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Arboriculture Research Note

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A comparison of 'target' pruning, versus flush cuts and stub pruning

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Summary

An assessment of four-year-old experimental pruning wounds on European beech trees (Fagus sylvatica) confirmed the view that wood discoloration develops more extensively beneath flush cuts than beneath those created at the natural stem/branch junction ('target' cuts). There was no difference between 'target' cuts and stub cuts in this respect. Cambial dieback extended only slightly from flush and 'target' cuts, but on stub cuts it typically extended to the stub base. Flush cuts induced the fastest 'callus' growth but, due to their large size relative to 'target' cuts, they showed proportionately less occlusion after four years. Other observations indicate that the most rapid occlusion occurs neither with 'target' nor with flush cuts, but with cuts intermediate between them. Stub cuts show very poor 'callus' growth and their occlusion is very protracted.

Introduction

1. For many years, pruners of trees and their mentors were divided between those who favoured the retention of branch stubs and those who preferred cuts made flush with the trunk. The supposed advantage of the stub cut was that it avoided damage to the parent stem. However, proponents of the flush cut have pointed out that stubs usually die back to the branch base, thus obstructing wound occlusion, and that decay often extends from the stubs into the parent stems. Also flush cuts have the outward attraction of inducing rapid 'callus' growth. Total occlusion of wounds by 'callus' is believed to help arrest any decay that may have developed since wounding.

2. Over the last ten years, flush cutting has been increasingly viewed with disfavour because it injures tissue that are automatically part of the parent stem. Flush cut transverse the natural plane that divides branch tissues from the stem tissues, and which is externally visible as a ridge ('branch bark ridge' Fig.1) (Shigo 1982).

Target pruning

3. To avoid injuring the parent stem, a cut should not damage the 'branch bark ridge'. Although the ridge defines the absolute 'allowable' closeness for the upper edge of a pruning cut, there is no corresponding natural guideline for defining the lower edge. However, use can sometimes also be made of a swollen 'collar', which if present, marks the position where wood cells belonging to the parent stem wood encircle those of the branch (Shigo 1985). Collars can be distinguished with certainty only in cases where the diameter growth of the branch has been (disproportionately) slower that that of the parent stem.

4. 'Target' pruning involves removing the branch immediately distal to the branch collar, if one is apparent, or distal to the branch bark ridge in the absence of such a collar (Shigo 1982). If the cut starts from the ridge, its optimum angle may vary according to the type of tree, but a rough guide is that it should be opposite and equal to the angle of the ridge (fig. 1).

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5. Before the widespread adoption of ‘target’ pruning, conventional pruning cuts were often intermediate between ‘target’ cuts and flush cuts, since most practitioners have avoided removing the entire basal flare of branches, even when adopting flush cutting in principle (Neely 1988).

Evaluation of ‘target’ pruning

6. Initial evidence in favour of target pruning came from unreplicated observations of flush and non-flush cuts, which showed differences in the extent of staining and in patterns of wound occlusion (Shigo 1982). There has thus been a clear requirement for experimental studies.

7. Investigations on pruning position have been conducted under the DoE contracts, starting in 1981 with a comparison of ‘target’ and flush wounds on a single much-branched specimen of Swedish Whitebeam (*Sorbus intermedia*). A major experiment was set up in July 1986 on 40-year-old beech trees (*Fagus sylvatica*) at the edge of the plantation. Three types of pruning wound were included: ‘target’ cuts made as described in para.4; flush cuts made by removing the entire flare of the branch bases, and stub cuts created by cutting the branches transversely, leaving 50mm of their length distal for the apex of the branch bark ridge. All branches used had a basal diameter of at least 50mm and were on the open –grown sides of the trees. The three types of cut were replicated 10 times among the trees used in the experiment.

8. After four years the experiment was destructively sampled and analyzed with respect to (a) cambial dieback and (B) callus growth around the wound edge, (c) the extent of wood staining beneath the sound surface and (d) the incidence of colonisation of the wood by decay fungi.

