ISSN 0111-4743

LOGGING INDUSTRY RESEARCH ASSOCIATION NEW ZEALAND

REPORT

Vol. 14 No. 9 1989

FELLING TECHNIQUES TO REDUCE BUTT DAMAGE

Lindsay Vaughan
Boy Biddle

ABSTRACT

The use of different techniques to reduce butt damage were evaluated in a series of controlled tests. The lowest values of draw wood were achieved with thin hinges. Alternative backcutting techniques are required to achieve this on leaning trees.

Both angled wingcuts and horizontal sidecuts were effective in controlling slabbing. Both techniques reduce hinge strength. For safety reasons, their use should be restricted to trees with little or no side lean. Steeply angled wingcuts have become the accepted technique, as there is less chance of over-cutting the ends of the hinge.

INTRODUCTION

This Report summarises a study of felling techniques to reduce butt damage to trees while felling. The work has been fully documented in LIRA Project Report No. 33 "Felling Techniques to Minimise Butt Damage".

With increasing volumes of high value pruned butt logs becoming available, significant savings can be achieved by careful use of appropriate felling techniques.

It has long been recognised that good felling techniques would be required to protect pruned butt logs by minimising slabbing and and draw wood. Previous work by Murphy and Buse (1984) noted that sidecutting reduced both the incidence and length of butt damage.

Figure 1 : Wingcuts

Strong industry demand for further work to test and develop suitable techniques led to the secondment of a trainer, Boy Biddle, to LIRA to undertake this work.

ACKNOWLEDGEMENTS

LIRA acknowledges the assistance of Tasman Forestry Limited in making Boy Biddle available on secondment.

FELLING PRACTICE

Felling techniques of nine fallers working in "transition crop"[1] radiata pine were studied. Each faller was observed while felling twenty trees. Information was collected on the faller, his chainsaw, felling techniques used and stump characteristics.

During the study, a variety of felling techniques were noted. All fallers used the conventional scarf (angled top cut, horizontal bottom cut) but average scarf angles varied from 28° to 49°.

Some problems in aligning the top and bottom cuts were also noted. Only three fallers used side-cutting techniques - two used angled wingcuts (Figure 1) and one used horizontal sidecuts (Figure 2). Average backcut heights were 7 to 11 cm above the bottom cut of the scarf. Only one faller consistently placed his backcut level with or below the bottom cut in an effort to increase the length of pruned butt log, a dangerous practice.

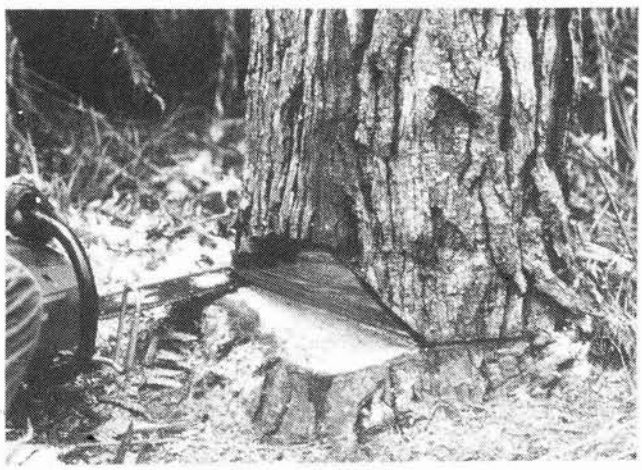

Figure 2 : Sidecuts

[1] *Transition crop refers to stands established in the 1950s and 1960s which have received a variety of pruning and thinning treatments.*

Two types of butt damage were recorded - draw wood (damage inside the log) and slab wood (damage to the outside). Draw wood averaged 13 cms (range 1 to 74 cm) and slabwood (on 12% of the stumps) averaged 55 cm (range 7 to 130 cm).

FELLING TESTS

A series of felling tests, where selected trees were assessed and felled under controlled conditions, were undertaken to evaluate different techniques. Each technique was replicated on a small number of trees using the same scarf type and scarf angle, and keeping such factors as scarf depth, back cut height and hinge thickness (as a proportion of diameter) constant.

The assessment included an evaluation of lean in two directions - side lean and forward/back lean. This proved to be critical in identifying trees susceptible to butt damage.

