CHARACTERISTICS OF THE CROSS-CUTTING OPERATION ON LANDING AREA

A. CIUBOTARU[1]   GH. D. MARIA[2]

Abstract: Cross-cutting wood on landing area aims to transform wood pieces harvested to length of assortments that will be delivered to customer. Work conditions in landing area, other than in cutting area, require a separate analysis of cross-cutting operation in the specific conditions from landing area. Research carried out in the mountains area (Vâlsan Valley, Făgăraş Mountains) on a total of 351 pieces, with a volume of 361,581 m³ in total working time of 47,880 s and the cut surface of 260,700 cm², showed that there can established significant correlations between the number of sections, cut surface, work productivity and the diameter of breast height of the tree marked, and between the average number of sections, cut surface and the tree volume.

For specific work conditions on the landing area, the wood cross-cutting with mechanical chain saw Husqvarna 365, revealed the following values: the average number of cross/cutting - 1.29 cross-cuttings·m⁻³; operative time work - 64% from total work time; specific cut surface - 721 cm²·m⁻³; cutting productivity - 73.33 cm²·s⁻¹

Key words: landing area, cross-cutting, spruce, chainsaw Husqvarna.

1. Introduction

Cross-cutting is one of the important operations in wood exploitation process, in which there are created favorable conditions for logging of wood, and, at the same time, conditions for recovery, at a high level, of quality of wood. This operation is performed in cutting area and landing area.

The purpose of cross-cutting of wood in cutting area is to extract from felled trees logs or parts of tree with favorable lengths in correlation with harvesting conditions and technical characteristics of planned logging machinery. The length of logs will be set so as to allow use at full capacity of logging machinery, while the potential of displacement damage to be minimal. Also, for a better ecological effect of wood exploitation and better capitalization of the wood, the length of pieces of wood must be exactly the length or a sum of lengths of several wood assortments.

The cross-cutting operation in the landing area is intended to create timber assortments, namely pieces of wood with lengths corresponding with delivery conditions.

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[1] Dept. of Wood Exploitation, Forest Management and Terrestrial Measurements, *Transilvania* University of Braşov.
[2] Dept. of Doctoral School, *Transilvania* University of Braşov.

Conditions for performance of cross-cutting operation in two mentioned places - cutting area and landing area - are very different (Kilander, 1960; Piegai, 1990; Ciubotaru, 1996; Nakagawa et al., 2010). The authors conducted the research aimed to establish the characteristic features of the cross-cutting operation in mountain landing area conditions, for spruce wood, with mechanical saw Husqvarna 365.

2. Study sites

The research was conducted in three cutting areas in the mountain conditions, with a total area of 45.00 ha; the cuts were applied in the group shelter wood system. From the cutting area there was extracted a number of 837 spruce trees, diameters of breast height between 22 and 76 cm and a total volume of 2137 m3, respectively mean tree volume of 2.54 m3.

Measurements were made in the landing area associated with each cutting area.

3. Methodology

The cross-cutting is considered a work operation because it meets the requirements imposed, by ergonomic regulations. This part of the wood exploitation process is performed by an operator, on a job place clearly determined by a specific machine or tool, aiming to modify the shape - respectively the length - of the object of work properly a certain objective.

Specifically, in the situations analyzed, cross-cutting operation means the turning of a log into round raw wood assortments with a length corresponding to the customer's requirements by a worker with mechanical chainsaw.

Research carried out aimed to highlight specific characteristics of the cross-cutting operation of the spruce wood logs in landing area.

The measurements refer to:
- Dimensional structure of the logs entering the landing area;
- Number of sections made in landing area to achieve the range of round wood assortments;
- The area effectively cut to achieve assortments;
- The structure of time of work for cross-cutting logs with mechanical chainsaw in landing area;
- The cross-cutting productivity in the landing area.

The operation is usually subject to determination of working time structure in the process of work.

Given the peculiarities of the work operations in the landing area, the research conducted was considered according to structure of working time: the time for preparation of start work and end of work; the time for effective work; the time to break off (Hidoş, Isac, 1971ş Rouă et al., 1976).

