

Branch Pruning Guidelines II: *K. senegalensis* water sprouts attachment strength study in Singapore

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Objective

The objective of this technical note is to guide arborists in Singapore on the points to be considered when crown reducing a tree. A proper crown reduced tree can look good and structurally sound. The guidelines are based on the results of the water sprouts attachment strength study in Singapore.

Background



In Singapore crown reduction is often carried out on mature trees growing along the roadsides, in the parks, housing estates and private condominium compounds to reduce the tree failure risk. This operation is conducted just before the onset of the monsoons as often as every 2 to 3 years. Many of the mature trees are crown reduced (Figures 1a & 1b) by cutting at internodes (topping method), back to lateral branches (reduction method) and at branch collars (natural target method) (Figures 2a, 2b & 2c), leaving only few bare branches and few leaves on the crown. The percentage of the tree crown removed can range between 25% to 90%.

Figures 1a & 1b Crown reduced mature *K. senegalensis* along Lornie Road



Figures 2a, 2b & 2c Different pruning methods used for crown reduction of mature trees: natural target pruning method (2a), topping pruning method (2b) and reduction pruning method (2c) [back to lateral branch which is 1/3 the diameter of the attachment branch]

Crown reduction stimulates the growth of dense, upright water sprouts (Figures 3a & 3b) derived from epicormic (or adventitious) buds that lie dormant beneath the bark near the pruning cuts and along the branch. The water sprouts are always thought to be weakly attached to the branch and can get easily detached in adverse environmental conditions.



Figures 3a & 3b Two-year old water sprouts of *K. senegalensis* along the branch and below the pruning cuts

A study on *Khaya senegalensis* water sprouts attachment strength conducted by CUGE confirmed that water sprouts when compared to similar size branches that derived from axillary buds from natural growth and development are 25% weaker i.e. less force is required to break/detach the water sprouts from their attachment. The breaking modes for the water sprouts are snapped at and wrapped round (Figures 4a & 4b), with wrapped round being the most common. A typical wrapped round breaking mode for water sprouts is shown in Figure 4b. The water sprouts appeared to be attached only to the surface of the attachment branch (Figure 5), rather than anchored from within the attachment branch. The wrapped round breaking mode for water sprout was also observed for water sprouts of *Syzygium grande*, *Pterocarpus indicus* and *Tabebuia rosea*.

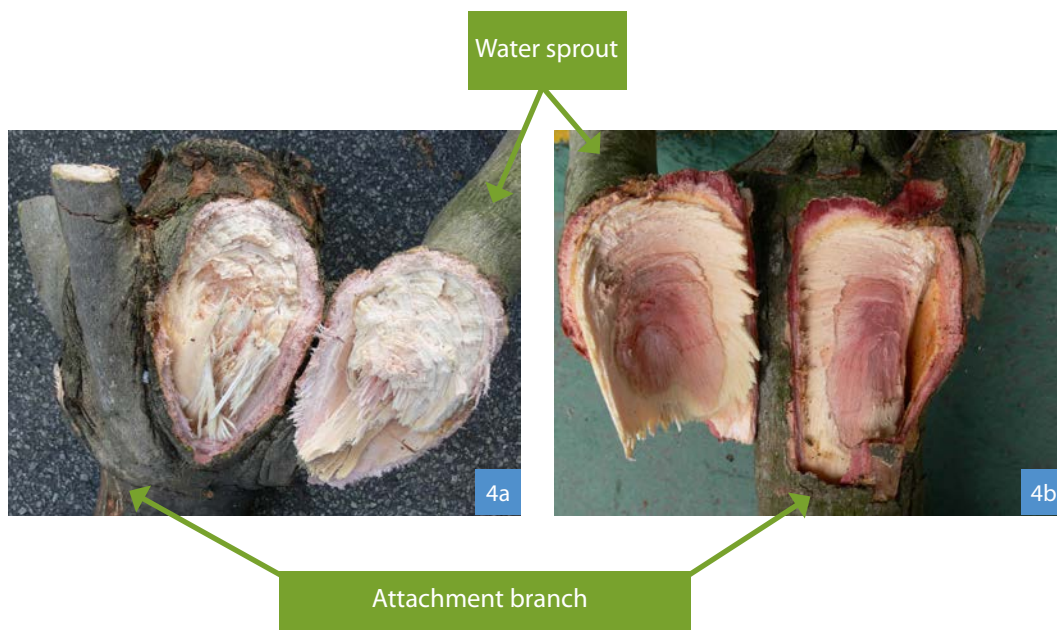


Figure 4a & 4b Snapped at breaking mode (4a) & Wrapped round breaking mode (4b) for water sprout of *K. senegalensis*

