



# **Forestry Research Report 2007**

## **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 and East Malling Research in July and November 2007 and April 2008.

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

All walnuts were measured in 2006 and during those assessments it was noted that several exhibited poor form and, indeed, several were of the wrong species, probably due to unavailability of correct species at the time of beating up.

Therefore, three periods of field work were agreed for 2007:

### 1. Summer 2007

- ascertain walnut species of the silviculture trial
- carry out stumping on block 1
- pruning of all walnuts to improve form.

## 2. Winter 2007

- carry out stumping on block 2
- assess stumping of block 1
- measure the black walnut progeny and provenance trials

## 3. Spring 2008

- assess stumping of block 2
- assess phenology of the black walnut trials.

### **Stumping of walnut**

Stumping is the practice of cutting back the stem just above ground level either at planting time or during the early years of establishment to stimulate a vigorous new shoot from a healthy root system. It can only be used on those species that regenerate from dormant buds, such as walnut and oak. It can be done for a number of reasons, more commonly, to improve the shoot to root ratio, to promote a straighter, more vigorous main leader or as a corrective measure following damage by browsing or frost.

In walnut silviculture, the most important benefit of stumping is in its promotion of rapid height increment through the early frost sensitive phase of growth. However, in this case, stumping has been carried out as a corrective measure due to poor form. The silviculture trial at Lount lends itself very well to further experimentation on silvicultural practices as it comprises 2 replicates, each with four blocks of a single species or hybrid. Thus, two treatments can be applied – a summer and a winter stumping.

The trial was visited in July (when the trees were in full leaf) to ascertain correct species of each tree. There were 14 incorrect walnuts in block 1 and 37 in block 2. These are detailed in Appendix 1. Appendix 2 shows the layout of the silviculture trial at Lount.

Stumping was carried out on those trees in block 1 that exhibited very poor form, approximately 10cm about ground level. All other walnuts were pruned in both blocks to promote a single leader and good form for timber production. 161 walnuts were stumped in block 1 (summer treatment) and 241 walnuts stumped in November in block 2 (winter treatment). Block 1 was assessed in November 2007 when block 2 was stumped, and all new shoots for each stump were recorded as either strong (>20cm) or weak (<20cm). Appendix 3 lists the individual trees.

**Table 1.** Number of walnuts stumped by species and block.

<b>Number stumped</b>	
<b>Block 1</b>	
regia	29
nigra	70
MJ209	24
NG23	38
<b>Block 2</b>	
regia	30
nigra	91
MJ209	65
NG23	55

Nearly all trees in block 1 had sent out several shoots by the time of assessment in November. Out of the 161 trees stumped, all but 36 had sent out at least one strong shoot, and only 9 trees had sent out no shoots at all. The black walnut trials were assessed for bud burst in April, but at this time, block 2 had not started to shoot although buds were plainly visible. Block 1 was also briefly re visited. Here much damage had occurred due partly to frost damage of new shoots that had not fully hardened before winter, but mainly due to browsing by deer.



Figure 1. Clockwise from top left: pruned walnut; new shoots arising after winter pruning; deer browse to summer stumping; frost damage to summer stumping.

## ***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).

Height was recorded and the data analyzed with Genstat 10<sup>th</sup> 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 four 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	10827.95	321.95	<.001
Site/Rep	18	104.17	3.10	<.001
Prov	4	697.88	20.75	<.001
Site × Prov	4	39.75	1.18	0.326
Residual	72	33.63		
Total	99			

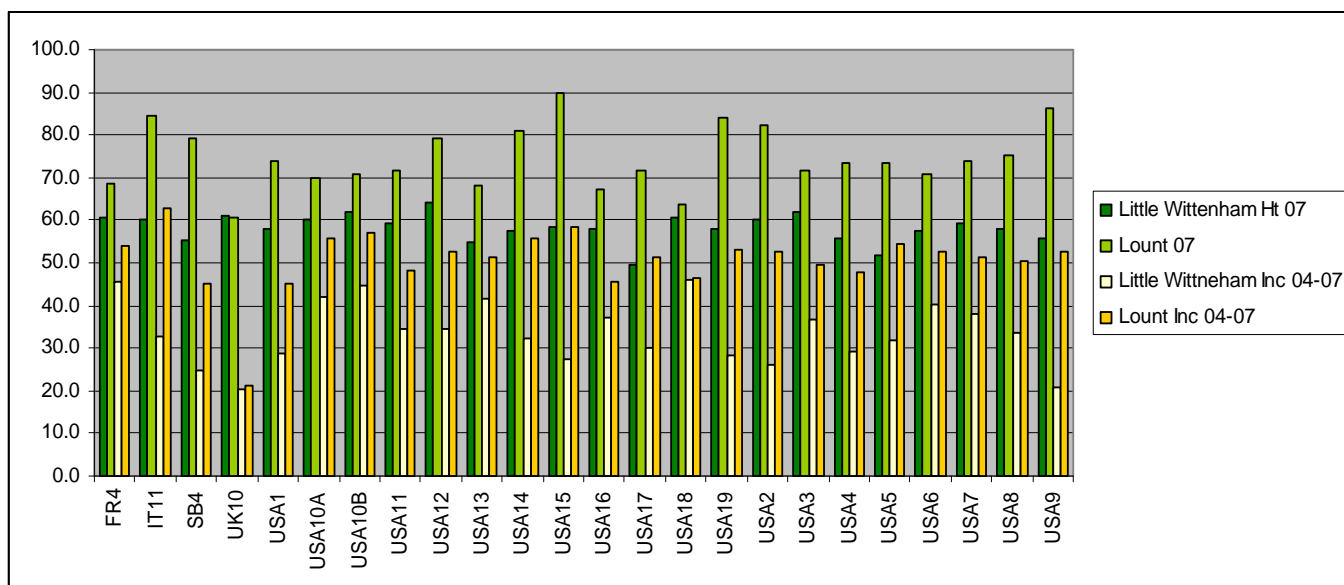
**Table 3.** Mean tree height by provenance at both sites at time of planting and four years later, including height increment from 2003 to 2007.

