LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND

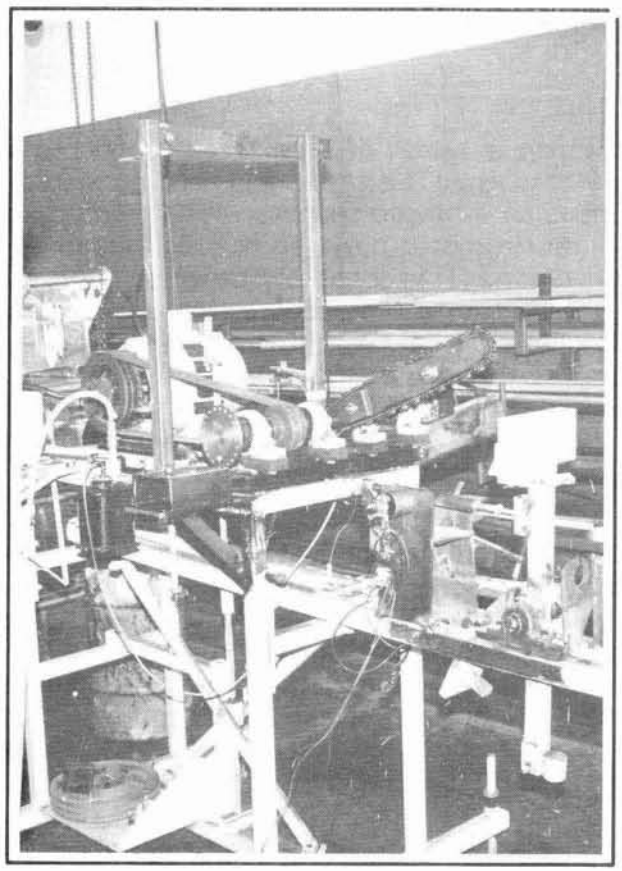
ISSN 0111-6711

REPORT

Vol. 8 No. 11 1983.

LIRA TESTS TRI-RAKER ANTI-KICKBACK CHAIN

R. L. Prebble



Kickback testing rig

INTRODUCTION

Kickback is the sudden vertical force acting through the bar of a chainsaw causing it to rotate about its centre of mass. This force is initiated when the moving chain strikes an obstruction while passing around the tip of the bar. In severe cases, the saw may be thrown out of the operator's control and the result can be a serious injury.

The causes and effects of chainsaw kickback were outlined in a LIRA publication in 1978 (Ref. 1). This report summarised the developments that had occurred to reduce kickback injuries, but concluded that the inter-reacting factors causing this phenomenon were not fully understood.

Saw chain manufacturers are constantly experimenting with different ways of reducing chainsaw kickback. These measures are often successful but invariably they result in lower cutting performance, particularly the chains suitability for bore cutting. The Townsend Company in the United States who market Sabre saw chain claim to have overcome this problem with their new Tri-raker 888 chainsaw chain. According to the advertising, this chain has up to 85% reduction in kickback energy, compared to "other" anti-kickback chains.

To establish the validity of these claims, the Department of Labour requested that LIRA test Tri-raker chain against other brands commonly used in logging. This report covers the tests that were undertaken.

ACKNOWLEDGEMENTS

LIRA acknowledges the support and assistance from the Department of Labour who supplied the Tri-raker chain, the N.Z. Forest Service Engineering Division who were responsible for the testing at the Experimental Workshop at Tapawera, and both Whakarewarewa and Kinleith forests where the field tests were conducted.

THE CHAINS

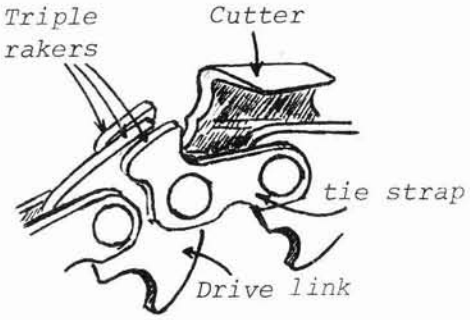
The difference between Sabre Tri-raker 888 and conventional chainsaw chain is the presence of a wider depth gauge surface. This extra width is brought about by having an additional depth gauge attached to the tie-strap adjacent to the cutter, and a further depth gauge incorporated in the drive link immediately in front of the cutter, hence the term Tri-raker (refer diagram). The extra width of the triple rakers reduces the tendency of the depth gauges to bury themselves into the wood and controls the bite taken by each cutter.

