Research Technical Note
Urban Greenery Series
RTN
02-2013
February

Mechanical Injury and Occlusion: an Urban, Tropical Perspective for Eight Common Trees Species in Singapore

Author: Dr. Genevieve Ow

Introduction

Pruning of urban trees unlike forest trees is undertaken for safety over and beyond all other considerations. The trees alongside infrastructures (e.g. buildings, footpaths or roadways) require regular pruning because the result of a fallen branch can have serious impacts on human life/activity. The ability of a tree to heal itself quickly following pruning is important as it reduces the risk of infection and negative impact on tree growth, and it improves the quality of its wood.

The techniques of proper tree pruning are well documented in the literature and if these guidelines are adhered to, the tree should be able to effectively repair the tissue around the pruning wound or occlude the wound. The following illustrations are suggested dos (**Fig 1A**) and don'ts (**Fig 1B**) of tree/branch pruning:

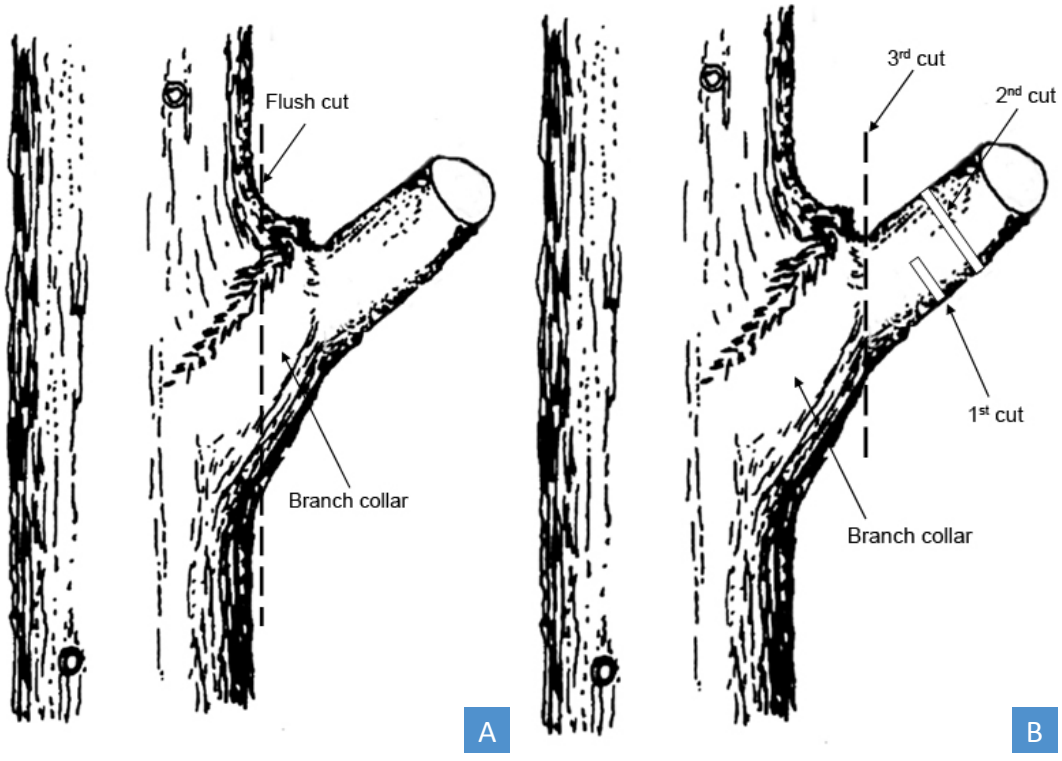

Fig 1. Two different techniques of branch pruning.

Although, extensive reports are available in the literature, conflicting recommendations over a seemingly simple yet central concept (of pruning) still exist. More importantly, much of the work conducted so far had been carried out predominantly in the temperate regions with limited studies conducted in tropical areas. Even less is known about the effects of pruning and subsequent occlusion in urban trees.

Therefore, the Centre for Urban Greenery and Ecology developed a study around this subject, working with eight common tree species which are as follows:

- *Samanea saman*
- *Khaya senegalensis*
- *Peltophorum pterocarpum*
- *Mimusops elengi*
- *Lagerstroemia speciosa*
- *Pterocarpus indicus*
- *Eugenia grandis*
- *Milletia pinnata*

Objectives of study

1. To determine if different pruning methods has an impact on the rate and extent of occlusion in tropical urban tree species.
2. To identify the effects of wound size on the rate and extent of occlusion.
3. To determine the consequences of wounding through the subsequent development of wound induced discoloration in stems.
4. To identify the variability between species in rate and extent of occlusion.

Methodology

The experiment was conducted between 2009 to 2012 involving eight tree species. The trees were grown by the side of the road and exposed to natural conditions, comprising of five experimental trees (with ten pruning wounds) per species.