The method of measurement used was the continuous timing. Measurements made by the authors consisted of: measuring the diameter of the breast height of the felled tree and marking results logs after cross-cutting to the stump; measuring length of harvested pieces; measurement of working time for each specific phase of cross-cutting operation, by timing, with the precision of one second; measuring the diameter for each cut area, with the forest caliper, with an accuracy of 1 cm; measuring the dimensions of results logs, after cutting, in landing-area: diameter at halfway along the logs and length of log.

The work team consisted of a chainsaw worker.

4. Results

Characteristics of the cross-cutting operation in landing area depend on a large extent on the size of the pieces harvested

and structure of the technological process of harvest.

In researched cutting areas logs were harvested by tractor U 651M, directly from stump. This situation is commonly known as skidding of logs. There were a total of 350 pieces, with a length from 12 to 25 m and a total volume of 361,581 m³.

Distribution of the number of harvested logs by categories of length (Fig. 1) shows that the lengths of 14, 16, 18 and 20 m, about 63% are predominant, reflecting the fact that the cross-cutting in the cutting area was made taking into account the length assortments to be delivered, i.e. combinations of lengths 4, 6, 8 m.

Fig. 2. *The percentage of total number of round wood pieces resulting after cross-cutting in handing area*

Another analyzed aspect was the correlation between the number of cross-cuttings of a felled tree and diameter of breast height. This correlation is shown in the graph from Figure 3.
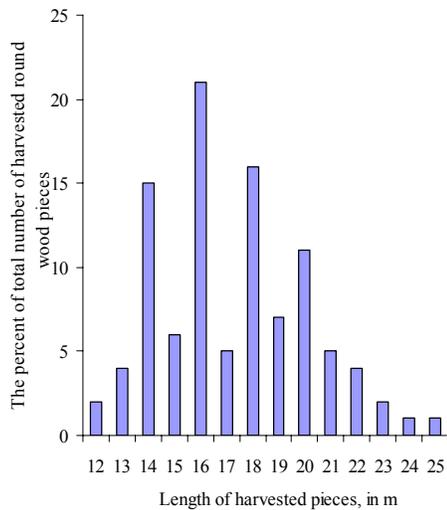
Fig. 1. *Percentage distribution of number of round wood pieces on categories of length*

As shown in the mentioned figure, the dominant length of harvested logs is 16 m (21%). As the length of pieces after cross-cutting, the dominant length is 8 m (Fig. 2), which represent about 60% of the total number of 817 pieces that emerged after cutting.
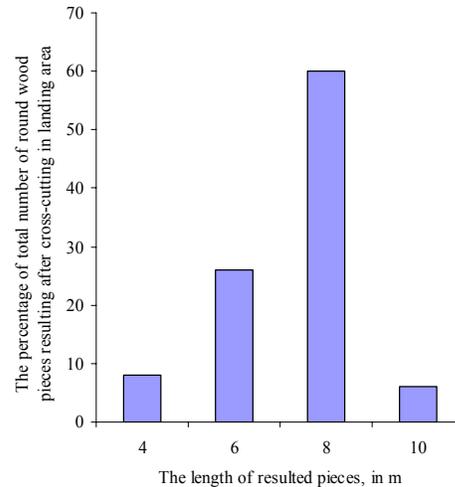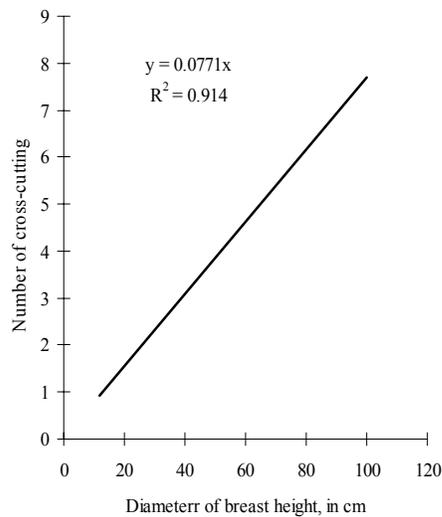
$$y = 0.0771x$$
$$R^2 = 0.914$$

Fig. 3. *Correlation between number of cross-cutting and diameter of breast height*

It should be noted that topping of tree is included in the limbing operation for each felled tree. The correlation is very significant and reinforced by the coefficient of determination ($R^2 = 0,914$).

