Telescopic Saw For Pruning

Warji Warji, Tamrin Tamrin

Abstract: Pruning is the cutting of young branches and growing on the main trunk of the tree. This activity aims to increase the free height of branches and reduce the main branches of the trunk. Pruning branches or twigs that are not needed makes the nutrition of the tree more concentrated for tree growth (main trunk and canopy or fruit). The pruning process requires cutting tools. One of the cutting tools that can be used is a saw. To make the pruning process easier, a saw can be applied from the ground or without climbing trees. Therefore it is necessary to design telescopic saws that can be used to prune. The design of a telescopic saw includes a saw blade, a saw blade, a connector for the saw frame, a telescopic rod, and a connector between the handles. The results showed that the telescopic saws from the design can be used to trim the palm fronds and teak branches properly. The dimensions are 645 cm long and 15 cm wide. The cutting rate of teak tree branches is 43.47 mm^2/s on the tree and 77.89 mm^2/s on the ground. The rate of cutting of oil palm fronds is 160.18 mm^2/s in trees and 226.26 mm^2/s in the ground. Cutting rates on the ground are faster than on trees. The rate of cutting of oil palm fronds is faster than teak branches. The effectiveness of cutting 59.14% teak branches and palm fronds 74.24%.

Index Terms: saws, telescopic saws, pruning, design and construction, teak, oil palm.

1 INTRODUCTION

PRUNING is needed for plantation or forestry plants. Pruning of hardwoods coming from forest plantations is becoming more and more important to replace scarce wood from tropical forest. Pruning is a routine maintenance activity carried out in the development of a plantation forest. Pruning activities in plantation forests are primarily intended for producing wood for carpentry. Pruning activities are closely related to the quality of the resulting stems where high economic value wood is expected, namely large wood with few knots, control growth and maintain desired shapes [1]. Trunks with many knots or loose knots will have a low value, besides that the yield of sawn timber is also low [2] The pruning process requires cutting tools. One of the cutting tools that can be used is a saw. To facilitate the pruning process, a chainsaw is required which can be applied from the ground; without c limbing trees. Pruning the oil palm plant is the process of removing the unproductive midrib; dry midribs of the oil palm plantations. Pruning is included in harvest preparation activities with the aim that it does not interfere with the harvesting process as well. Pruning is one of the techniques to improve plant growth and production [3]. Trimming the leaves on oil palm plants must be done, because it is not easy to fall out, even though it is old or dry, sometimes it only falls after a few years later [4]. Pruning the oil palm plantations is done since the immature plantations and continued until the plants have produced with the aim to influence the production of the oil palm. Implementing intensive pruning is important because inadequate interventions may threaten the growth, yield, and wood quality of T. grandis plantation [5]. Pruning leaves can also reduce the danger of fallen trees due to wind [6]. Pruning techniques are carried out regularly in accordance with the development or age of existing plants. Pruning is a regular part of the maintenance routine which helps to keep trees healthy [7]. Pruning of hardwoods coming from forest plantations is becoming more and more important to replace scarce wood from tropical forests [8]. Futhermore, the fruits retained better quality characteristics in terms of size, weight, volume, colour change, firmness, organoleptic rating, physiological loss in weight, spoilage, acid content, total soluble solids, sugars (total, reducing and non-reducing sugars) and calcium content due to summer pruning [9]. Shoot emergence was found earlier in pruned trees as compared to unpruned trees [10]. While pruning teak is the pruning of young branches and growing on the main trunk of the tree. This activity aims to increase the free height of branches and reduce the main branches of the trunk. By eliminating unnecessary branches or twigs, tree nutrients will be more concentrated for tree growth (main trunk and canopy). Pruning may improve wood quality by preventing knot formation. This study aims to design and test the performance of telescopic saws that can be used to prune plantation (oil palm) and forest (teak) plants.

- *Warji Warji and Tamrin Tamrin are currently lecturing and researching in Agricultural Engineering Department (Teknik Pertanian) in Agriculture Faculty of Lampung University, Indonesia. 35145.*
- *Corresponding author: Warji Warji, warji1978@gmail.com.*

2 MATERIALS AND METHODS

2.1 Material and Tools

The tools used were workshop tools; including vise, hammer, hacksaw, grinding machine and welding machine. The material used to make telescopic saws was 2 x 2 cm long iron rod 1 m long, 2 rods of 1 inch pipe size (size 4 m per rod), 7 pairs of bolt nuts of 7 pairs. The materials used for testing the tool were teak branches and palm fronds.