	Lount Wood	Little Wittenham	Both sites
<b>Tree height (2003)</b>			
Austria, Altenworth	59.7	56.4	58.0
Austria, Seebarn	54.6	57.7	56.1
Croatia	55.8	57.9	56.9
Slovakia	45.3	44.0	44.7
UK	37.3	33.1	35.2
mean (cm)	50.3	49.8	50.1
<b>Tree height (2007)</b>			
Austria, Altenworth	104.3	80.5	92.4
Austria, Seebarn	102.0	83.5	92.7
Croatia	99.1	80.0	89.5
Slovakia	102.3	78.3	90.3
UK	99.1	78.3	88.7
mean (cm)	101.4	80.1	90.7
<b>Height increment (2003-07)</b>			
Austria, Altenworth	44.5	24.1	34.3
Austria, Seebarn	47.2	25.7	36.4
Croatia	43.3	22.2	32.8
Slovakia	57.6	33.0	45.3
UK	52.8	37.0	44.9
mean (cm)	49.1	28.4	38.7

Table 2 indicates that both site and provenance are highly significant factors ( $p < 0.001$ ) for height growth. This is reflected in Table 3 which illustrates that while differences in height were minimal at time of planting, four years later the growth rate of trees at Lount was almost twice that at Little Wittenham.

### 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.



**Figure 2.** Mean height (cm) of north American provenances of black walnut recorded Phase II in 2007, and increment since planting.

Analysis of variance revealed that both site and provenance were highly significant ( $p < 0.001$ ) variables for height in 2007.

### Phase III

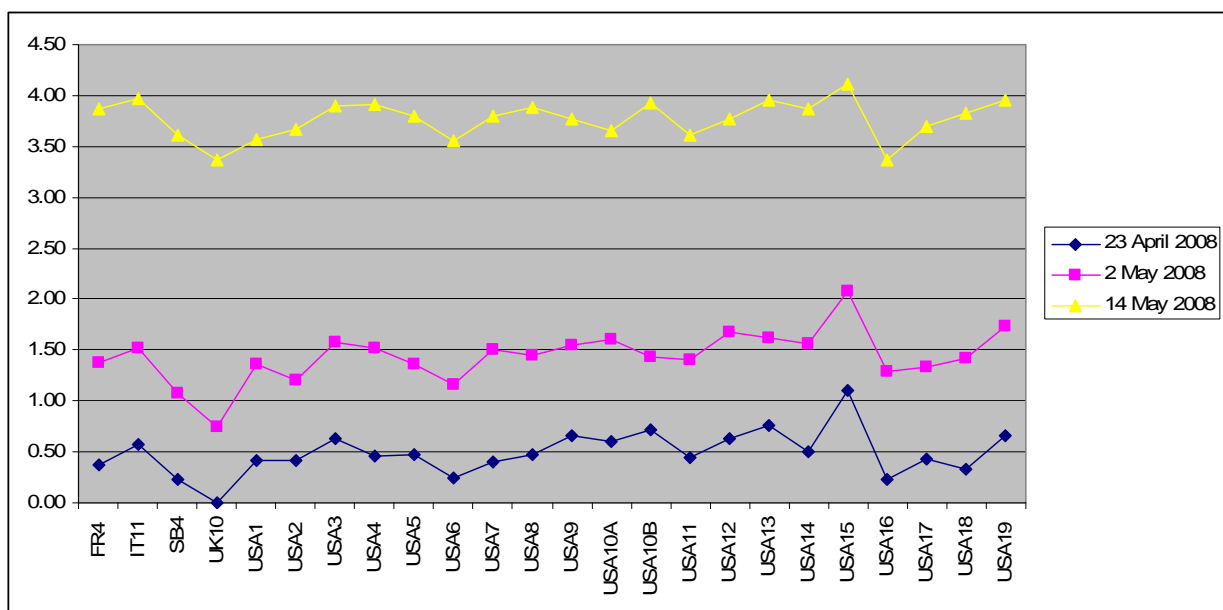
Phase III was planted in February 2005 and comprises 10 reps of 100 trees, and is replicated at Northmoor Trust. It contains the same material as planted in Phase II, and also additional European selections. Seven trees were dead in 2007 at Little Wittenham and ten at Lount. As this is only the second year since planting, many trees still exhibited dieback and were not above the height of the tubes. It has proved to be the norm for black walnut to hardly grow, and in many instances to dieback and then sprout from the base within the first two years after planting. It is expected that next year the trees will become established and start to put on height growth. No data are presented here as it is too early to present meaningful information.