Tree wounding:

The wounds inflicted on the stems were at approximately the same height on the trees and within 2 m to 5 m from the ground (**Fig 2**). The size of wounds were between 10 cm to 23 cm (width measurements). The wounds made were ellipses with rounded edges. Chisels were used to remove the bark and fully expose the wood.

Fig 2. Induction and measurement of wound.

Two pruning methods were applied to inflict wounds on the stem. The first method was a flush cut which is a technique of pruning the stem, branch or major limb back to the base. This involved cutting the stem or branch back against the trunk or parent limb (**Fig 1A**). The other method used is known as natural target pruning. This practice makes use of the branch collar to identify the appropriate location for branch removal. A three-cut process was used in this technique so as to ensure preservation of bark tissue and branch collar (**Fig 1B**).

Wound occlusion and cross sectional discolouration:

The extent of wound closure was determined on a monthly basis. Horizontal and vertical measurements were observed and the same readings were repeated every month. The closure of wounds was generally divided into three categories: full closure, intermediate coverage and

poor coverage (**Fig 3**). For the measurement of wound induced discolouration in wood, branches were dissected and the extent of discolouration was established at their maximal extension points in an axial and tangential direction. The maximal width and length of discolouration present over the branch cross section was measured.

Fig 3. Extent of callus formation over pruning wounds – illustrations show (**A**) good coverage of healing tissue (fully closed wound), (**B**) intermediate coverage of healing tissue and (**C**) poor coverage of healing tissue.

Findings

Synthesis of the results obtained from this long term (three-year) field study indicated that the method of flush cut pruning (**Fig 1A**) is not beneficial to wound occlusion while the technique of natural target pruning (**Fig 1B**) is the preferred method as the percentage of wound closure rose from 0 to 60% (varying with species).

The exposed wood diameter for all species were significantly reduced after the second growing season for injuries derived through natural target pruning but for the same period, injuries derived through flush cut pruning, only six species showed significant reductions in exposed wood diameter. Two other species (*Mimusops elengi* and *Lagerstroemia speciosa*) were observed to have no further reduction in exposed wood following the first growing season.

As for discolouration in the stem, a strong positive relationship between width of the wound and the length of discolouration suggested that smaller cuts were better suited to avoid extensive wound induced discolouration. Furthermore, these findings were reinforced by visual observations of dissected stems that indicated that smaller cuts were better able to callus over as opposed to larger wounds.

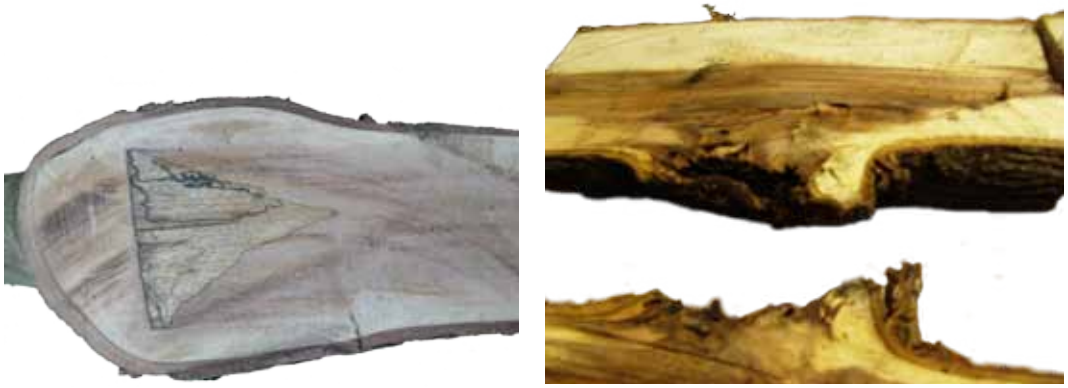

Fig 4. Internal discolouration in wood.

Discussion

The process of occlusion in tropical trees is different from that of temperate trees given that growth occurs throughout the entire year. Additionally, very little is known about occlusion in an urban environment where trees are exposed to harsh growing conditions (e.g. constrained planting spaces and polluted atmospheric conditions). These reasons support the need for research focusing on pruning and wound occlusion in tropical trees and especially on trees growing in an urban environment.

The ability to heal over effectively was found in this study to be species specific – whereby *Khaya senegalensis* was able to fully close all wounds observed in this study and achieved this in the shortest period of time. The other seven species were generally only capable of an intermediate coverage (of callus tissue), with few exceptions. Of the seven species examined in this study, *Mimusops elenegi* and *Lagerstroemia speciosa* were the least responsive to wound occlusion.