2.2 Structural and Functional Design

Telescopic saws included saw blades, frame saw blades, connector rods on the saw frame, telescopic, and connector between stalks. Functionally the saw blade functions as a branch cutter or midrib. The saw blade was designed to be sturdy, not flexible and sharp so that it can be used to cut branches or twigs or palm fronds. Elbow iron was chosen to be sturdy; did not flex when used to cut branches. The stem connector was made of perforated iron pipe; a place to put nuts and bolts. Pipe joints were designed to be able to unite pipes used as stems. Iron pipe was chosen so that it can be grasped properly; so it can be used comfortably. Stalk connector made of iron pipe. Elbow iron selection was intended so that the connector can unite the pipe stems with precision. Structural telescopic saws include saw blades, saw blade frames, connector rods on the saw frame, telescopic, and connector between handles. The overall length of the telescopic saw was 645 cm. The saw blade used was a hand saw for wood with dimensions of length 45.72 cm (18 inches). The saw blade was made of 2 x 2 cm iron, with a length of 50 cm and a width of 12 cm. Connectors were made of 1 inch iron pipe with 3 holes perforated with 8 mm hole size; a place to install bolt nuts. The stem was made of 1 inch iron pipe, 3 m long. Saw blades are designed as many as 3 pieces, so that

the overall length of the stalk was 6 m. The stalk connector was made of 1 inch iron pipe which is cut in half. Connector length of 20 cm. Connectors were given 4 holes with a diameter of 8 mm; this holes were useful for installing bolt nuts.

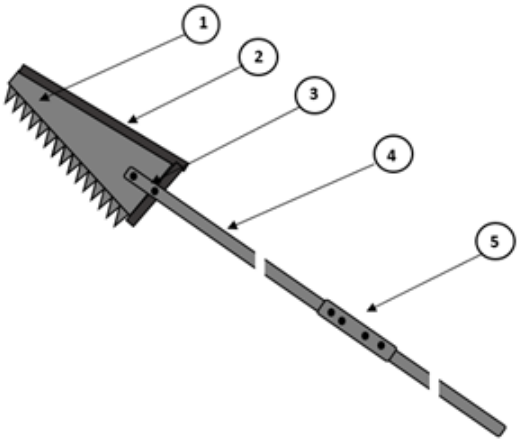

***Fig. 1**. Sketch of telescopic saw. (1) saw, (2) saw frame, (3) Stalk connector on the saw frame, (4) Telescopic rod, (5) Connector.*

2.3 Performance test

The performance test of telescopic saws in the form of a test of the success rate of cutting of teak branches and palm tree midrib. Test the speed of cutting of teak branches on trees and on the ground, the speed of cutting of oil palm fronds on trees and on the ground. The effectiveness of cutting (ε) is calculated from the comparison of cutting time in trees (tp) compared to cutting time on land (tt) multiplied by 100%.

3 Results and Discussion

The results of the telescopic saw design are presented in Figure 2. This picture shows the parts of the telescopic saw including the saw blade, the saw frame, the connecting rod on the frame of the saw, telescopic, and the connector between the handles. Chainsaws used are wood saws that are used manually. The overall dimensions of the tool are 645 cm long and 15 cm wide.

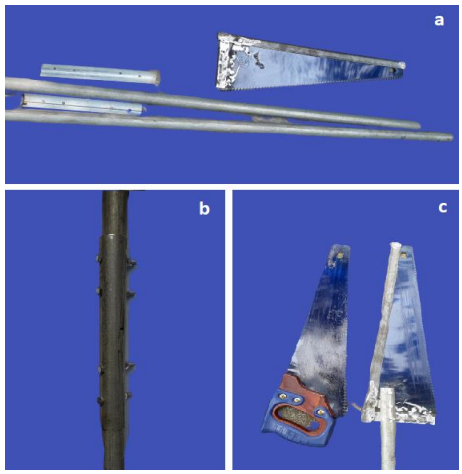

***Fig. 2**. Telescopic saw (a) Telescopic saw kit, (b) Rod conector and (c) Saws*

The saw wood was removed by the holder (handle) and the frame was added to the saw. The addition of the framework of the iron elbow was intended to be a rigid saw; not flexible when used to cut branches. Joints between rod use pipe irons of the same type and size as rod used in telescopic saws. Fastening between rod using bolts as presented in Figure 3; with this connection the rod can be extended or shortened according to trimming needs.

