch taking over as leader.

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).

Height to the nearest centimeter, apical dominance and a wow score were recorded and the data analyzed with Genstat 10th Edition using plot means. The model of the variance of analysis used was: *site* + *site/rep* + *site* × *prov*.

At time of planting, there were no significant differences between sites, although there were between provenances. By 2007, site had become a highly significant factor ($p > 0.001$, Table 2.).

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

Source of variation	<i>d.f.</i>	<i>m.s.</i>	<i>v.r</i>	<i>p</i>
Site	1	16870.14	377.65	<.001
Site/Rep	18	190.49	4062	<.001
Prov	4	1482.28	33.18	<.001
Site × Prov	4	26.14	0.59	0.674
Residual	72	44.67		
Total	99			

All factors, site, rep and provenance were highly significant for height (Table 2). Walnuts at Lount continually out performed those at Little Wittenham, regardless of provenance (Figure 5). However, when apical dominance and wow were looked at, performance for these factors tended to be slightly better at Little Wittenham. With the exception of Croatia, Little Wittenham always had more trees scoring 1 (highest) for overall wow, although it also has more in the lowest category (4) (Figures 6 and 7). When looked at as mean scores by provenance (Table 3), Austria (Altenworth) consistently

performed better at Lount, as did Serbia, but Austria (Seebarn), Croatia and the UK performed better at Little Wittenham. However, analysis of variance revealed that site was not significant for either of these factors, although in both cases, provenance was. Overall, scores were disappointingly low at both sites.

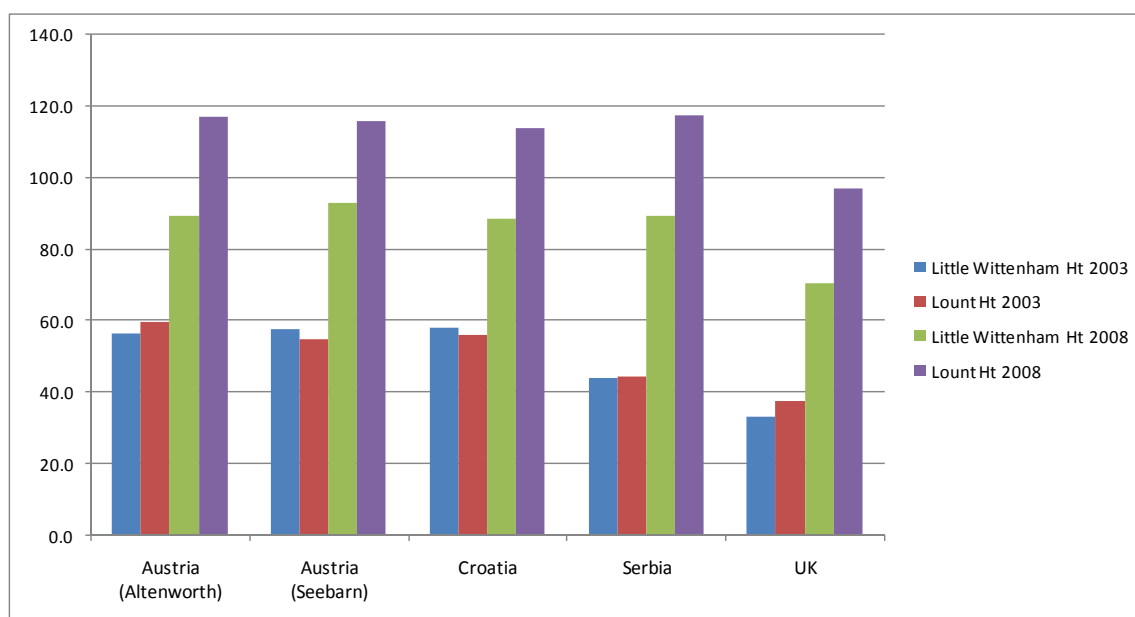


Figure 5. Mean tree height by provenance at both sites at time of planting and five years later in 2008.