RESULTS

Effect on Draw Wood

The tests examined the effects on draw wood of :

- hinge thickness
- backcut height
- scarf type
- scarf depth
- scarf angle
- sidelean

The most important finding was that the lowest values of draw wood were achieved with thin hinges and the highest values from thick hinges (Figure 3). Hinge thickness was measured as a proportion of stump diameter; thin (5%), conventional (10%), and thick (15%). This relationship is well known amongst experienced fallers. However, thin hinges are difficult to achieve on leaning trees, particularly forward leaners, if the conventional backcutting technique (starting at

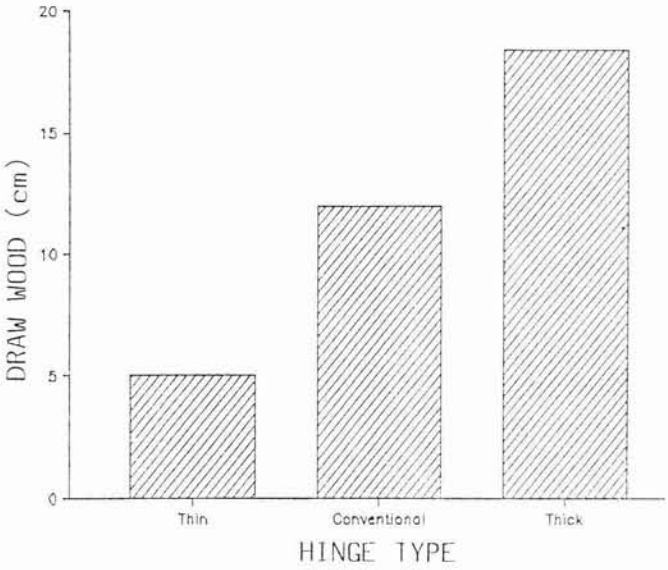

Figure 3 : Effect of Hinge Thickness on Draw wood

the back of the tree and cutting towards the scarf) is used. Alternative back cutting techniques can be applied, which involve setting up the hinge first (by boring) before completing the back cut (by cutting towards the back of the tree). These achieve a thin hinge and will need to be more widely applied with increasing use of smaller, lighter chainsaws with shorter bars. Perhaps surprisingly, increasing back cut height did not consistently reduce the amount of draw wood, although it is a practice widely used by experienced fallers to reduce draw wood in forward leaners.

Testing of the other factors confirmed the benefits of good basic practice on trees with little or no sidelean. This involves :

- a conventional scarf with a 45° scarf angle
- a scarf depth of 1/4 to 1/3 of tree diameter
- a back cut height of 1/10 tree diameter
- a hinge width of 1/10 tree diameter

Variations in these techniques are needed to deal with heavily leaning trees. These techniques are described in the LIRA Project Report and in the Logging and Forest Industry Training Board training guides. They are taught by the Logging and Forest Industry Training Board trainers.

Effect on Slabbing

Initial results with sidecuts were impressive and showed a substantial reduction in the frequency of slabbing.

The results from one set of tests in Kinleith Forest (Table 1) show substantial reductions in the length of the slab as well as the frequency of slabbing.

Analysis of the results of all trial data (for 252 trees from 4 forests) showed a dramatic reduction in the frequency of slabbing, from 37% down to 3%.

TABLE 1 : EFFECTS OF SIDECUTTING ON SLABBING

Treatment	*No. of Trees*	*Frequency of Slabbing*	*Slab Length (cm)*	
			Mean	*Range*
No sidecuts	*19*	*47%*	*24*	*0-120*
Two sidecuts	*17*	*6%*	*0.4*	*0-7*

Comparison on Wingcuts and Sidecuts

Comparisons of sidecuts and wingcuts were carried out. Both techniques were effective in controlling slabbing (Table 2).

TABLE 2 : EFFECT OF SIDECUTS AND WINGCUTS ON SLABBING

Treatment	*No. of Trees*	*Frequency of Slabbing*
Sidecuts	*25*	*4%*
Wingcuts	*13*	*8%*

