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THE HAHN HARVESTER IN RADIATA THINNINGS

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Figure 1 - Hahn Harvester working in Kaingaroa thinnings

ABSTRACT

A study to investigate the productive capability of a Hahn Harvester processing wood from a thinnings operation in Kaingaroa Forest was undertaken. The stand was characterised by 0.39m^3 merchantable trees, heavy branching habit and 20% stem malformation. The machine was monitored for a three day period during which 542 work cycles were measured. The Hahn processed 31.2m^3 per productive machine hour (PMH) during the study. The study showed that if the Hahn is to be used in thinning operations a larger average merchantable tree size is required to obtain optimum production rates. Careful harvest planning is required to ensure high production rates are achieved.

INTRODUCTION

The Forest Engineering Research Institute of Canada (FERIC) has carried out evaluations of the Hahn Harvester working in a number of applications. These include central yard processing (Powell, 1981) and a comparison of a "hot deck" landing operation to a continuous roadside (Peterson, 1986). In the central yard application 42.5 m^3/PMH was achieved. The piece size of the Contorta pine was 0.4m^3 and the trees were straight and lightly limbed. During that study machine availability and utilisation was 87% and 84% respectively.

The Hahn Harvester was introduced into New Zealand for exhibition at the FI 1990 in-bush demonstrations and was trialled soon after in Kaingaroa, Kinleith and Kaweka Forests in radiata clearfell (Hill, 1990). Two of the operations processed the skidded trees as they arrived at the landing and the third operation processed trees from a cold deck stack. Production rates ranged from 39.5 m^3/PMH to 52.5 m^3/PMH for the three short duration trials. The average piece sizes in the three trials ranged from 1.35 to 1.47m^3. The three trials had some organisational difficulties as can be expected with the integration of new machinery and systems into existing operations. The Hahn was purchased on the completion of these trials by a thinnings contractor in Kaingaroa Forest and was used in a fully mechanised thinning operation.

This Report summarises the investigation of the productive capability of the Hahn Harvester in thinnings.

ACKNOWLEDGEMENTS

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STUDY DESCRIPTION

The Hahn worked in a hot deck system on a landing in Compartment 1032, Kaingaroa Forest (Table 1).

Table 1 - Stand Details

Stand Age	*(years)*	*17*
Stocking	*(s/ha)*	*671*
Residual Stocking	*(s/ha)*	*278*
Volume per Piece	*(m^3)*	*0.39*
Branching Habit		*heavy*
Malformation	*(%)*	*20*

Table 2 - Summary of Cycle Times

ELEMENT:	*N*	Mean per Observation	95% Confidence Limit	*N*	Mean per Cycle	95% Confidence Limit
Loading processor	*521*	*0.13*	*0.01*	*542*	*0.12*	*0.01*
Processing	*542*	*0.58*	*0.02*	*542*	*0.58*	*0.02*
Loader Assisting Processor	*116*	*0.17*	*0.04*	*542*	*0.04*	*0.01*
Total Processing Time				*542*	*0.74*	*0.03*
Operational delays	*5*	*1.53*	*3.85*	*542*	*0.01*	*0.03*
Productive Machine Time				*542*	*0.75*	*0.03*
Repair and Maintenance	*12*	*14.61*	*0.27*	*542*	*0.32*	*0.05*
Total Cycle Time				*542*	*1.07*	*0.11*
Form	*542*	*1.3*	*0.04*			
Diameter (cm)	*542*	*28.0*	*0.57*			
Volume (m^3)	*542*	*0.39*	*0.01*			

A Bell Super T feller-buncher felled trees and placed them in bunches of approximately three to four trees. Two Caterpillar 518 grapple skidders extracted these bunches to the landing. Whole trees were loaded into the processing head by the Hahn's crane. The trees were processed full length therefore the measuring function was not used. A Bell Logger was used to fleet processed logs to stacks ready for loadout. A wheeled loader loaded the wood out once the Hahn had completed a landing area.