### Flushing Assessments

Time of bud burst was assessed at Lount Wood on three occasions: 23<sup>rd</sup> April, 2<sup>nd</sup> May and 14<sup>th</sup> May 2008 on Phase I and II. Any tree that was below the height of the tube was discarded from the analysis as flushing would be highly influenced by the effect of the tube. Phase III was not assessed as the majority of trees were still in the tubes. There were no significant differences between provenances for any of the assessments for either Phase I or Phase II. Mean data are presented in Table 4 for Phase I and in Figure 3 for Phase II.

**Table 4.** Mean flushing score (range 0-5) by provenance for Phase I of the black walnut progeny trials. Bud burst was assessed on three dates: 23<sup>rd</sup> April, 2<sup>nd</sup> May and 14<sup>th</sup> May 2005.

Provenance	23 <sup>rd</sup> April	2 <sup>nd</sup> May	14 <sup>th</sup> May
Phase I			
Austria, Altenworth	0.7	1.5	4.0
Austria, Seebarn	0.4	1.3	3.7
Croatia	0.5	1.3	3.7
Slovakia	0.5	1.5	3.9
UK	0.7	1.5	3.6



**Figure 3.** Mean flushing score (range 0-5) by provenance for Phase II of the black walnut progeny trials. Bud burst was assessed on three dates: 23<sup>rd</sup> April, 2<sup>nd</sup> May and 14<sup>th</sup> May 2005.

This is the first time that bud burst has been scored on the black walnut trials, and was not carried out at Little Wittenham. Figure 3 shows clearly that the UK provenance is much the latest to flush. The histogram in Figure 2 also shows that the UK provenance is one of the smallest. It would be interesting to do this work again in 2009 at both Lount and Little Wittenham to determine whether this is the case for both sites and in subsequent years also. The next latest to flush is USA16 which comes from Wisconsin. While not as small as UK10, it is below average. Given the problems associated with growing walnut in the UK, a provenance that is late flushing such as USA16 may prove to be an appropriate one for future walnut planting in the UK.

## **General Comments**

The black walnut trials are looking excellent. Next year will be year 5 for Phase I. The trial will not need to be measured again until year 10.

As mentioned above, there was a fair amount of damage to the silviculture trial on those trees that had been stumped. It was not apparent that deer were such a problem at this site. It would be beneficial to protect the trees in some way, but given the numbers involved, and that they will have got well established by now, this may be very difficult to achieve.

## **Required Work Programme for 2008**

### **Walnut Silviculture Trial**

1. Assess regrowth on both blocks and damage caused by browse or frost (on block 1).
2. Assess both blocks and ascertain if singling is required.
3. Discuss with FE the feasibility of protecting those walnuts that were stumped

### **Black Walnut Trials**

1. Measure Phase I, II and III.
2. Carry out flushing assessments (spring 2009) on Phase I and II.

## **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 1.** Individual walnuts that are incorrect species as per the blocked planting plan. *Juglans regia* and *J. nigra* are easily distinguished, but the hybrids MJ209 and NG23 are more difficult to tell apart, even in leaf.

Block 1. Stumped July 2007

Plot	Tree	Tree Nurse	Shrub Nurse	Should be	Planted Walnut
1	5	larch	elaeanus	nigra	regia
7	5	cherry	hazel	nigra	NJ209
8	6	cherry	none	nigra	NG23
9	2	alder	none	nigra	hybrid
11	3	larch	none	nigra	MJ209
11	6	larch	none	nigra	MJ209
14	2	cherry	elder	nigra	hybrid
15	1	larch	elder	nigra	regia
16	1	Birch	none	nigra	hybrid
16	5	birch	none	nigra	regia
17	4	larch	hazel	nigra	regia
17	5	larch	hazel	nigra	hybrid
15	6	larch	hazel	NG23	nigra
17	5	larch	none	NG23	nigra

Block 2. Stumped November 2007

Plot	Tree	Tree Nurse	Shrub Nurse	Should be	Planted Walnut
11	5	cherry	elaeanus	regia	nigra
1	3	cherry	elder	nigra	hybrid
1	5	cherry	elder	nigra	hybrid
2	5	none	none	nigra	hybrid
4	2	cherry	hazel	nigra	hybrid
4	5	cherry	hazel	nigra	hybrid
5	2	cherry	elaeanus	nigra	hybrid
6	3	larch	elaeanus	nigra	hybrid
7	1	alder	elder	nigra	hybrid
8	2	larch	hazel	nigra	regia
8	4	larch	hazel	nigra	hybrid
9	4	birch	elaeanus	nigra	regia
10	5	larch	elder	nigra	hybrid
11	1	alder	hazel	nigra	hybrid
11	5	alder	hazel	nigra	hybrid
13	5	alder	elaeanus	nigra	hybrid
17	6	birch	none	nigra	hybrid
4	3	cherry	none	NG23	nigra
5	3	cherry	elaeanus	NG23	nigra
6	2	birch	hazel	NG23	nigra
8	5	larch	none	NG23	nigra
10	6	larch	elder	NG23	nigra
13	3	none	none	NG23	nigra
14	4	larch	hazel	NG23	nigra
15	5	cherry	hazel	NG23	nigra
2	2	cherry	elder	MJ209	nigra
6	6	larch	elaeanus	MJ209	nigra
7	3	cherry	none	MJ209	hybrid
7	5	cherry	none	MJ209	nigra
8	1	birch	elder	MJ209	nigra
8	3	birch	elder	MJ209	nigra
9	6	larch	elder	MJ209	nigra
13	2	birch	hazel	MJ209	nigra
14	1	alder	elaeanus	MJ209	nigra
15	2	alder	hazel	MJ209	hybrid
15	5	alder	hazel	MJ209	regia
17	3	birch	elaeanus	MJ209	nigra

Appendix 2. Layout of walnut silviculture trial, Lount.