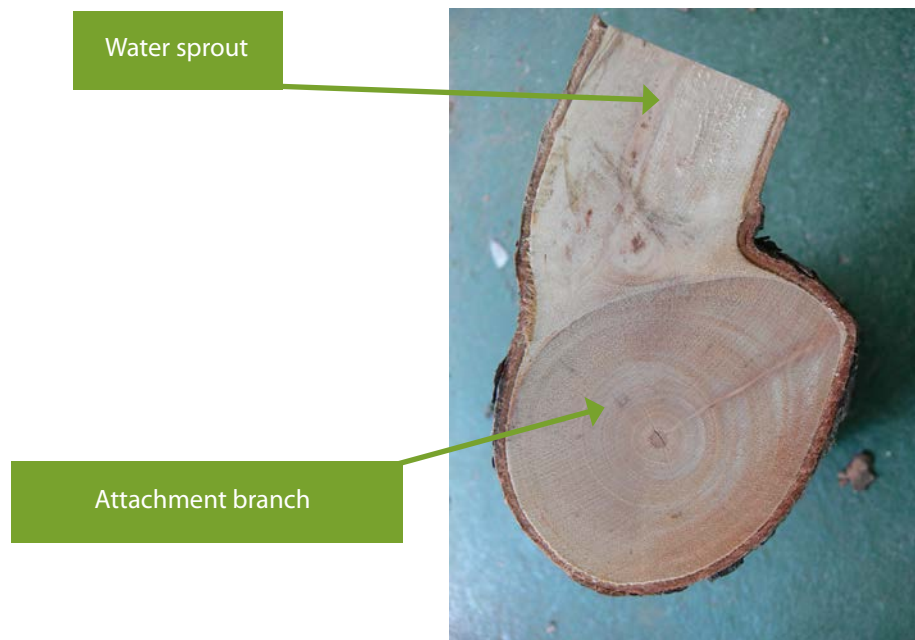
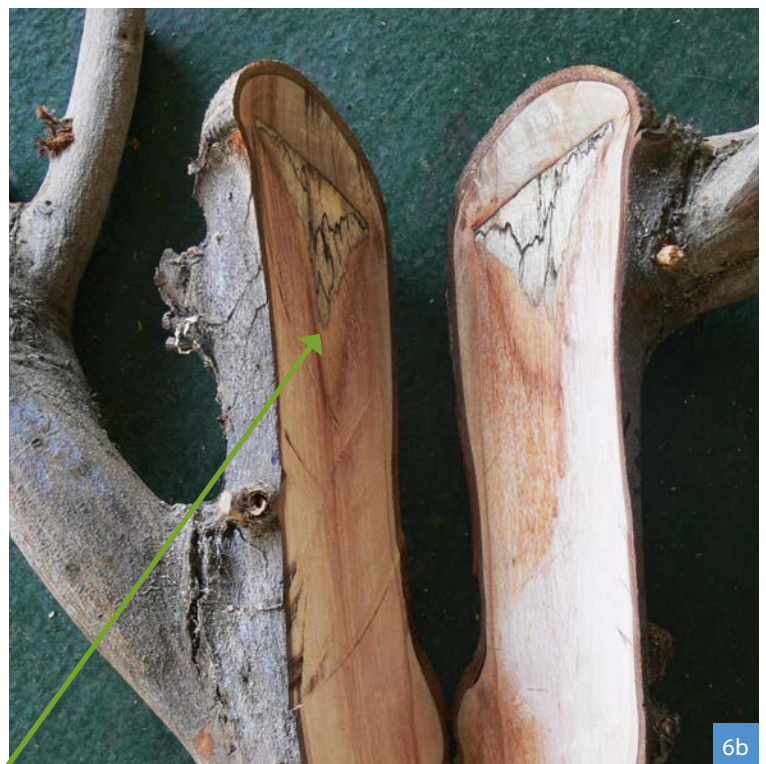


Figure 5 A cross section of a water sprout of *K. senegalensis* on an attachment branch. There is no indication of anchorage from within the attachment branch

Pruning of branches often result in discolouration and decay just below the pruning cuts (Figures 6a, 6b & 7b). In this study we found that the depth of discoloration and decay within a pruned branch below the pruning cut is significantly correlated with the diameter of the branch during pruning i.e. small wounds are associated with less discoloration and decay than big wounds. Branch diameter of 4.5cm appeared to be the threshold value for healthy branch pruning for *K. senegalensis*.