A continuous time study of the Hahn was carried out for 9.5 hours during which 542 work cycles were recorded. The work cycle times were related to measured tree parameters, such as tree diameter, allowing the effect of individual tree characteristics on machine productivity to be quantified. Each tree was subjectively ranked into two form classes. Form 1 trees were straight with light to moderate branching habit and Form 2 trees were heavily branched, malformed or swept.

RESULTS AND DISCUSSION

The measured cycle times and productivity of the Hahn Harvester are summarised in Table 2.

The Hahn processed 80 trees or $31.2m^3$/PMH during the study. The processing element accounted for 77% of the productive machine time. Machine utilisation was 70.1% and was affected by a large mechanical delay as a result of the saw hydraulic motor becoming damaged. Excluding this large delay, the repair and maintenance delays accounted for only 3% of the total study time. The skidders caused only half a minute of delay to the Hahn during the study and no delay occurred through wood not being available to process.

The effect tree form had on the processing element time and the total processing time (loading plus processing plus loader assisting) is given for various tree volume classes (Figure 2). As tree size increased, processing time also increased. To illustrate further the effect piece size had on production, a tree $0.62m^3$ took twice as long to process as a tree of $0.13m^3$ (almost five times the volume).

A similar trend occurs for all differences in tree volumes. Therefore, the highest production rate was achieved when

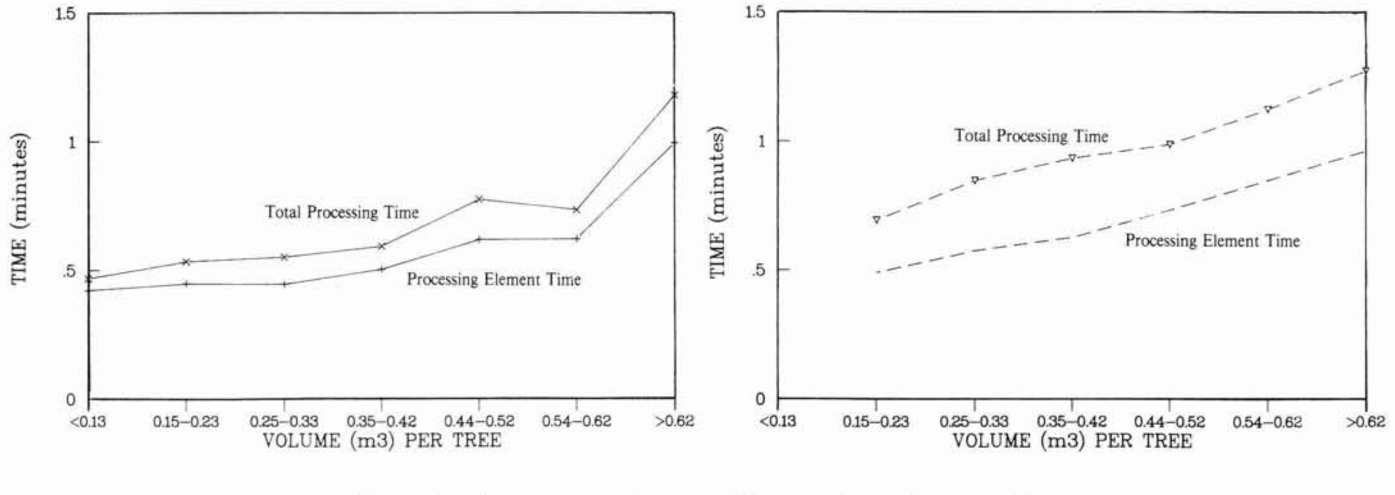

Figure 2 - Processing element time and total processing time against tree volume for each tree form