In order to determine the effectiveness of this anti-kickback device, the Tri-raker was tested alongside three other types of chain. They were :-

(1) Oregon 73LP chisel chain - with safety link.

(2) Windsor 58AL chisel chain - without safety link.

(3) Oregon 77LG low profile chisel chain - with safety link.



Tri-raker chain

The Sabre Tri-raker had a semi chisel cutter and weighed .10 gm/cm more than the Oregon 73, which was the heaviest of the other three chains. All chains tested were 3/8" pitch, .058 gauge.

THE TESTS

Kickback Tests

To determine the kickback energy of each chain, a series of tests were conducted at the experimental section of the Tapawera Workshop. The test equipment consisted of a 40 cm long solid nose chainsaw bar mounted on a hinged support,which pivoted about the centre of the drive sprocket. A 5 hp electric motor powered the eight-toothed drive sprocket through a V-belt and pulley system. This sprocket turned at 3100 rpm which gave a chain speed of 402 m/min. During the test procedure, the chains were lubricated by an automatic oiler. The grip of a chainsaw operator was simulated by a constant 1.62 kg counterweight working against the upward force of the bar. When kickback occurred, a friction pointer measured the movement of the weight on a vertical scale, calibrated in millimetres. To stop the bar from bouncing back down on to the test block after the initial kickback, a ratchet had been installed at the pivot point of the bar support.

The test blocks consisted of 197 mm x 100 mm x 40 mm laminated customwood, clamped to a hinged arm. With each chain, the block was set 6 mm away from the chain cutter at the very tip of the bar,and held there with a manually operated catch. On being released, a weight and lever mechanism propelled the block on to the tip of the bar to effect kickback. The weight acting on the block could be varied according to the demands of the tests. As soon as the bar moved from the horizontal axis, two solenoids retracted the test block to prevent the chain striking the block twice. After each test, the block had to be moved along in the clamps to present a clean face for the next test.

Before testing a chain, it was run in and the rig adjusted to give the required distance between the block and cutter. The vertical scale was then zeroed, the ratchet engaged, and solenoids set prior to the motor being started. Once the motor had attained maximum speed, the test block was released against the tip of the bar to cause kickback. The movement on the vertical scale was read, the block moved across, and the process repeated. All chains were subjected to 24 tests, 12 with a 2.0 kg weight and 12 with a 3.1 kg weight, acting on the hinged arm holding the test block.

Cutting Speed Tests

The test rig for cutting speed tests was a parallelogram construction hinged within a frame and working on a counter-balance system, to feed the saw into the test block with the required degree of force. The chainsaw used was a Husqvarna 280 driving through a seven-tooth sprocket at approximately 10,500 rpm. A standard 50 cm solid nose bar was used for the tests. The test blocks were 254 mm x 152 mm radiata billets, held on the rig by pneumatically controlled clamps.

As with the kickback tests, each chain was run in prior to testing. The saw was then set at maximum revs, and released on to the test block to cut a 2 cm wide slice with the force acting through the centre of the guide bar. The time from the start to the finish of each cut was recorded with four, five and six kilogram weights respectively acting on the saw.

Field Tests

To further test the chains under operational conditions, a series of 30 discs were cut with each chain using the three most common cutting techniques, i.e. downcut, undercut and borecut. The time for each cut was divided by the cross-sectional area of the disc, to give the cutting rate for that particular technique. A 62 cc chainsaw with a 38 cm bar was used for these tests which were conducted in windblown 35 year old P. radiata with an average diameter of 31.24 cm. The chains were then used for half a day each in a felling and delimbing exercise in 13 year old P. radiata on the same 62 cc chainsaw and 38 cm bar.

RESULTS

Kickback Tests

The kickback test results showed that with a 2.0 Kg weight on the test block, the Tri-raker had between 49 and 75% less kickback energy than the other chains, and with a 3.1 Kg weight on the test block it had between 30 and 77% less kickback energy (refer Fig. 1). Surprisingly, the Oregon safety chain (73LP) had higher kickback energy than any of the other chains, including the Windsor, which did not have a safety link. The Oregon low profile chain had the least variation in kickback energy with less than .34 Nm between maximum and minimum results. By comparison, the Tri-raker chain recorded up to 1.12 Nm difference.