Block 1. Northern field

1 MJ209 + ALDER + ELAEAG	2 MJ209 + CTRL	3 MJ209 + LARIX + ELDER	4 MJ209 + ALDER + NONE	5 MJ209 + BIRCH + ELAEAG	6 MJ209 + LARIX + ELAEAG	1 REGIA + CHERRY + ELAEAG	2 REGIA + ALDER + HAZEL	3 REGIA + LARIX + HAZEL	4 REGIA + BIRCH + HAZEL	5 REGIA + ALDER + ELAEAG	6 REGIA + CHERRY + HAZEL
12 MJ209 + BIRCH + HAZEL	11 MJ209 + LARIX + NONE	10 MJ209 + CHERRY + ELAEAG	9 MJ209 + ALDER + ELDER	8 MJ209 + LARIX + HAZEL	7 MJ209 + CHERRY + ELDER	11 REGIA + CHERRY + NONE	10 REGIA + LARIX + ELAEAG	9 REGIA + BIRCH + NONE	8 REGIA + CHERRY + ELDER	7 REGIA + BIRCH + ELDER	
13 MJ209 + CHERRY + NONE	14 MJ209 + ALDER + HAZEL	15 MJ209 + BIRCH + NONE	16 MJ209 + CHERRY + HAZEL	17 MJ209 + BIRCH + ELDER	12 REGIA + LARIX + NONE	13 REGIA + ALDER + NONE	14 REGIA + ALDER + ELDER	15 REGIA + CTRL	16 REGIA + LARIX + ELDER	17 REGIA + BIRCH + ELAEAG	
1 NG23 + BIRCH + NONE	2 NG23 + BIRCH + ELDER	3 NG23 + BIRCH + HAZEL	4 NG23 + LARIX + NONE	5 NG23 + CHERRY + HAZEL	6 NG23 + ALDER + NONE	1 NIGRA + LARIX + ELAEAG	2 NIGRA + BIRCH + ELAEAG	3 NIGRA + ALDER + ELDER	4 NIGRA + ALDER + ELAEAG	5 NIGRA + ALDER + HAZEL	6 NIGRA + BIRCH + HAZEL
12 NG23 + CTRL	11 NG23 + CHERRY + ELAEAG	10 NG23 + BIRCH + ELAEAG	9 NG23 + LARIX + ELAEAG	8 NG23 + CHERRY + NONE	7 NG23 + CHERRY + ELDER	11 NIGRA + LARIX + NONE	10 NIGRA + CTRL	9 NIGRA + ALDER + NONE	8 NIGRA + CHERRY + NONE	7 NIGRA + CHERRY + HAZEL	
13 NG23 + ALDER + HAZEL	14 NG23 + ALDER + ELAEAG	15 NG23 + LARIX + HAZEL	16 NG23 + ALDER + ELDER	17 NG23 + LARIX + ELDER	12 NIGRA + BIRCH + ELDER	13 NIGRA + CHERRY + ELAEAG	14 NIGRA + CHERRY + ELDER	15 NIGRA + LARIX + ELDER	16 NIGRA + BIRCH + NONE	17 NIGRA + LARIX + HAZEL	

Block 2. Southern field.