This study also confirmed that pruning at branch collars (Figures 2a & 7a) is a better way to remove branches than pruning at the internodes, resulting in topping wounds (Figures 2b, 6a & 6b). In this study topping wounds were found to have 279% more discoloration and decay than branch collar wounds.



Topping wounds with discolouration & decay below pruning cuts

Figures 6a & 6b Topping wounds of *K. senegalensis* with discolouration and decay



7a

Branch collar wound



7b

Discolouration and decay

Figures 7a & 7b Branch collar wounds of *K. senegalensis* with discolouration and decay

The percentage of pruning wound closure can vary from branch to branch (Figures 8a and 8b). The percentage of closure is directly related to the depth of discolouration and decay below the pruning cuts. Old pruning cuts with <25% (Figure 8b) closure, is a good indicator for severe discolouration and decay within branches.



8a

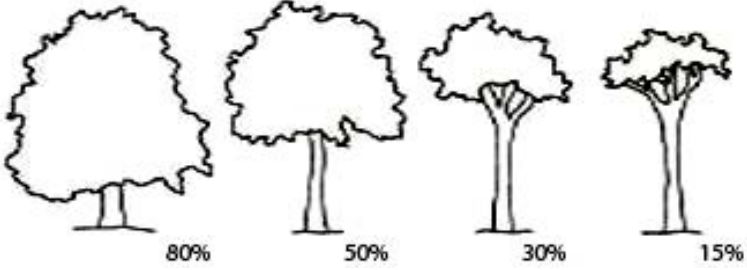


8b

Circumference of previous pruning cut

Figures 8a & 8b >75% closure of previous pruning cut (8a) of *K. senegalensis* and <25% of closure (8b)

How to use research findings to guide crown reduction on *K. senegalensis*?

Current operational practices	Proposed operational practices
<p>1. Crown reduction is conducted on mature to overly mature trees.</p>	<p>Crown reduction can be conducted on trees of girth G2 when their live crown ratio* exceeds 60%. Do not wait until they have big branches.</p> <p>Crown reduction needs to be carried out with special care and over a few years. 25% of crown removal is recommended each year.</p> <p><i>*Live crown ratio = ratio of foliage canopy to total height of tree (Matheny & Clark, 1994)</i></p>  <p>The diagram illustrates four trees from left to right, each with a different live crown ratio. The first tree has a ratio of 80%, the second 50%, the third 30%, and the fourth 15%. The trees show a progressive reduction in the proportion of their total height that is covered by foliage canopy.</p>
<p>2. Big and small branches are indiscriminately cut at internodes by topping/heading method resulting in topping wounds.</p>	<p>Avoid cutting big branches. Small branches are safe to cut back for minimal discoloration and decay.</p> <p>Avoid cutting any branches by topping/heading method*.</p> <p><i>*Inappropriate pruning cut</i></p>
<p>3. All water sprouts are kept on the trees for about 2 years before selective removal. Water sprouts are overcrowded on branch ends before removal.</p>	<p>Water sprouts should be selectively pruned when young to avoid overcrowding of branches.</p> <p>Those on the trunk to the first primary branch should be removed.</p> <p>Keep most of the strong sprouts on scaffold branches that receive adequate sunlight as permanent branches. Reduced permanent sprouts in length by cutting them back to lateral branches that are large enough to assume the terminal roles i.e. at least 1/3 the diameter of the cut branch. This controls the growth of the sprouts and ensures adequate attachment for the size of the sprouts.</p> <p>Remove all the weak sprouts back to original heading cuts, leaving no bud behind.</p>
<p>4. Large pruning cuts on trees are seldom inspected for % of wound closure and decay.</p>	<p>Regular inspection of large pruning cuts on mature trees for % of wound closure and decay.</p> <p>Big branches with old pruning cuts with <25% closure need to be checked using resistograph drilling to determine decay behind pruning cuts. Take immediate action to prune branches if decay is found to be severe behind cuts.</p>

Expected Outcomes

Crown reduced mature *K. senegalensis* will have less discoloration and decay below pruning cuts, stronger attachment for all branches, may result in less branch failure during adverse environmental conditions.