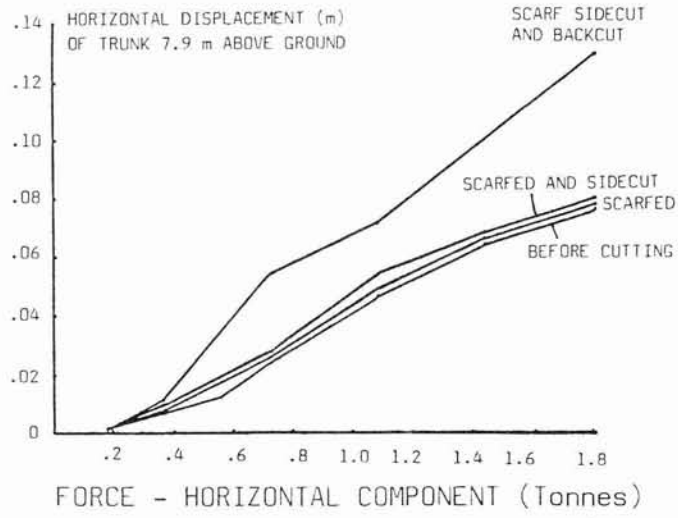

Figure 4 : Results of Standing Tree Tests

EFFECT OF SIDECUTTING TECHNIQUES ON HINGE STRENGTH

There has been considerable concern expressed over the potential loss of hinge strength with the use of wingcuts and sidecuts. Trees with some side lean could fall sideways if the hinge was weakened too much.

Three series of tests were undertaken to assess the effect of sidecuts on hinge strength.

(1) <u>Measurement on Standing Trees</u>

This test examined the effect on standing trees. Six trees with little or no lean in a 35 year old stand at Kinleith Forest were assessed. A sidewards force was applied 8m up the tree using a portable winch. A load cell measured the force applied and a theodolite measured the sidewards movement. The procedure was repeated after each step in the felling process:

- on the whole tree before scarfing
- after scarfing
- after sidecutting
- after backcutting.

Care was taken to remain within the elastic limit of the trees and to leave sufficient hingewood to support the tree during the test.

There was no measurable difference before or after scarfing (which removed about 15% of the cross-sectional area) or sidecutting (further 2%) (Figure 4). A noticeable difference occurred after backcutting (removing a further 65%). This left only 18% of the stump as hingewood supporting the tree.

These results suggested that sidecutting techniques could be safely applied after scarfing to trees with little or no side lean, without affecting their stability.

(2) <u>Measurements on High Stumps</u>

To closely examine the effect of sidecuts on hinge strength, tests were carried out on selected trees in a 40 year old stand in Kaingaroa Forest. Similar size

Figure 5 : Hinge Strength Testing on High Stumps

trees (60-70cm dbh) were topped off at 4m height. Eleven trees were scarfed and five of these were sidecut.

The winch rope on a cable skidder was used to apply a side force (Figure 5).

A load cell measured the maximum load required to break the hingewood.

The results (Figure 6) showed a significant reduction in the strength of the sidecut hinges. It also showed a wide variation in hinge strength between trees of a similar size and age. It indicated that some sidecut hinges would be stronger than full hinges on different trees.

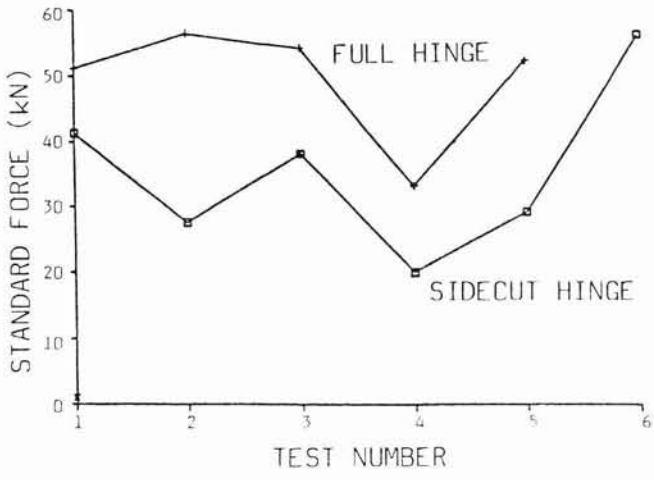

Figure 6 : Results of Sidecuts on Hinge Strength for 4m high stumps

(3) Measurements on Tree-length Logs

These tests were carried out in Kaingaroa Forest using two notched stumps to support the horizontal test log. The logs used were from trees of a similar size to those in the previous test. The winch rope from a crawler tractor was attached to the end of the log. After scarfing and backcutting the log 4m from the end, the rope was winched in until the hinge was broken (Figure 7).

A load cell was used to record the maximum force required to break the hinge (Figure 8).