		1 REGIA + ALDER + HAZEL	2 REGIA + BIRCH + ELDER	3 REGIA + CHERRY + ELDER	4 REGIA + ALDER + ELDER	5 REGIA + BIRCH + ELAEAG	6 REGIA + CHERRY + HAZEL	1 NIGRA + CHERRY + ELDER	2 NIGRA + CTRL	3 NIGRA + LARIX + NONE	4 NIGRA + CHERRY + HAZEL	5 NIGRA + CHERRY + ELAEAG	6 NIGRA + LARIX + ELAEAG	
		12 REGIA + BIRCH + NONE	11 REGIA + CHERRY + ELAEAG	10 REGIA + LARIX + ELDER	9 REGIA + LARIX + NONE	8 REGIA + CTRL	7 REGIA + LARIX + ELAEAG	11 NIGRA + ALDER + HAZEL	10 NIGRA + LARIX + ELDER	9 NIGRA + BIRCH + ELAEAG	8 NIGRA + LARIX + HAZEL	7 NIGRA + ALDER + ELDER		
		13 REGIA + LARIX + HAZEL	14 REGIA + BIRCH + HAZEL	15 REGIA + ALDER + NONE	16 REGIA + ALDER + ELAEAG	17 REGIA + CHERRY + NONE	12 NIGRA + CHERRY + NONE	13 NIGRA + ALDER + ELAEAG	14 NIGRA + BIRCH + HAZEL	15 NIGRA + ALDER + NONE	16 NIGRA + BIRCH + ELDER	17 NIGRA + BIRCH + NONE		
	13 MJ209 + BIRCH + HAZEL	14 MJ209 + ALDER + ELAEAG	1 MJ209 + ALDER + NONE	2 MJ209 + CHERRY + ELDER	3 MJ209 + LARIX + NONE	4 MJ209 + BIRCH + NONE	5 MJ209 + CTRL	6 MJ209 + LARIX + ELAEAG	1 NG23 + ALDER + ELAEAG	2 NG23 + ALDER + HAZEL	3 NG23 + ALDER + NONE	4 NG23 + CHERRY + NONE	5 NG23 + CHERRY + ELAEAG	6 NG23 + BIRCH + HAZEL
15 MJ209 + ALDER + HAZEL	16 MJ209 + ALDER + ELDER	17 MJ209 + BIRCH + ELAEAG	12 MJ209 + CHERRY + HAZEL	11 MJ209 + LARIX + HAZEL	10 MJ209 + CHERRY + ELAEAG	9 MJ209 + LARIX + ELDER	8 MJ209 + BIRCH + ELDER	7 MJ209 + CHERRY + NONE	11 NG23 + BIRCH + NONE	10 NG23 + LARIX + ELDER	9 NG23 + LARIX + ELAEAG	8 NG23 + LARIX + NONE	7 NG23 + ALDER + ELDER	
								12 NG23 + BIRCH + ELAEAG	13 NG23 + CTRL	14 NG23 + LARIX + HAZEL	15 NG23 + CHERRY + HAZEL	16 NG23 + CHERRY + ELDER	17 NG23 + BIRCH + ELDER	

Appendix 3. Individual trees stumped and number of shoots arising for the summer treatment only.

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
1	mj209	1	2	alder	elaeagnus	0	1
1	mj209	1	5	alder	elaeagnus	3	5
1	mj209	4	1	alder	none	1	3
1	mj209	5	3	birch	elaeagnus	0	4
1	mj209	5	5	birch	elaeagnus	4	2
1	mj209	5	14	birch	elaeagnus	1	6
1	mj209	7	7	cherry	elder	0	0
1	mj209	7	13	cherry	elder	3	3
1	mj209	8	1	larix	hazel	4	8
1	mj209	9	2	alder	elder	6	4
1	mj209	11	3	larix	none	3	6
1	mj209	11	5	larix	none	3	3
1	mj209	11	9	larix	none	4	29
1	mj209	12	12	birch	hazel	5	5
1	mj209	13	4	cherry	none	4	2
1	mj209	13	6	cherry	none	3	2
1	mj209	13	12	cherry	none	10	5
1	mj209	14	7	alder	hazel	5	2
1	mj209	14	12	alder	hazel	1	5
1	mj209	16	4	cherry	hazel	1	4
1	mj209	16	5	cherry	hazel	0	0
1	mj209	17	1	birch	elder	7	2
1	mj209	17	7	birch	elder	4	2
1	mj209	17	12	birch	elder	8	4
1	regia	3	10	larix	hazel	4	14
1	regia	3	11	larix	hazel	1	1
1	regia	3	12	larix	hazel	4	10
1	regia	4	1	birch	hazel	3	7
1	regia	4	12	birch	hazel	2	6
1	regia	5	9	alder	elaeagnus	3	7
1	regia	6	1	cherry	hazel	0	6
1	regia	6	2	cherry	hazel	3	6
1	regia	6	3	cherry	hazel	2	9
1	regia	6	7	cherry	hazel	0	9
1	regia	6	9	cherry	hazel	4	12
1	regia	6	14	cherry	hazel	4	11
1	regia	7	6	birch	elder	5	7
1	regia	7	7	birch	elder	4	9
1	regia	7	10	birch	elder	3	2
1	regia	8	4	cherry	elder	4	6
1	regia	8	6	cherry	elder	3	11
1	regia	8	9	cherry	elder	3	6
1	regia	9	9	birch	none	4	5
1	regia	9	10	birch	none	4	11
1	regia	9	13	birch	none	3	13
1	regia	10	12	larix	elaeagnus	3	9
1	regia	11	6	cherry	none	3	7
1	regia	12	10	larix	none	3	8
1	regia	13	5	alder	none	4	4
1	regia	13	15	alder	none	2	6