The method of flush cut pruning resulted in wounds that did not completely close but when injuries were inflicted through natural target pruning, the rate of wounds that healed over increased. The following species were identified as the better healers: *Samanea saman*, *Khaya senegalensis*, *Peltophorum pterocarpum*, *Pterocarpus indicus*, *Eugenia grandis* and *Milletia pinnata*. Similarly, the two exceptions were *Mimusops elengi* and *Lagerstroemia speciosa* where only 20% of the wounds that were inflicted, healed over with callus tissue. No further occlusion on all species occurred after the second year.

Lastly, correlation analyses between the width of the wound and the length of discolouration (**Fig 4**) in the stems provided evidence to suggest that smaller cuts were better suited to avoid extensive wound induced discolouration. This finding was further reinforced through the dissection of numerous pruning wounds of all eight species which showed that smaller cuts were better able to heal as opposed to larger wounds.

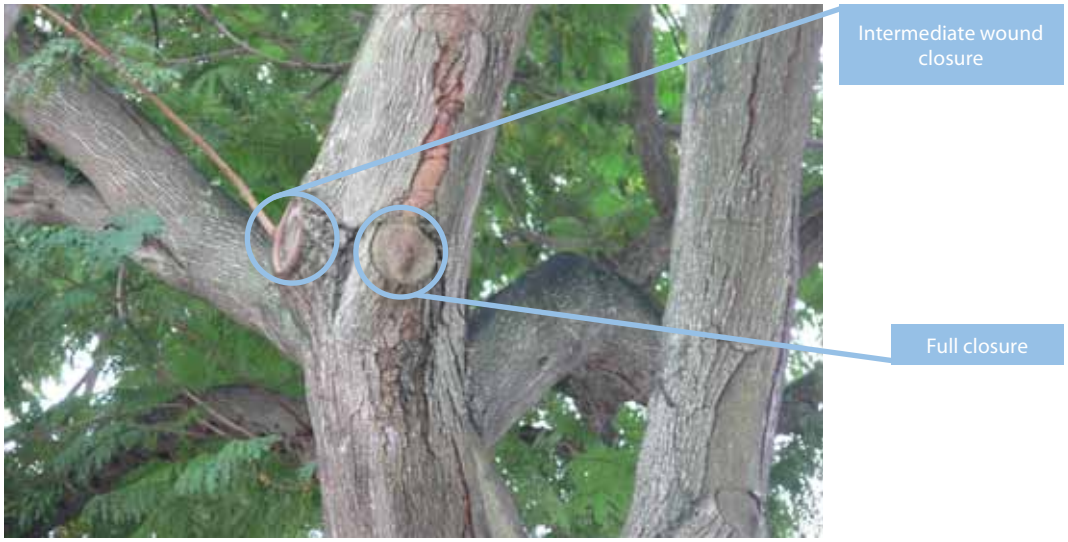

Fig 5. Illustration showing an intermediate and good coverage of healing tissue on the same tree.

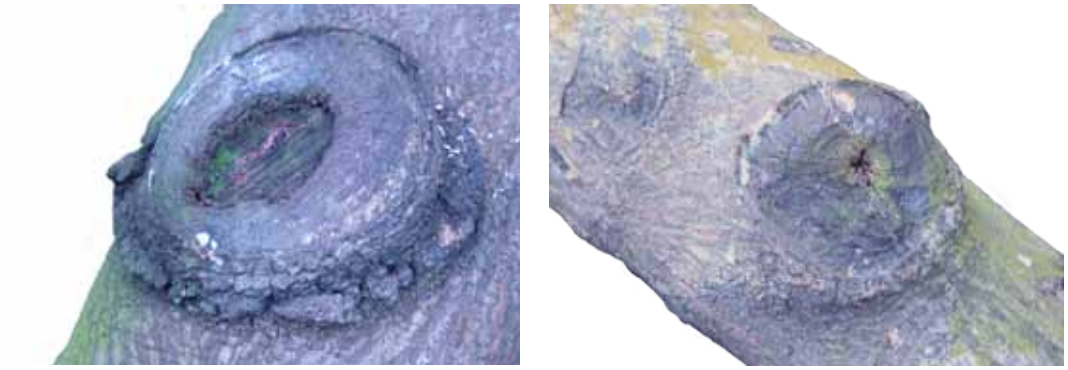

Fig 6. Examples illustrating intermediate and good coverage of healing tissue.

Recommendations

The following recommendation is put forth based on the findings of this study - ranking species according to their potential to occlude promptly and effectively. It should be emphasised that wound occlusion do not proportionately correlate to the avoidance of stem discolouration or spread of decay within the pruned stem. Additional details (of this study) can be obtained from CUGE Research.

Ideal ↕ Least Ideal	Type of tree
	Khaya senegalensis
	Samanea saman
	Peltophorum pterocarpum
	Eugenia grandis
	Pterocarpus indicus
	Milletia pinnata
	Lagerstroemia speciosa
	Mimusops elengi

NATIONAL PARKS

CUGE
CENTRE FOR URBAN GREENERY AND ECOLOGY