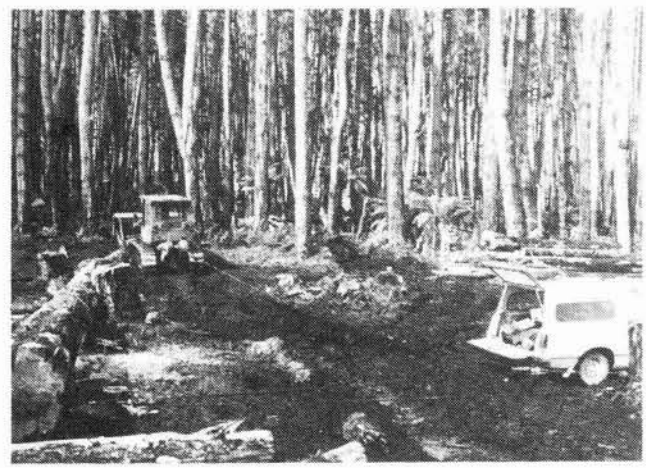

Figure 7 : Hinge Testing on Tree-length Logs

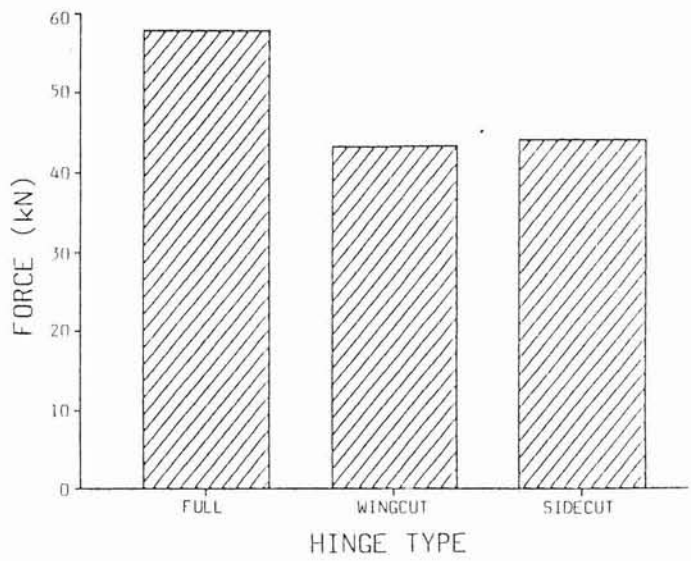

Figure 8 : Estimates of Hinge Strength for Different Hinge Types

The data was adjusted for a standard hinge size; wingcut and sidecut hinges were 10cm shorter in length, after allowing 5cm for sidecutting each end.

These results show a significant reduction in hinge strength of about 25% for both sidecuts and wingcuts. This suggests that sidecutting techniques should not be applied to the end of the hinge under tension (the top side) on heavy side leaners. For trees with a moderate degree of side lean, the reduction in hinge strength by sidecutting can be offset to some extent by increasing hinge width, a standard practice.

DISCUSSION

A felling working group containing representatives of the major forestry organisations, Logging and Forest Industry Training Board, Department of Labour and contractors, met four times during the project. Some group members expressed their concern at the use of sidecutting techniques by inexperienced fallers. The high turnover rates within the logging industry meant that many fallers did not have an adequate grasp of the basic felling techniques. As a result of the discussion within the group, a number of recommendations were made. The two major recommendations were:

Recommendation 1

That wingcuts become an accepted technique to control slabbing on trees with little or no side lean.

Recommendation 2

That sidecuts are not acceptable for controlling slabbing because of the possibility of overcutting the sides of the hinge, allowing the tree to fall offline.

Current Practice

The current practice for controlling slabbing as recommended by the Logging and Forest Industry Training Board is to use steeply-angled wingcuts (60° to 70°), starting level with the bottom cut and cutting down into the stump to a depth of one bar width at each end of the hingewood.

CONCLUSIONS

Techniques to reduce butt damage were evaluated using a series of controlled tests. Thin hingewood was found to produce much lower values of draw wood than thick hinges. Alternative methods of backcutting may be required on trees with substantial lean. Both wingcuts and sidecuts were highly effective in controlling slabbing. Both techniques were found to reduce hinge strength and should only be used on trees with little or no side lean.

For safety reasons, wingcutting is the only acceptable technique.

REFERENCES

Murphy, G., Buse, J. (1984) : "How To Reduce Felling-Related Damage". LIRA Technical Release Vol. 6 No. 6.

Vaughan, L., Biddle, B. (1986) : "Felling Techniques to Minimise Butt Damage". LIRA Project Report No. 33.

For further information, contact:

N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O. Box 147,
ROTORUA, NEW ZEALAND.

Fax: (073) 462-886 *Telephone (073) 87-168*