

Supplementary Materials

Chainsaws

A variety of chainsaws are available with different power supplies and types of cutters. Most chainsaws are either electric or petrol driven. The petrol chainsaw used was a two stroke petrol chainsaw, a Stihl 024, Figure S.1, suitable for forestry work with a bar of length 35 cm and chain speed of 20 ms^{-1} . The electric chainsaw was a Challenge Xtreme chainsaw suitable for home use and garden maintenance with a bar of length 35 cm and a chain velocity of 10 ms^{-1} , Figure S.2.

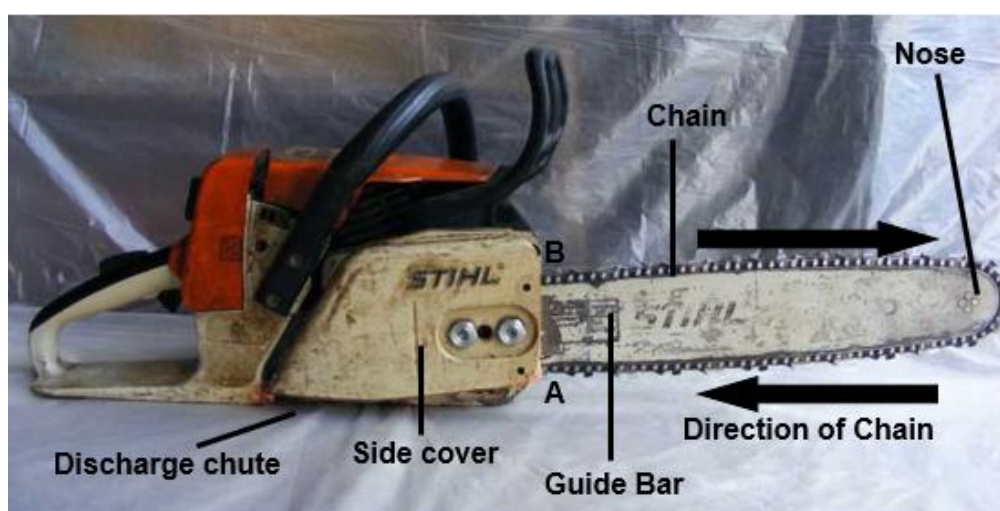


Figure S.1. Stihl, petrol chainsaw. A is where the chain enters the side cover. B is where the chain leaves the side cover.



Figure S.2. Challenge electric chainsaw.

The chain on a chainsaw rotates around a guiding bar, Figure S.1. It enters the side cover at point A, Figure S.1. It then rotates around the sprocket inside the cover, Figure S.3. The sprocket provides the power to the chain. The chain then leaves the cover at point B, travels along the bar, around the nose and back along the bottom of the bar.

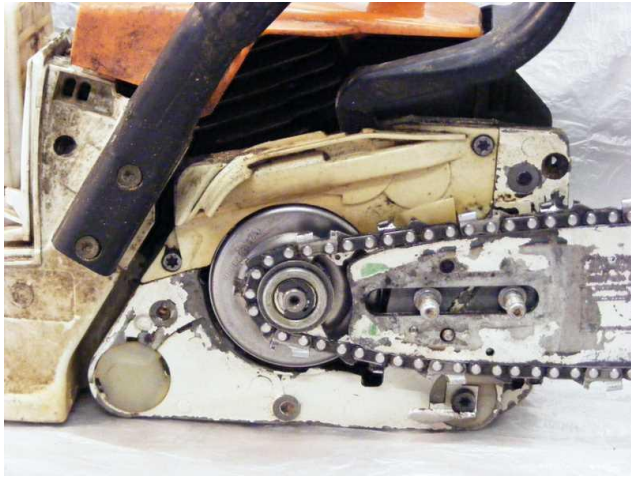


Figure S.3 Inside the cover of the Shitl petrol chainsaw showing the chain around the sprocket.