Likewise there is a significant correlation ($R^2 = 0,898$) between the average number of cross-cuttings and average tree volume presented in the graph from Figure 4.
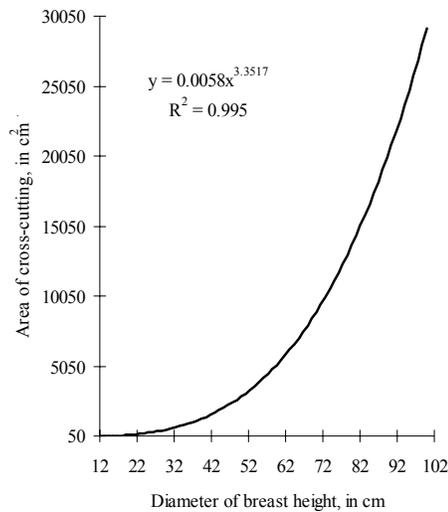

Fig. 4. *Correlation between area of cross-cutting and diameter of breast height*

Of practical interest is to establish a correlation between cross-cutting surface and the breast height diameter of tree. As shown in the graph from figure 5, the correlation expressed by an exponential equation between the two parameters is very significant ($R^2 = 0,995$).
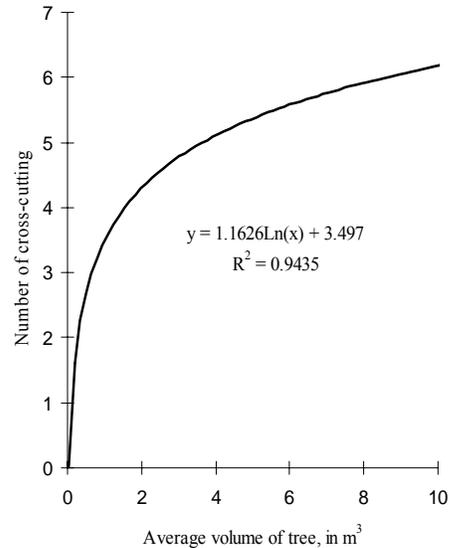

Fig. 5. *Correlation between number of cross-cutting and volume of tree*

Concerning the size of the cross-cutting area which is necessary to obtain round wood assortments and the volume of marked tree it can be stated that the correlation between these two parameters can be expressed by an exponential equation (Fig. 6).
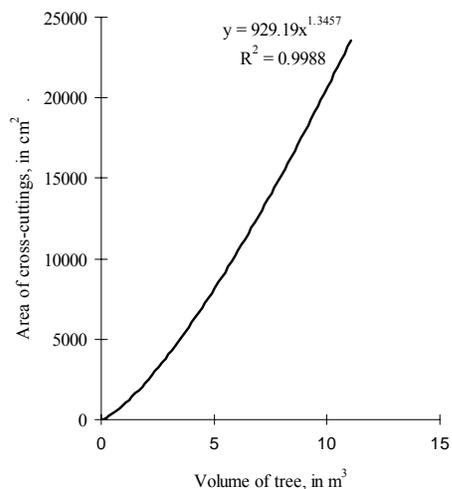

Fig.6. *Correlation between area of cross-cuttings and tree volume*

The coefficient of determination is expressed by value (R^2=0,998).

Observed values showed that to obtain 1 m^3 of round wood assortments the average number of sections was 1.29, and the effective cross-cutting area was 721 cm^2.

Concerning the time spent for performing cross-cutting, analyzed data led to the conclusion that there is a very significant correlation (Fig. 7) between the time of cross-cutting and cutting diameter, which is reinforced by the coefficient of determination ($R^2 = 0,9137$).
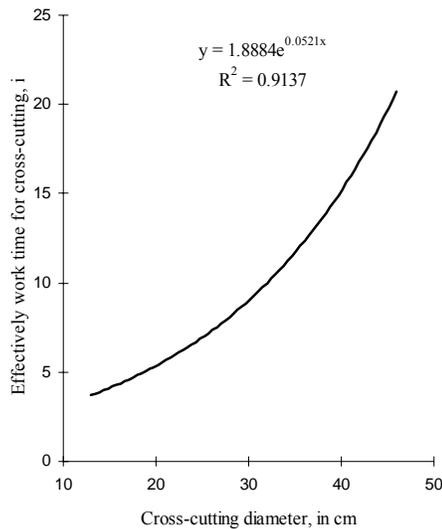

Fig. 7. *Correlation between time for cross-cutting and diameter of cross-cutting*

There has been a total working time of 48. 880 s, of which 6703 were (14%) - time for preparation of work start and end of work; 29,686 s (64%) – effective work time and 11,491 s (24%) - time to break off. The effective cutting time was 3761 s, i.e. 7.4% of total working time.