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
1	regia	14	15	alder	elder	7	10
1	regia	15	14	none	none	2	9
1	regia	17	4	birch	elaeagnus	0	1
1	nigra	1	3	larix	elaeagnus	0	3
1	nigra	2	6	birch	elaeagnus	3	1
1	nigra	2	13	birch	elaeagnus	0	0
1	nigra	3	4	alder	elder	6	4
1	nigra	3	6	alder	elder	1	3
1	nigra	3	8	alder	elder	0	2
1	nigra	3	9	alder	elder	0	3
1	nigra	3	14	alder	elder	0	3
1	nigra	4	7	alder	elaeagnus	2	2
1	nigra	5	8	alder	hazel	0	1
1	nigra	5	9	alder	hazel	5	7
1	nigra	5	11	alder	hazel	1	1
1	nigra	5	13	alder	hazel	2	3
1	nigra	5	14	alder	hazel	0	2
1	nigra	6	5	alder	hazel	0	0
1	nigra	6	6	birch	hazel	2	3
1	nigra	6	7	birch	hazel	0	4
1	nigra	6	8	birch	hazel	0	3
1	nigra	6	10	birch	hazel	2	1
1	nigra	6	12	birch	hazel	4	2
1	nigra	6	14	birch	hazel	3	3
1	nigra	7	10	cherry	hazel	3	18
1	nigra	7	15	cherry	hazel	2	4
1	nigra	8	4	cherry	none	1	1
1	nigra	8	5	cherry	none	0	1
1	nigra	8	6	cherry	none	2	4
1	nigra	9	3	alder	none	4	3
1	nigra	9	7	alder	none	1	4
1	nigra	9	12	alder	none	3	3
1	nigra	9	13	alder	none	0	3
1	nigra	10	3	none	none	1	4
1	nigra	10	4	none	none	4	3
1	nigra	10	7	none	none	3	1
1	nigra	10	8	none	none	4	5
1	nigra	10	9	none	none	4	2
1	nigra	10	10	none	none	0	4
1	nigra	10	15	none	none	3	0
1	nigra	11	1	larix	none	2	3
1	nigra	11	3	larix	none	2	2
1	nigra	11	4	larix	none	0	0
1	nigra	11	5	larix	none	4	0
1	nigra	11	6	larix	none	1	4
1	nigra	11	14	larix	none	1	5
1	nigra	12	3	birch	elder	0	0
1	nigra	12	4	birch	elder	2	2
1	nigra	12	8	birch	elder	2	2
1	nigra	12	9	birch	elder	0	6
1	nigra	12	11	birch	elder	0	1
1	nigra	12	13	birch	elder	0	4
1	nigra	13	9	cherry	elaeagnus	2	0

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
1	nigra	13	10	cherry	elaeagnus	6	5
1	nigra	13	11	cherry	elaeagnus	0	7
1	nigra	13	13	cherry	elaeagnus	3	3
1	nigra	14	8	cherry	elder	5	5
1	nigra	14	11	cherry	elder	5	1
1	nigra	14	12	cherry	elder	0	0
1	nigra	14	13	cherry	elder	3	3
1	nigra	15	3	larix	elder	4	0
1	nigra	15	6	larix	elder	4	6
1	nigra	15	9	larix	elder	3	1
1	nigra	15	10	larix	elder	0	4
1	nigra	15	12	larix	elder	4	0
1	nigra	15	13	larix	elder	3	0
1	nigra	15	15	larix	elder	0	0
1	nigra	16	12	birch	none	0	5
1	nigra	16	13	birch	none	2	0
1	nigra	16	13	birch	none	1	6
1	nigra	17	2	larix	hazel	2	1
1	nigra	17	3	larix	hazel	2	3
1	nigra	17	4	larix	hazel	2	2
1	ng23	1	7	birch	none	3	0
1	ng23	1	10	birch	none	3	3
1	ng23	2	6	birch	elder	3	4
1	ng23	2	12	birch	elder	3	3
1	ng23	2	13	birch	elder	3	6
1	ng23	2	15	birch	elder	3	1
1	ng23	3	5	birch	hazel	7	5
1	ng23	3	7	birch	hazel	0	8
1	ng23	4	11	larix	none	4	4
1	ng23	4	12	larix	none	5	8
1	ng23	6	10	alder	none	3	3
1	ng23	6	15	alder	none	1	5
1	ng23	7	3	cherry	elder	1	6
1	ng23	7	4	cherry	elder	3	5
1	ng23	7	12	cherry	elder	0	3
1	ng23	7	13	cherry	elder	1	2
1	ng23	7	15	cherry	elder	2	5
1	ng23	8	3	cherry	none	12	9
1	ng23	8	8	cherry	none	5	2
1	ng23	8	10	cherry	none	4	5
1	ng23	9	4	larix	elaeagnus	2	1
1	ng23	9	14	larix	elaeagnus	0	2
1	ng23	10	1	birch	elaeagnus	0	0
1	ng23	10	4	birch	elaeagnus	3	4
1	ng23	10	5	birch	elaeagnus	4	2
1	ng23	10	15	birch	elaeagnus	8	2
1	ng23	11	3	cherry	elaeagnus	1	1
1	ng23	11	4	cherry	elaeagnus	3	7
1	ng23	11	7	cherry	elaeagnus	2	7
1	ng23	12	3	none	none	6	1
1	ng23	12	4	none	none	4	6
1	ng23	12	15	none	none	3	2
1	ng23	13	8	alder	hazel	4	1