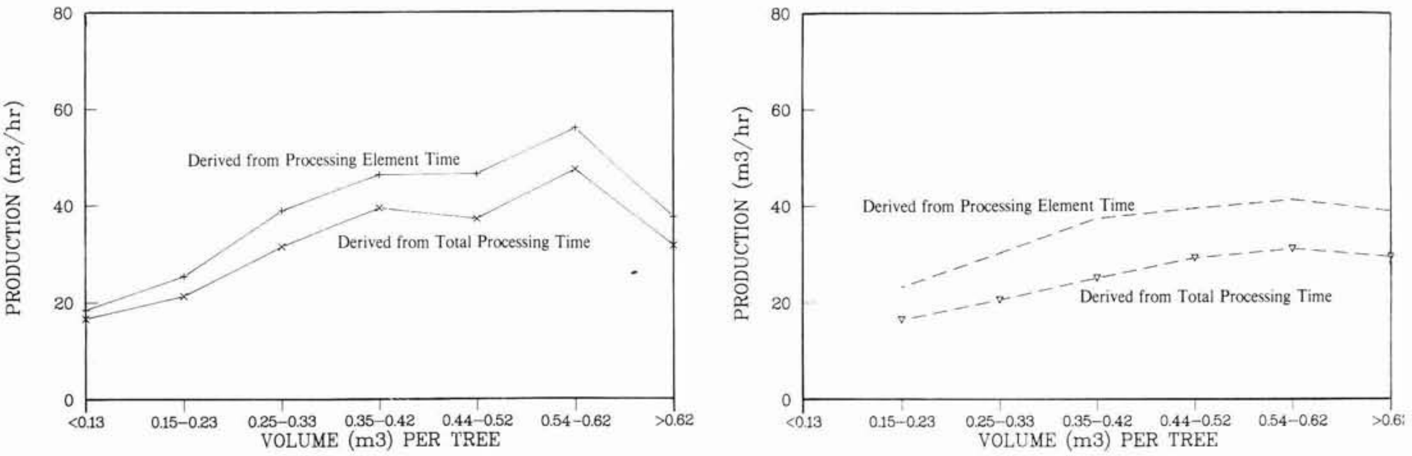

Figure 3 - Productivity per hour against tree volume for each tree form

processing trees $0.62m^3$ in size. As shown in Figure 2, a significant difference existed between the total processing time of straight and lightly limbed trees (Form 1) and trees with heavy branching, sweep or multiple stems (Form 2).

Production levels (in m^3/PMH) were derived from the processing element times and total processing times for each form class (Figure 3). A decline in production when piece size exceeded $0.62m^3$ was not expected. Probable reasons for this are a combination of the subjective nature of the Form classification and the fact that the largest trees were edge trees and were more difficult to delimb.

A total of 182 Form 2 trees were processed (34%) and of those 56% had double leaders. Double leaders were torn from the main stem using the loader while the tree butt was held in the processor head. This method of separating double leaders caused excessive wear on the processor knife bushes and has since been discontinued.

Total processing time included the loader assisting the processor. Loader assistance was only necessary for Form 2 trees. This explains the accentuated difference in total processing time between Form 1 and Form 2 trees, compared to the smaller difference in processing times between the two form classes.

COST ANALYSIS

LIRA's costing format (Wells 1981) was used to derive the costs outlined in Table 3.

Table 3 - System Costing - Single Shift

	$/Day
Hahn	*1080*
Skidder (2 x 518 grapple)	*806*
Bell Super T Feller-Buncher	*273*
Bell Logger	*198*
Operating supplies	*80*
Vehicle (@ $0.6/km)	*60*
Labour (7 men)	*1200*
Total Operation Costs	*$ 3697*

CONCLUSION

The Hahn is capable of high production as has been reported from earlier studies in radiata clearfell. In 0.39m^3 thinnings the production rate averaged 31.2m^3/PMH. The production rate reflects the effect small piece sized trees, heavy branching habit and the high degree of stem malformation had on total processing time. In comparison to the heavily branched trees from within the stand, the large edge trees were very difficult to delimb and resulted in lower production when processing trees greater than 0.62m^3.

Trees with multiple stems significantly increased the total processing time per tree as the processor often required assistance from the loader to remove the extra stems.

If the large mechanical delay was removed from the analysis, productive time accounts for 95% of each cycle. Refining the processing system will only have a small effect on improving daily production.

The merchantable tree size of this stand was smaller than the size required to obtain optimum production rates. If the Hahn is to be used in thinning operations, specific blocks should be selected where the merchantable crop is of good form.

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The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook for Logging Contractors. They are only an indicative estimate and do not necessarily represent the actual costs for this operation.

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