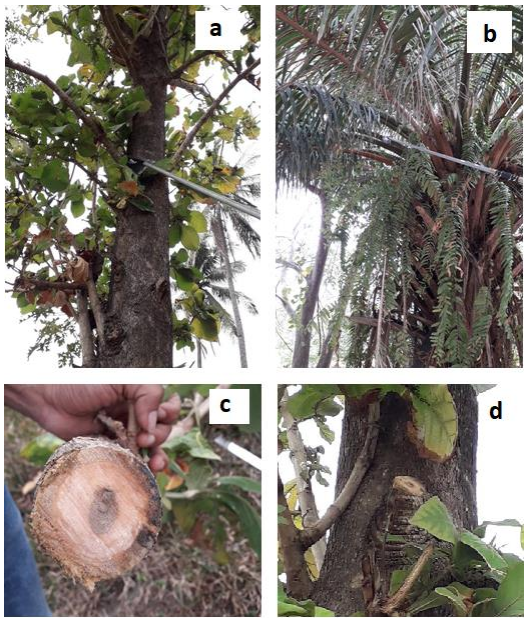

***Fig. 3**. The process of cutting branches (a) teak, (b) palm trees, (c) surface of branch of teak, and (d) remain of branch cutting.*

This telescopic saw is the same as an ordinary hand saw; the difference between the two saws is that the telescopic saw is made long (Figure 4). The size of the stems can be adjusted as needed, the shortest stems are 3 m and can be extended in accordance with multiples; which is 6 m or 9 m. The performance test results show that the telescopic saws from the design can be used to cut the branches of teak trees and palm tree fronds well. The cutting process is easy; telescopic saws are pushed and pulled after the saw is right on the branch or midrib to be cut.

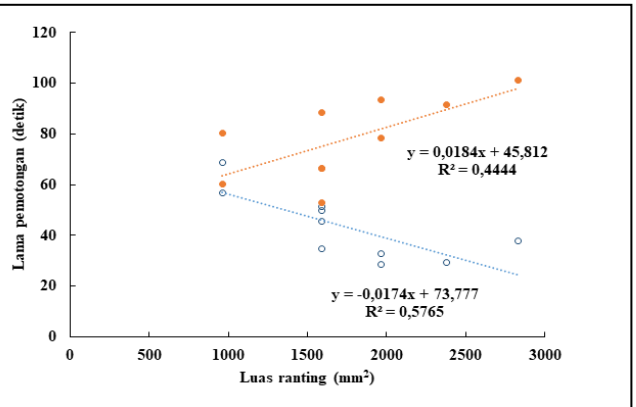

***Fig. 4**. Cutting rate of teak branches ( ) on trees and ( ) on the ground*

The process of cutting teak branches is presented in Figure 3. This cutting can be done for branches that are less than 5 m high; considering that in this trial the saw shaft is 6 m long. If it is desired to cut the taller handle, it can be done by accommodating the handle of the saw.

The average cutting rate of teak branches is 43.47 mm2 / second on trees and 77.89 mm2 / second on the ground. Cuts on the ground are faster than those in trees. This is due to cutting in the tree need greater caution compared to that done on the ground. The length of cutting to the branch area follows the linear equation y = 0.0184x + 45.812 for trees and y = -0.0174x + 73.777 for soil. This shows that cutting larger branches in the tree requires more time; conversely cutting in the ground is getting smaller compared to the same area.

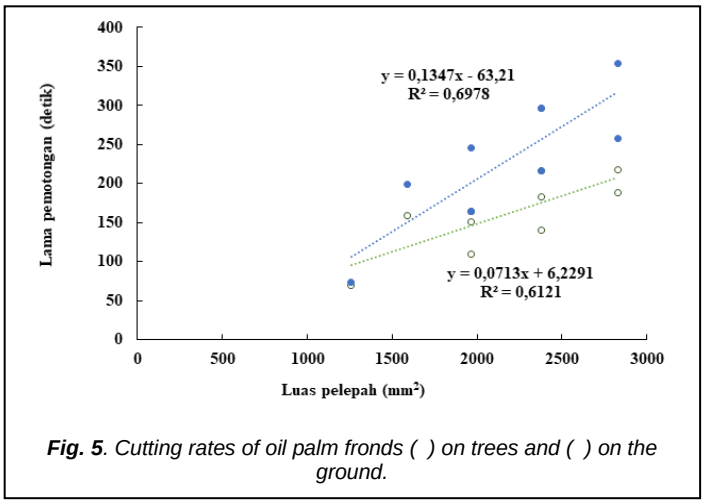

Fig. 5*. Cutting rates of oil palm fronds ( ) on trees and ( ) on the ground.*

The rate of cutting of oil palm fronds is 160.18 mm2 / second in trees and 226.26 mm2 / second in the ground. Cutting rates

TABLE 1
EFFECTIVENESS OF TEAK BRANCHES CUTTING

No	ϕ (mm)	Sa(mm^2)	Ct (s)		Cr (mm$^{2/}$s)		Eff. (%)
			Ot	Og	Ot	Og	
1	55	2377	81	26	29	91	32
2	54	1591	46	24	35	66	52
3	60	2829	75	28	38	101	37
4	53	963	14	12	69	80	86
5	50	1964	60	21	33	94	35
6	54	1591	32	24	50	66	75
7	53	963	17	16	57	60	94
8	54	1591	31	18	51	88	58
9	50	1964	69	25	28	79	36
10	54	1591	35	30	45	53	86
			Average		43,5	77,9	59,1

Sa= Surface area, Ct= Cutting time, Gr=Cutting rate, Ot= On tree, Og= On ground, Eff.= Effectiveness

on the ground are faster than on trees. The rate of cutting of oil palm fronds is faster than teak branches. The length of cutting of the palm fronds to the area of the twigs follows the linear equation y = 0.1347x - 63.21 for trees and y = 0.0713x + 6.2291 for the soil.