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
1	ng23	15	10	larix	hazel	0	3
1	ng23	15	12	larix	hazel	2	0
1	ng23	17	7	larix	elder	3	11
1	ng23	17	8	larix	elder	1	2
1	ng23	17	15	larix	elder	0	1
2	regia	2	4	birch	elder		
2	regia	2	6	birch	elder		
2	regia	2	12	birch	elder		
2	regia	3	4	cherry	elder		
2	regia	3	10	cherry	elder		
2	regia	4	2	alder	elder		
2	regia	4	12	alder	elder		
2	regia	5	2	birch	elaeagnus		
2	regia	5	4	birch	elaeagnus		
2	regia	5	12	birch	elaeagnus		
2	regia	6	12	cherry	hazel		
2	regia	7	2	larix	elaeagnus		
2	regia	7	4	larix	elaeagnus		
2	regia	7	8	larix	elaeagnus		
2	regia	7	14	larix	elaeagnus		
2	regia	8	1	none	none		
2	regia	8	3	none	none		
2	regia	8	13	none	none		
2	regia	8	14	none	none		
2	regia	9	10	larix	none		
2	regia	9	12	larix	none		
2	regia	9	13	larix	none		
2	regia	10	2	larix	elder		
2	regia	10	7	larix	elder		
2	regia	10	12	larix	elder		
2	regia	10	13	larix	elder		
2	regia	10	15	larix	elder		
2	regia	14	5	birch	hazel		
2	regia	15	1	alder	none		
2	regia	16	7	alder	elaeagnus		
2	nigra	1	5	cherry	elder		
2	nigra	1	6	cherry	elder		
2	nigra	1	13	cherry	elder		
2	nigra	2	4	none	none		
2	nigra	2	5	none	none		
2	nigra	2	8	none	none		
2	nigra	2	9	none	none		
2	nigra	2	10	none	none		
2	nigra	2	11	none	none		
2	nigra	3	4	larix	none		
2	nigra	3	5	larix	none		
2	nigra	3	6	larix	none		
2	nigra	3	7	larix	none		
2	nigra	3	8	larix	none		
2	nigra	3	12	larix	none		
2	nigra	3	13	larix	none		
2	nigra	3	14	larix	none		

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
2	nigra	3	15	larix	none		
2	nigra	4	4	cherry	hazel		
2	nigra	4	7	cherry	hazel		
2	nigra	4	8	cherry	hazel		
2	nigra	4	9	cherry	hazel		
2	nigra	5	2	cherry	elaeagnus		
2	nigra	5	4	cherry	elaeagnus		
2	nigra	5	5	cherry	elaeagnus		
2	nigra	5	6	cherry	elaeagnus		
2	nigra	5	8	cherry	elaeagnus		
2	nigra	5	10	cherry	elaeagnus		
2	nigra	5	11	cherry	elaeagnus		
2	nigra	5	14	cherry	elaeagnus		
2	nigra	5	15	cherry	elaeagnus		
2	nigra	6	3	larix	elaeagnus		
2	nigra	6	9	larix	elaeagnus		
2	nigra	6	11	larix	elaeagnus		
2	nigra	7	2	alder	elder		
2	nigra	7	6	alder	elder		
2	nigra	8	1	larix	hazel		
2	nigra	8	2	larix	hazel		
2	nigra	8	12	larix	hazel		
2	nigra	8	13	larix	hazel		
2	nigra	8	14	larix	hazel		
2	nigra	9	1	birch	elaeagnus		
2	nigra	9	4	birch	elaeagnus		
2	nigra	9	6	birch	elaeagnus		
2	nigra	9	9	birch	elaeagnus		
2	nigra	9	10	birch	elaeagnus		
2	nigra	10	6	larix	elder		
2	nigra	10	9	larix	elder		
2	nigra	10	15	larix	elder		
2	nigra	11	1	alder	hazel		
2	nigra	11	3	alder	hazel		
2	nigra	11	4	alder	hazel		
2	nigra	11	6	alder	hazel		
2	nigra	11	9	alder	hazel		
2	nigra	11	14	alder	hazel		
2	nigra	12	1	cherry	none		
2	nigra	12	2	cherry	none		
2	nigra	12	3	cherry	none		
2	nigra	12	6	cherry	none		
2	nigra	12	7	cherry	none		
2	nigra	12	8	cherry	none		
2	nigra	12	10	cherry	none		
2	nigra	12	11	cherry	none		
2	nigra	12	12	cherry	none		
2	nigra	12	13	cherry	none		
2	nigra	12	15	cherry	none		
2	nigra	13	2	alder	elaeagnus		
2	nigra	13	7	alder	elaeagnus		
2	nigra	13	8	alder	elaeagnus		
2	nigra	13	10	alder	elaeagnus		