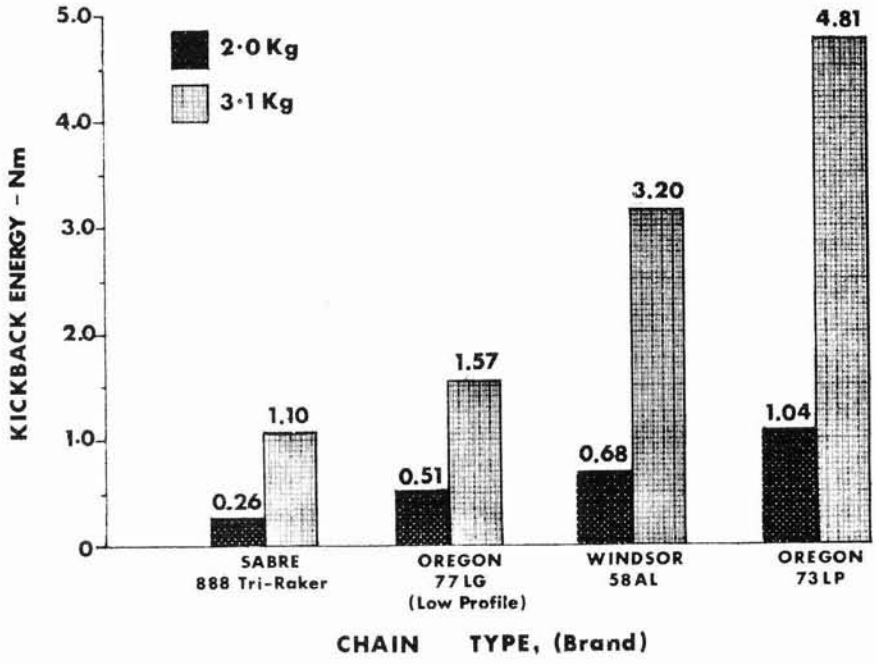


Fig. 1 - Kickback energy generated by each chain with 2.0 and 3.1 Kg respectively acting on the test block.

Cutting Rate Tests

The cutting rate tests indicated that the Tri-raker was, on average, 9.9 cm^2/second slower than Oregon low profile chain, 21.23 cm^2/second slower than Oregon 73 LP, and 22.6 cm^2/second slower than the Windsor chain (refer Fig. 2). However, because the comparison was between a semi chisel chain and full chisel chains, the results were compared with earlier N.Z. Forest Service tests of Sabre semi chisel chain in 1976 and the Tri-raker proved to be, on average, 3.68 cm^2/second faster than ordinary semi chisel chain.

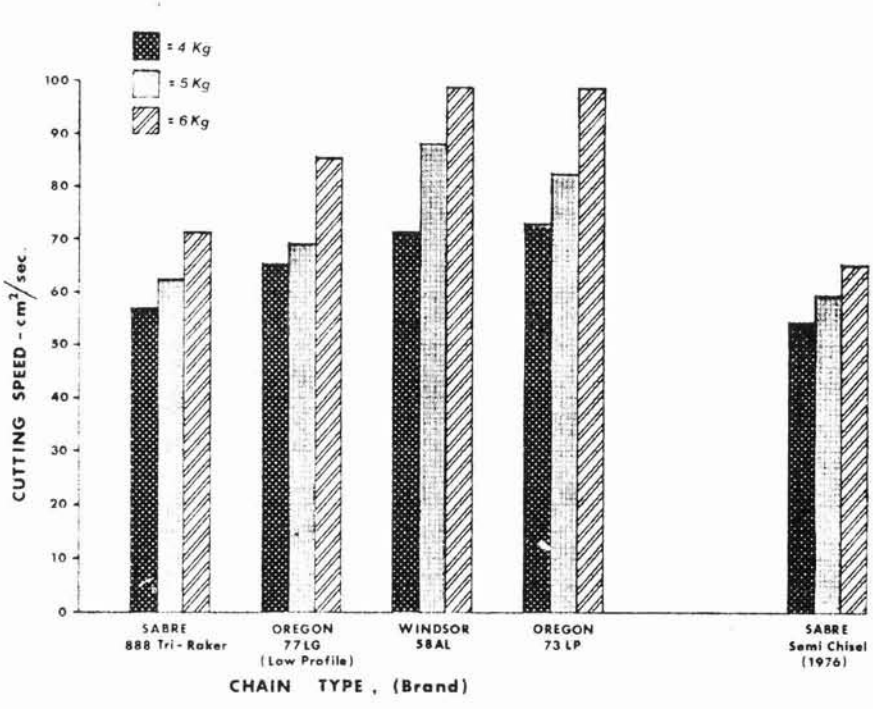


Fig 2 - Cutting rates of chains tested with 4, 5 and 6 Kg weights acting on the chainsaw bar.