Table 3. Overall mean scores for apical dominance and wow, by provenance, for both Lount and little Wittenham, based on a four point system with 1 being highest and 4 lowest.

	Austria (Altenworth)	Austria (Seebarn)	Croatia	Serbia	UK
Little Wittenham Wow	2.74	2.66	2.93	2.56	3.11
Lount Wow	2.80	2.65	2.80	2.81	2.95
Little Wittenham Apical Dominance	2.39	2.30	2.59	2.37	2.71
Lount Apical Dominance	2.72	2.23	2.40	2.37	2.56

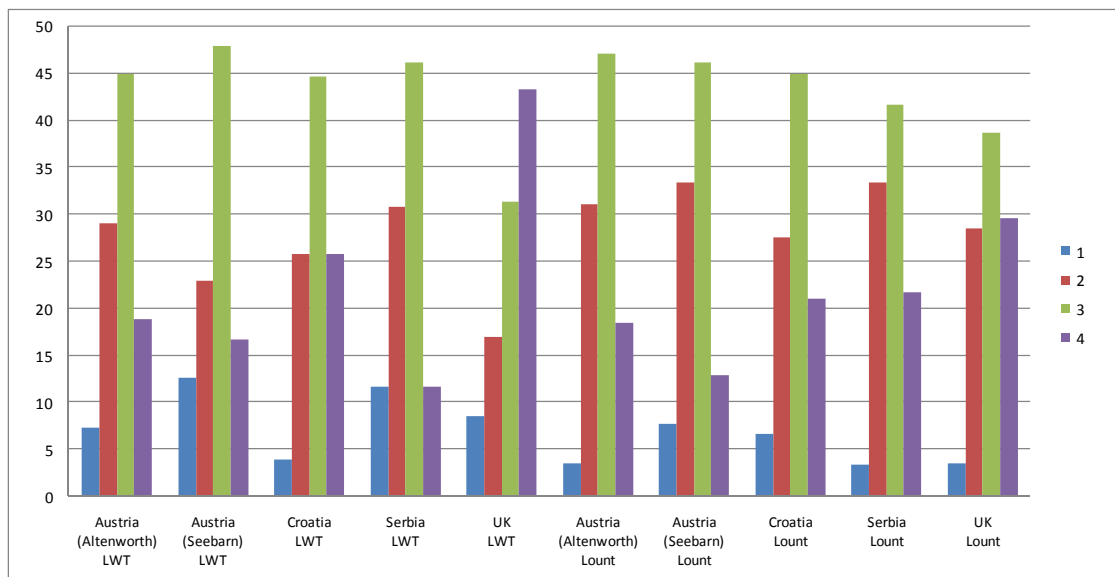


Figure 6. Percentage of trees with wow scores 1 to 4, by site and provenance. A score of one is a perfect tree, 2 indicates the need of some pruning, 3 indicates much pruning, and 4 would be a tree removed at first thinning.