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
2	nigra	13	11	alder	elaeagnus		
2	nigra	13	13	alder	elaeagnus		
2	nigra	13	14	alder	elaeagnus		
2	nigra	14	9	birch	hazel		
2	nigra	15	3	alder	none		
2	nigra	15	6	alder	none		
2	nigra	15	7	alder	none		
2	nigra	15	9	alder	none		
2	nigra	15	14	alder	none		
2	nigra	16	1	birch	elder		
2	nigra	16	4	birch	elder		
2	nigra	16	5	birch	elder		
2	nigra	16	13	birch	elder		
2	nigra	16	15	birch	elder		
2	nigra	17	1	birch	none		
2	nigra	17	5	birch	none		
2	nigra	17	6	birch	none		
2	nigra	17	7	birch	none		
2	nigra	17	10	birch	none		
2	nigra	17	12	birch	none		
2	nigra	17	15	birch	none		
2	ng23	1	8	alder	elaeagnus		
2	ng23	1	13	alder	elaeagnus		
2	ng23	2	3	alder	hazel		
2	ng23	2	14	alder	hazel		
2	ng23	3	9	alder	none		
2	ng23	3	10	alder	none		
2	ng23	3	12	alder	none		
2	ng23	4	1	cherry	none		
2	ng23	4	7	cherry	none		
2	ng23	4	8	cherry	none		
2	ng23	4	9	cherry	none		
2	ng23	4	12	cherry	none		
2	ng23	4	15	cherry	none		
2	ng23	5	9	cherry	elaeagnus		
2	ng23	5	10	cherry	elaeagnus		
2	ng23	5	12	cherry	elaeagnus		
2	ng23	6	1	birch	hazel		
2	ng23	6	2	birch	hazel		
2	ng23	6	3	birch	hazel		
2	ng23	6	11	birch	hazel		
2	ng23	6	15	birch	hazel		
2	ng23	7	11	alder	elder		
2	ng23	8	4	larix	none		
2	ng23	8	12	larix	none		
2	ng23	9	14	larix	elaeagnus		
2	ng23	9	15	larix	elaeagnus		
2	ng23	10	1	larix	elder		
2	ng23	10	2	larix	elder		
2	ng23	10	8	larix	elder		
2	ng23	10	11	larix	elder		
2	ng23	11	1	birch	none		
2	ng23	11	13	birch	none		



Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
2	ng23	12	9	birch	elaeagnus		
2	ng23	12	14	birch	elaeagnus		
2	ng23	13	1	none	none		
2	ng23	13	2	none	none		
2	ng23	13	5	none	none		
2	ng23	13	10	none	none		
2	ng23	13	11	none	none		
2	ng23	13	13	none	none		
2	ng23	13	14	none	none		
2	ng23	14	2	larix	hazel		
2	ng23	14	6	larix	hazel		
2	ng23	14	7	larix	hazel		
2	ng23	15	6	cherry	hazel		
2	ng23	15	9	cherry	hazel		
2	ng23	15	11	cherry	hazel		
2	ng23	15	13	cherry	hazel		
2	ng23	15	15	cherry	hazel		
2	ng23	16	3	cherry	elder		
2	ng23	16	15	cherry	elder		
2	ng23	17	6	birch	elder		
2	ng23	17	9	birch	elder		
2	ng23	17	13	birch	elder		
2	ng23	17	14	birch	elder		
2	mj209	1	3	alder	none		
2	mj209	1	7	alder	none		
2	mj209	1	9	alder	none		
2	mj209	2	3	cherry	elder		
2	mj209	2	7	cherry	elder		
2	mj209	2	14	cherry	elder		
2	mj209	3	2	larix	none		
2	mj209	3	3	larix	none		
2	mj209	3	5	larix	none		
2	mj209	4	2	birch	none		
2	mj209	4	5	birch	none		
2	mj209	4	6	birch	none		
2	mj209	4	12	birch	none		
2	mj209	5	2	none	none		
2	mj209	5	5	none	none		
2	mj209	5	10	none	none		
2	mj209	6	1	larix	elaeagnus		
2	mj209	6	2	larix	elaeagnus		
2	mj209	6	7	larix	elaeagnus		
2	mj209	7	2	cherry	none		
2	mj209	7	4	cherry	none		
2	mj209	7	6	cherry	none		
2	mj209	7	9	cherry	none		
2	mj209	8	2	birch	elder		
2	mj209	8	4	birch	elder		
2	mj209	8	6	birch	elder		
2	mj209	8	8	birch	elder		
2	mj209	8	13	birch	elder		
2	mj209	8	15	birch	elder		
2	mj209	9	1	larix	elder		

Block	Walnut	Plot	Tree (1-15)	Tree Nurse	Shrub Nurse	strong	weak
2	mj209	9	4	larix	elder		
2	mj209	9	8	larix	elder		
2	mj209	9	13	larix	elder		
2	mj209	9	15	larix	elder		
2	mj209	10	2	cherry	elaeagnus		
2	mj209	10	4	cherry	elaeagnus		
2	mj209	10	6	cherry	elaeagnus		
2	mj209	10	10	cherry	elaeagnus		
2	mj209	11	15	larix	hazel		
2	mj209	12	2	cherry	hazel		
2	mj209	12	3	cherry	hazel		
2	mj209	12	4	cherry	hazel		
2	mj209	12	5	cherry	hazel		
2	mj209	12	6	cherry	hazel		
2	mj209	12	7	cherry	hazel		
2	mj209	12	12	cherry	hazel		
2	mj209	13	2	birch	hazel		
2	mj209	13	12	birch	hazel		
2	mj209	13	14	birch	hazel		
2	mj209	14	7	alder	elaeagnus		
2	mj209	14	8	alder	elaeagnus		
2	mj209	14	10	alder	elaeagnus		
2	mj209	14	14	alder	elaeagnus		
2	mj209	14	15	alder	elaeagnus		
2	mj209	15	2	alder	hazel		
2	mj209	15	3	alder	hazel		
2	mj209	15	5	alder	hazel		
2	mj209	15	6	alder	hazel		
2	mj209	16	1	alder	elder		
2	mj209	16	2	alder	elder		
2	mj209	16	5	alder	elder		
2	mj209	16	6	alder	elder		
2	mj209	16	11	alder	elder		
2	mj209	17	6	birch	elaeagnus		
2	mj209	17	10	birch	elaeagnus		