Chainsaws can be fitted with different types of cutters. The cutters affect how the chainsaw cuts through the material and the width of the cut (or kerf) and therefore the volume of material displaced. Cutters can be chisel, semi chisel and micro chisel. The latter two are widely available, while the chisel cutters are more likely to be employed for specialist use. The semi chisel, Figure S.4a, is a standard professional chainsaw type producing a tearing type cut which can make the chainsaw harder to control. The micro chisel is less aggressive and narrower, producing a kerf approximately two thirds the width of the semi chisel and therefore displacing less material. The shape and narrower width of the micro chisel creates a slicing action through material. More details can be found in [18].

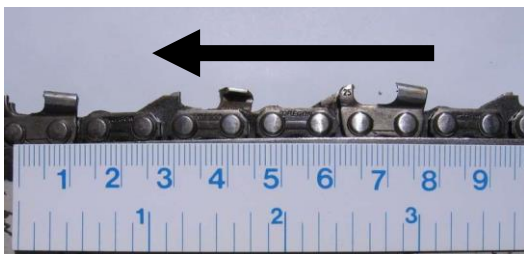


Figure (a)



Figure (b)

Figure S.4. Chisel cutters, a) Semi chisel cutter, b) micro chisel cutter. Arrow denotes direction of movement.

Chain oil for chainsaws has anti-fling properties preventing oil being flung off the chain as it is carried from the cutting surface along the chain towards the discharge chute. Vegetable oil is often used for health and environmental reasons. Commercially produced bio-degradable oil and mineral based oil have a higher viscosity index and are considered to have better anti-fling properties than pure vegetable oil. Gearbox oil has also been used to lubricate the bar and chain. For this work rape seed oil was used to lubricate the chain and bar on both chainsaws.

Statistical analysis of length of tissue in front of the cut.

Data set	Levene test raw data	Levene test log data	ANOVA results
All cross sectional areas (Cuts A, B and C)	$p = 0.02$ Different variances of errors	$p = 0.034$ Different variances of errors	-
Cross sectional area > 300 mm ² only (Cuts A and B)	$p = 0.02$ Different variances of errors	$p = 0.84$ Same variance of errors	$F_{1,10} = 83.8$ $p \leq 0.001$ Significant difference

Comparison of the length of tissue in front of the cut for petrol and electric chainsaws. A dash means no analysis was carried out.

Statistical analysis of particle size.

ANOVA tests to compare the particle size of electric versus petrol chainsaws. Data is for the largest cut, Cut A, with a cross sectional area of 604 to 716 cm².

Data set		Levene test	Different	ANOVA results	Difference is
Distance from cut	Side of cut	raw data	variance of errors		significant
0 – 50 cm	Left	$\rho = 0.107$	No	$F_{1,4} = 4.99$ $\rho = 0.089$	No
50 - 100 cm	Left	$\rho = 0.687$	No	$F_{1,4} = 1.75$ $\rho = 0.256$	No
0 – 50 cm	Right	$\rho = 0.07$	No	$F_{1,4} = 8.64$ $\rho = 0.042$	Yes
50 – 100 cm	Right	$\rho = 0.201$	No	$F_{1,4} = 0.626$ $\rho = 0.473$	No

ANOVA tests to study the effect of distance on the particle size of electric and petrol chainsaws. Data was compared for the particle size between 0 and 50 cm, to that from 50 to 100 cm. Data is for the largest cut, Cut A, with a cross sectional area of 604 to 716 cm².

Data set		Levene test	Different	ANOVA results	Difference is
Chains saw	Side of cut	raw data	variance of errors		significant
Electric	Left	$\rho = 0.417$	No	$F_{1,4} = 7.63$ $\rho = 0.051$	No
Petrol	Left	$\rho = 0.333$	No	$F_{1,4} = 15.5$ $\rho = 0.017$	Yes
Electric	Right	$\rho = 0.129$	No	$F_{1,4} = 9.46$ $\rho = 0.037$	Yes
Petrol	Right	$\rho = 0.085$	No	$F_{1,4} = 0.252$ $\rho = 0.642$	No