The effectiveness of cutting teak branches an average of 59.14% (Table 1) and oil palm fronds on average 74.24% (Table 2). This shows that the cutting of the palm fronds is more effective compared to teak branches. The effectiveness of pruning is thought to be influenced by the softness or hardness of wood fibers. Pruning wood that has soft fibers is more effective than hard wood.

4 CONCLUSIONS

The telescopic saws from the design can be used to trim the palm fronds and teak branches properly. The dimensions are 645 cm long and 15 cm wide. The cutting rate of teak tree branches is 43.47 mm^2/second on the tree and 77.89 mm^2/second on the ground. The rate of cutting of oil palm fronds is 160.18 mm^2/second in trees and 226.26 mm^2/second in the ground. Cutting rates on the ground are faster than on trees. The rate of cutting of oil palm fronds is faster than teak branches. The effectiveness of cutting 59,14% teak branches and palm fronds 74.24%.

ACKNOWLEDGMENT

The authors wish to thank Dean of Agricultural Faculty of Lampung University. This work was supported in part by a grant from DIPA FP of Lampung University.

TABLE 2
EFFECTIVENESS OF OIL PALM BRANCHES CUTTING

No	ϕ (mm)	Sa (mm^2)	Ct (s)		Cr (mm^2/s)		Eff. (%)
			Of	Og	Ot	Og	
1	50	1964	13	12	151	164	92
2	40	1257	17	18	70	74	94
3	45	1591	10	8	159	199	80
4	55	2377	11	8	216	297	73
5	50	1964	18	12	109	164	67
6	60	2829	13	11	218	257	85
7	60	2828	15	8	189	354	53
8	50	1964	12	8	164	246	67
9	55	2377	13	11	183	216	85
10	55	2377	17	8	140	297	47
			Average(		159,8	226,7	74,2

Sa= Surface area, Ct= Cutting time, Gr=Cutting rate, Ot= On tree, Og= On ground, Eff.= Effectiveness

REFERENCES

[1] A.L. Shigo, Tree Decay and Pruning, The International Journal of Urban Forestry, Vol. 8, No.1, pp. 1-12, 1984.

[2] Junaidah, Pemangkasan pada Hutan Tanaman, GALAM, Vol 4, No.3, pp. 209-221, 2010.

[3] S. Susanto, M. Melati and S.A. Aziz, Pruning to Improve Flowering and Fruiting of 'Crystal' Guava, AGRIVITA Journal of Agricultural Science, Vol. 41, No. 1, pp. 48-54, 2019.

[4] R.E. Lubis and A.Widanarka, Buku Pintar Kelapa Sawit. Jakarta, Indonesia: Agromedia Pustaka, pp. 174-175, 2011.

[5] E. Víquez, and D. Pérez, Effect of pruning on tree growth,

yield, and wood properties of Tectona grandis plantations in Costa Rica, Silva Fennica, Vol. 39, No.3, pp. 381–390, 2015.

[6] I. Pahan, Paduan Lengkap Kelapa Sawit. Jakarta, Indonesia: Penerbar Swadaya, pp. 176-178, 2004.

[7] N, Badrulhisham and N, Othman, Knowledge in Tree Pruning for Sustainable Practices in Urban Setting: Improving our quality of life, Procedia - Social and Behavioral Sciences Vol. 234, pp. 210 – 217, 2016.

[8] L. Nutto, R.A. Malinovski, M. Brunsmeier, S.A.F. Schumacher, Ergonomic aspects and productivity of different pruning tools for a first pruning lift of Eucalyptus grandis Hill ex Maiden, Silva Fennica, Vol. 47, No. 4. pp. 1026-1040, 2013.

[9] N. Ashraf, and M. Ashraf, Summer pruning in fruit trees, African Journal of Agricultural Research, Vol. 9, No. 2. pp. 206-210, 2014.

[10] H.S. Dhaliwa, A.K. Banke, L.K. Sharma, and S.K. Bali, Impact of pruning practices on shoot of growth and bud production in kinnow (Citrus reticulata Blanco) plant, Journal of Experimental Biology and Agricultural Sciences. Vol. 1, No.7, 507-512.