Silviculture of common walnut

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Walnut (*Juglans regia*) is an attractive species to grow for landowners. When grown on the right site, it can produce a final crop on a 50 year rotation, and can be more valuable than veneer oak.

However, it has the reputation to be tricky to get right, and to produce valuable straight stems. Earth Trust and Future Trees Trust have established several walnuts trials over the years in partnership with the National Forest and Forest Enterprise. These include a silviculture trial at Jaguar Lount Wood in Leicestershire which investigates the effects of various tree and shrub nurse combinations of the growth of common, black and hybrid walnuts, as well as several progeny and provenance trials for common and black walnut planted between 1998 and 2005. Several of the walnuts in the silviculture trial at Lount Wood, particularly the black walnut were of very poor form, and treatments (summer and winter) were carried out to investigate the effects of stumping and the growth response in eight year old walnut (Clark and Brocklehurst 2011). The results were so favourable – most walnuts stumped in winter caught up with non-stumped walnuts within two years – that it was decided to carry out this treatment on a common walnut trial which was suffering from severe dieback in Paradise Wood in south Oxfordshire.

In 1998, combined progeny and provenance trials for common walnut were planted at three sites in lowland England. These are at Northwick Estate in Gloucestershire, Maunsel Estate in Somerset, and the Earth Trust Estate in Oxfordshire. They form a genetically diverse collection from the natural range of common walnut, comprising 365 progenies, of 25 provenances from seven countries – Spain, Tajikistan, Kyrgyzstan, Iran, Romania, Slovakia and Turkey. Trees were planted at 5 x 5 m spacing in blocks of 100 trees. There are 14 blocks at the Oxfordshire site and four blocks at both the Gloucestershire and Somerset sites, a total of 2,200 trees. All provenances are replicated at every site, but not all progenies due to insufficient numbers for some progenies.

Although all trees originally established well, it was evident from early on that the form of all trees was extremely poor, with severe dieback occurring every year. Although silvicultural interventions are not usually carried out on genetics trials, during the summer of 2004 all trees at the site in Oxfordshire were pruned to a single leader in an attempt to correct form (Figure 1). The Oxfordshire site was assessed most years from early establishment, and all three trials were assessed for 5 and 10 year growth and form (2003 and 2008) and timing of budburst was assessed at year 10. Two reports were written on 1) performance and 2) form relating to timing of budburst by undergraduates from the University of Oxford. Spring frost damage is uncommon, as walnut is usually the last tree to come in to leaf, and the poor from is attributed to insufficient hardening off in the autumn. The form of all trees was so poor at year 10 (2008) that the analysis of the family data was of little value, with environmental effects overriding genetic differences.

Table 1 gives mean data (height and survival and growth increment) for the trial at Little Wittenham until 2008, the time of the last full assessment.

It shows that year by year, survival decreased gradually, as did growth increment. The slight increase in increment in 2004 can be attributed to the extensive formative pruning carried out that summer, with the trees sending resources to the singled leader.

Table 1. Survival and growth of walnut at the Oxfordshire site over several years.

Year	Survival (%)	Height (cm)	Inc. / yr^{-1} (cm)
1998	100	11.1	
1999	98.4	42.4	31.3
2001	98.1	97.8	27.7
2002	98.1	118.1	20.3
2003	98.0	129.6	11.5
2004	97.7	150.0	20.4
2008	93.0	180.0	7.5
2014[†]	85.6	102.0	102.0

[†]Stumped January 2014, assessed December 2014 – one year's growth.

Methods and materials

Based on the work carried out in the silvicultural trial for walnut in the National Forest, Leicestershire, it was decided to stump the trial in Oxfordshire. The trial hosts in Gloucestershire and Somerset declined to stump their trees, although form was equally poor at these sites. Prior to stumping, the nitrogen fixing shrub, *Elaeagnus umbellata*, had been planted in between walnuts trees within row (i.e. also at 5 x 5 m spacing) and also in between the rows of walnut, but at double the density, at 2.5 m spacing. Thus, each walnut was surrounded by eight *Elaeagnus* which were planted in 2007 as 20 – 40 cm one year old plants. Some areas of *Elaeagnus* failed due to waterlogging, and were beaten up in 2008, but there remain a few areas within the trial where the *Elaeagnus* failed. Establishment of the *Elaeagnus* took several years, and it was necessary to ensure good nurse cover, prior to stumping.

In February 2012, one of the 14 blocks was stumped at the Oxfordshire site as a test to see if the results would be as dramatic as in the National Forest, where walnuts had been established with nurse species at time of planting. The walnuts responded well (by visual observation only) so in January 2014, the remaining 1300 walnuts were stumped at approximately 10 cm above ground level using a chainsaw. The stump diameter was measured to the nearest millimetre and the stumps protected with 60 cm meshguard, kindly donated by Tubex, and put in place using volunteers. In January 2015, all trees were assessed for regrowth, with the number of dominant and lesser shoots counted, and the height of the dominate shoot recorded. Coppice regrowth after stumping tends to occur at two heights – a few taller shoots (termed 'dominant' in this context) and a greater number of more variable shorter shoots (termed 'lesser'). A dominant shoot is classified as equally competing with the leaders. Trees were also assessed for how successful stumping had appeared on one year growth. A purely subjective score was given on a visual basis as 1 – 5.