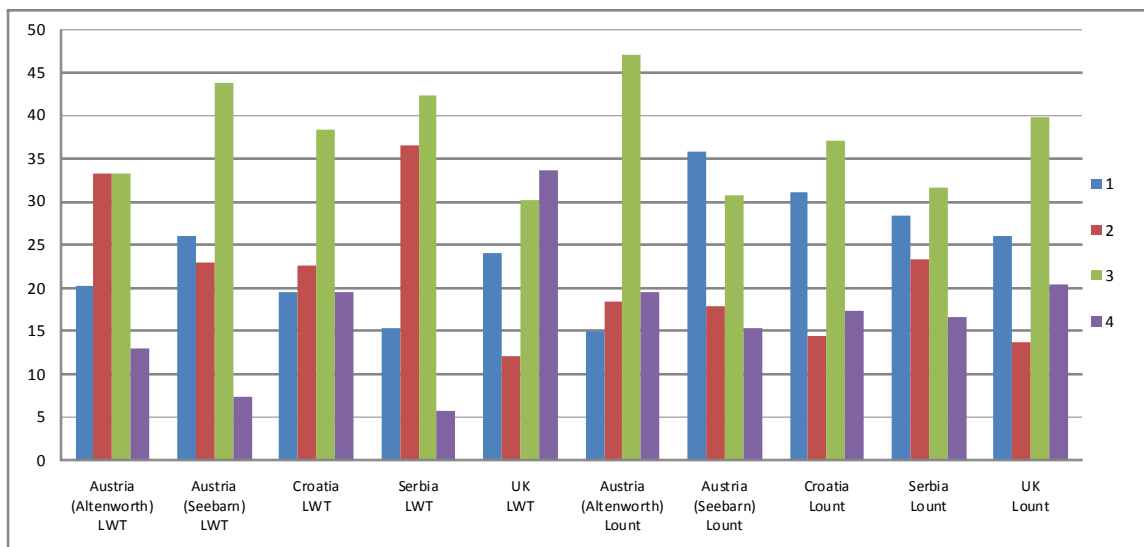


Figure 7. Percentage of trees with apical dominance scores 1 to 4, by site and provenance. A score of one is a perfect tree, 2 indicates the need of some pruning, 3 indicates much pruning, and 4 would be a tree removed at first thinning.



Figure 8. Black walnut progeny and provenance trials, October 2008. Phase I in the foreground to the left, Phase III to the right and Phase II in the distance behind Phase I.

General Comments

The black walnut trials are looking excellent. Phase II will be 5 years old in 2009 and will require measuring, Phase III in 2010. Phase I will not now be re-measured until year 10 in 2013.

The silviculture trial was also looking excellent, the pruning that was carried out in summer 2007, showing impressive results. The very poor walnut that were stumped have responded extremely well. There are now three options with this trial:

- 1) do nothing and see what happens. This will still require assessing next year.
- 2) Single all the walnuts and assess the next year.
- 3) Single a subset of walnuts from each species in each treatment.

This third choice would be my preferred option as this would deliver the most results from the minimum research. It would hopefully answer the question as to whether singling actually needs to be carried out, and how much it would cost the tree in terms of form and vigour were it not carried out.

Required Work Programme for 2009/10

Walnut Silviculture Trial

1. Assess both blocks autumn 2009
2. Singling of half the trees in each species in each treatment.

Black Walnut Trials

1. Measure Phase II for 5 year assessments

Other Work Proposals to Discuss

Should the National Forest wish to promote their unique research resource, some possible ideas are:

1. Walnut species and hybrids demonstration area with information board.
2. Walnut trees for nut production demonstrations.
3. The establishment of quality trees in small blocks in failed farm woodland plantings as demonstration.

Appendix:

5 year plan with the minimum amount of research required to continue with the existing trials.

Flushing of the black walnut trials included in spring 2011, when all phases will be a minimum of 5 years old and well out of the tubes. Flushing assessments are essential to link to form assessments and thus select best provenances for UK use.

Year	Walnut Silviculture Trial	Black Walnut I (EU material)	Black Walnut II (USA provenance material)	Black Walnut III (USA progeny material)	Total man days
2009/10					
Year 5 data assessment	0	0	2	0	2
data management	2	0	2	0	4
report writing	1	0	1	0	2
stumping assessment	4	0	0	0	4
singling of walnuts	4	0	0	0	4
sub-total	11	0	5	0	16
2010/11					
Year 5 data assessment	0	0	0	2	2
Flushing - all BW trials, 3 visits (2 people 2 days per visit)					12
data management	0	0	0	5	5
report writing	0	0	0	2	2
sub-total	0	0	0	9	21
2011/12					
Year 10 data assessment	4	0	0	0	4
data management	2	0	0	0	2
report writing	2	0	0	0	2
sub-total	8	0	0	0	8
2012/13					
field assessments	0	0	0	0	0
data management	0	0	0	0	0
report writing	0	0	0	0	0
sub-total	0	0	0	0	0
2013/14					
Year 10 data assessment	0	4	0	0	4
data management	0	2	0	0	2
report writing	0	1	0	0	1
sub-total	0	7	0	0	7