Field Tests

Comparing the cutting rates through the various operational techniques in the field produced a different set of figures again, with the Oregon low profile cutting faster than the Oregon 73 LP. However, as was shown in the controlled testing, the Tri-raker was consistently slower than the others (refer Fig. 3). What was impressive were the capabilities of the Tri-raker in bore cutting. It bored at 93% of the rate of its down-cutting performance, compared with Oregon 73 LP at 95%, Windsor 58AL at 73%, and Oregon 77 LG at 86%.

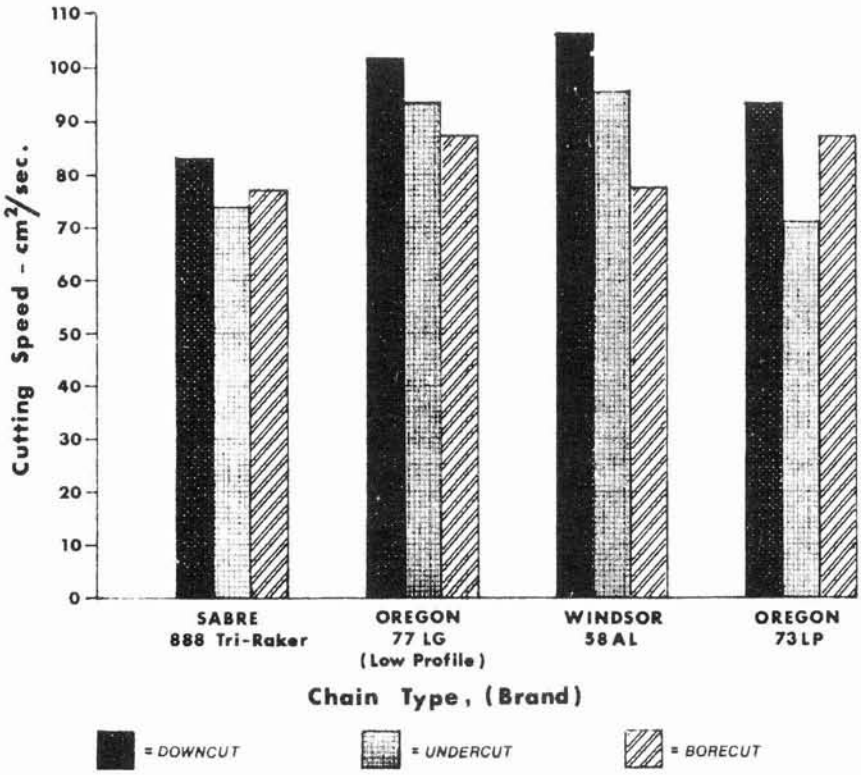


Fig. 3 - Cutting rates of each chain using the three main cutting techniques.

During the half day's cutting trial with each of the chains, they all performed well, although the Tri-raker was noticeably slower than the other three. Because of the short duration of the trial, it was not necessary to sharpen the chains so the ease of filing the Tri-raker depth gauges could not be assessed.

CONCLUSIONS

The Tri-raker did produce significantly less kickback energy than the other chains tested. While cutting performance was overall slightly down on the chisel chains, the Tri-raker's bore cutting capabilities, as a percentage of the down-cutting rate, were as good if not better than the rest. Indications are that with Tri-raker, Townsend have effectively reduced kickback energy without sacrificing performance, although to be completely confident with this assessment, full chisel Tri-raker should be tested.

Equally as interesting was the fact that the low profile Oregon chain also had lower kickback energy than the two standard profile chains but still returned competitive cutting performances.

It must be remembered that kickback can be influenced by a number of factors, including filing techniques, depth gauge setting, cutter wear, chain tension, etc. However, the objectives of these tests were to minimise the differences between variables and consequently make the results as comparable as possible.

Ref. 1 "Chainsaw Kickback", LIRA Report, Vol. 3 No. 1 1978.

For Further Information Contact: N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O.Box 147,
ROTORUA, NEW ZEALAND. Phone 87-168