1 = failed to resprout, or regrowth almost dead
2 = poor
3 = Acceptable
4 = Good
5 = Excellent.

These are somewhat arbitrary classes but easily assigned especially once several stems have been viewed and were given as a means of quantifying the success of the treatment.

Results and Discussion

Survival

Prior to any intervention, 99 out of 1400 of the walnuts were recorded as dead in 2011. Of these 99, 22 had resprouted in 2014. Of the live trees that were stumped, 125 failed to resprout, and 60 resprouted, but then died (swamped by grass or presumed lack of light in a few cases, or thrashed by deer). Therefore, the *Elaeagnus* were cut back sufficiently hard to ensure a clear growth area for the walnuts in spring 2015, prior to walnut budburst.

Stump diameter

Mean stump diameter of all walnuts was 70.3 mm (±27.8 SD; range 20 – 160 mm). Mean stump diameter for those that failed to sprout was 61.5mm (±23.7 SD; range 20 – 151 mm). While those trees that died had a slightly smaller than average stump diameter, this was unlikely to be a contributing factor to mortality as other trees with small stumps grew very well. In the vast majority of cases, it was possible to attribute mortality to dense shade or rank grass smothering regrowth.

Number of shoots

The mean number of dominant shoots was 1.8, with 27 trees having more than 5, and the mean number of minor shoots was 4, with 57 trees have more than 10 minor shoots.

During the first growing season after stumping many walnuts grew extremely well, many catching up with their pre-stumped height. While the regrowth was extremely impressive, it was almost too impressive such that the stem was unable to support the weight of all the leaves, and many of the most successful stems bent over and partially snapped. Fortunately, there were several stems to choose from, and when the trees were singled in February and March 2016, it was possible to select the best undamaged stems, and at the same time, cut back side branches to prevent the same happening again in 2016. Also, several trees were staked at this time

Table 2. The percentage of walnut trees at the Oxfordshire site that fell in to each regrowth category, two years after stumping.

Form Score	Percentage (%)
1 – dead	11.5
2 – poor	15.9
3 – acceptable	18.9
4 – good	23.7
5 - excellent	30.0

Top left: Figure 1. Pruning to a single leader at the Oxfordshire site, July 2004.

Above: Figure 2. Spring frost damage and extreme poor form, May 2011.

Left: Figure 3. A 15 year old walnut stumped in January 2014, with two years regrowth, photo taken April 2016.

Conclusions

This was a large undertaking, carried out over several years with the aim of improving the growth and form of the walnuts with the aim of being able to assess the genetic worth of the trees longer term. Optimal timings were hampered by lack of staff availability and funding, and this has affected results somewhat. While reps 1 – 13 were stumped two years later than rep 14, this will not alter results very much, as the *Elaeagnus* swamped rep 14, and much of the regrowth mortality occurred in this rep, due to not getting on top of the work in time. However, the 'stumps' are mostly still alive, and subsequent regrowth almost negate the time gap. So although rep 14 is now technically two years older than reps 1 – 13, they are in fact smaller and of poorer form.

An average of 1.8 dominant shoots is a good result. While a single leader might be viewed as ideal as requiring no singling subsequently, in reality, many leaders were bushy, and bent over due to weight of the leaves. Where there were two of more, it enabled a second winner to be chosen in 2015. The more vigorous of the lesser shoots have been removed, and many of the smallest ones left to provide some photosynthetic capability, while having minimal impact on form. It is expected that these minor shoots will become insignificant, and can be removed if desired, but will likely self-prune with time.

Although 15 years of age is late to be stumping, (because of the loss of 15 years growth) in this instance, the work has been well worth undertaking as it is now possible to see how this research trial can yield results in the future, and also realise some valuable timber.

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References

Clark J and Brocklehurst M 2011. Stumping in walnut. *Quarterly Journal of Forestry* **105**: 275-279.

Timeline (all operations in winter unless stipulated)

1998	trees planted
1999	trees assessed. Glyphosate applied.
2001	trees assessed. Glyphosate applied
2002	trees assessed
2003	trees assessed (5 year data). It becomes apparent that tree form is very poor.
Aug 2004	all trees singled, and formative pruning carried out
2004	trees assessed
2007	*Elaeagnus* planted between walnuts
2008	*Elaeagnus* beaten up
2008	trees assessed (10 year data)
2009	spring budburst assessments
Feb 2012	rep 14 stumped
Jan 2014	reps 1 – 13 stumped and stumps measured.
Jan 2015	first year regrowth assessed. *Elaeagnus* cut back hard.
Feb 2016	walnuts singled and tubed.
July 2016	walnuts lightly pruned and branches tipped back