Cambial dieback

9. Flush and ‘target’ cuts showed similar and slight amounts of dieback. There was much more dieback on the stub cuts but this simply reflected the tendency of most stubs to die back to their bases and rarely beyond this point.

‘Callus’ growth (Figs. 2&3)

10. As expected from the study of and from preliminary work on beech trees at another site, the flush cuts induced slightly more ‘callus’ growth that did the target cuts. However, with regard to wound closure, the ‘target’ cuts produced better results owing to their small initial size (Fig.3). Also, the flush cuts produced a slit-like rather than a circular pattern of closure because far more ‘callus’ growth occurred laterally than axially. This type of growth can lead to eventual cracking of the new wood due to physical stresses. The stubs produced very little ‘callus’ growth and this always occurred at the stub base, where it was probably restricted by the pressure of the overlying bark. In some cases this basal ‘callus’ developed after the delayed dieback of the stubs, until which stage a short-lived rim of ‘callus’ formed around the wound periphery. Many years of ‘callus’ growth over and around the stubs would have been needed to achieve wound occlusion.

Wood discoloration and fungal colonisation (Fig.4)

11. the flush cuts produced the most extensive discoloration of the wood in the parent stem (Fig 4.), and in some cases this discoloration extended up as well as down the stem. With stub cuts and ‘target’ cuts, discoloration developed only downwards in the parent stem and was similar in extent for both types of cut. However, in the case of stubs, the wood within the stub itself was discoloured and often decayed.

12. Basidiomycetes (decay fungi) and other fungi were present at similar relative frequencies in the wood underlying all three types of wound.

Conclusions and comparisons with other data

13. this study confirms the value of ‘target’pruning, relative to extreme flush or stub pruning. Avoidance of flush cuts on the grounds that they induce extensive discoloration in vindicated. Avoidance of stub cuts is also vindicated, but only on grounds of delayed occlusion; not of encouragement of decay.

14. The present findings do not seem to support general observations that extensive dieback often occurs below (and occasionally above) flush cuts, but they confirm that such cuts are associated with relatively poor 'callus' growth at these positions.

15. The extent of discoloration and decay beneath pruning wounds is a more important criterion for evaluating practices that is the occlusion rate. Experimental study of this requires a long 'incubation period' and the destructive analysis of the test trees. The four-year study which is reported here is the longest-term study completed so far. Some quantative data have, however, been published since the study was set up. In a survey of 'municipal' pruning wounds on lime (*Tilia* spp) in Germany, Liese *et al*(1988) found that flush cuts produced more extensive wood discoloration that 'target' cuts. The same research group also reported similar results from a single-season pruning experiment on large-leaved lime (*T.platyphyllos*) and Horse chestnut (*Aesculus hippocastanum*) (Dujesiefken *et al,* 1988). Horse chestnut was particularly prone to discoloration flowing flush cutting.

16. Since this experiment lasted only four years, it remains possible that the discoloration associated with the stubs would, in time, have extended further into the parent stems. This might be expected because the stubs would have remained unoccluded for many years, while providing a potential food base for decay fungus.

17. In comparing the present data with findings elsewhere, it should be noted that the flush cuts inflicted in this study were more extreme than the majority of so-called flush cuts that have been created in Arboricultural work. This was necessary because standardisation depended on removal of the entire branch flare; anything less severe would be hard to define. Neely (1988) has, however, attempted a comparison between target cuts and intermediate cuts that approximated to 'conventional flush cuts' on Pin oak (*Quercus palustris*), American plane (*Platanus occidentalis*) and Norway maple (*Acer platanoides*). He found that the conventional cuts became occluded more quickly.

18. The absence of extensive decay beneath four-year-old stubs lends support to the idea of 'phased target pruning' in which a branch is pruned to leave a stub whish is subsequently removed just beyond its natural pruning position than one-stage 'target' pruning. Although impracticable for many purposes, phased target pruning could be incorporated within long-term tree management contracts (e.g. for street trees).

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