Specific work conditions, in landing area, justify and set the cross-cutting operation productivity. Expressed through the cut surface per unit time, respectively in cm$^2 \cdot$s^{-1}, labor productivity varies depending on the average diameter of cut sections (Fig. 8). In the analyzed cases recorded productivity values were between 48 and 126 cm$^2 \cdot$s^{-1}.
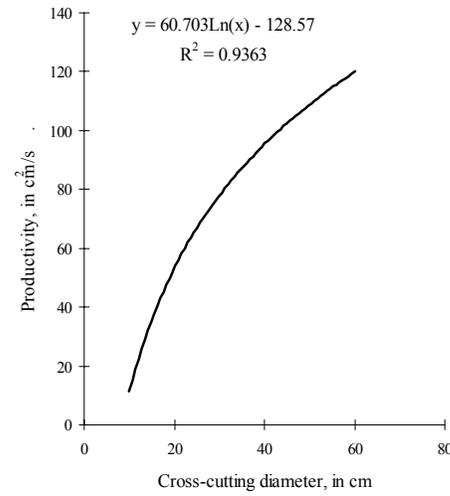

Fig. 8. *Correlation between cross-cutting productivity and diameter of cross-cutting*

Correlation between labor productivity in landing area and the average diameter of cut sections, as shown in Figure 8, is very significant, value of $R^2 = 0,9363$, and can be expressed by a logarithmic equation.

Mean total time recorded for work and work productivity shows a total consuming time of 18 s for cross-cutting 100 cm^2 and effective work time of 1.44 s to cross-cutting 100 cm^2 spruce round wood in landing area.

5. Conclusions

Research conducted on a total of 350 cross-cuttings pieces, with a volume of 361,581 m^3, in a recorded time work of 47.880 s, showed that prepared round wood assortments of spruce wood in landing area had specific characteristics: the average number of cross-cutting 1.29

for $1m^3$; effective work time- 64% from total work time; specific cross-cutting area - 721 $cm^2 \cdot m^{-3}$; cross-cutting productivity - 73.33 $cm^2 \cdot s^{-1}$.

The established correlations between characteristics of cross-cutting of round spruce wood in landing area, namely: the number of cross-cutting and breast height diameter of the marked tree; the average number of cross-cutting and breast height diameter; breast height diameter and cross-cutting surface; cross-cutting surface and volume of marked tree; time consumption and diameter of cross-cutting; productivity of cross-cutting and cross-cutting diameter are, with one exception, very significant, which justifies analysis for other forest tree species and other specific work conditions.

References

1. Ciubotaru A., 1996. Research on setting time consumption for trees harvesting with mechanical chainsaw Husqvarna 262. (in Romanian). Revista Pădurilor 4: 45-47.

2. Hidoş C. and Isac C., 1971. Work Study (in Romanian). Technical Publishing House, Bucureşti.

3. Kilander K., 1960. Work studies in forestry. Time studies without correction to normal work output. Pulp and Paper in Canada 61 (1): 132- 136.

4. Nakagawa M., Hayashi N., Narushima T., 2010. Effect of tree size on time of each work element and processing productivity using an excavator-based single-grip harvester or processor at a landing. Journal of Forest Research 15 (4): 226-233.

5. Piegai F., 1990. Work study of felling and cross-cutting of silver fir and Douglas fir (Tempi di lavoro e produttività nelle operazioni di abbattimento ed allestimento in soprassuoli di abete bianco e di douglasia). Annali - Accademia Italiana di Scienze Forestali 39: 3-32.

6. Rouă C., Ştefănescu E., Mihăilă I., Pafnote M., Petrican M., 1976. Erogonomics in Forestry. (in Romanian). Ceres Publishing House, Bucureşti.