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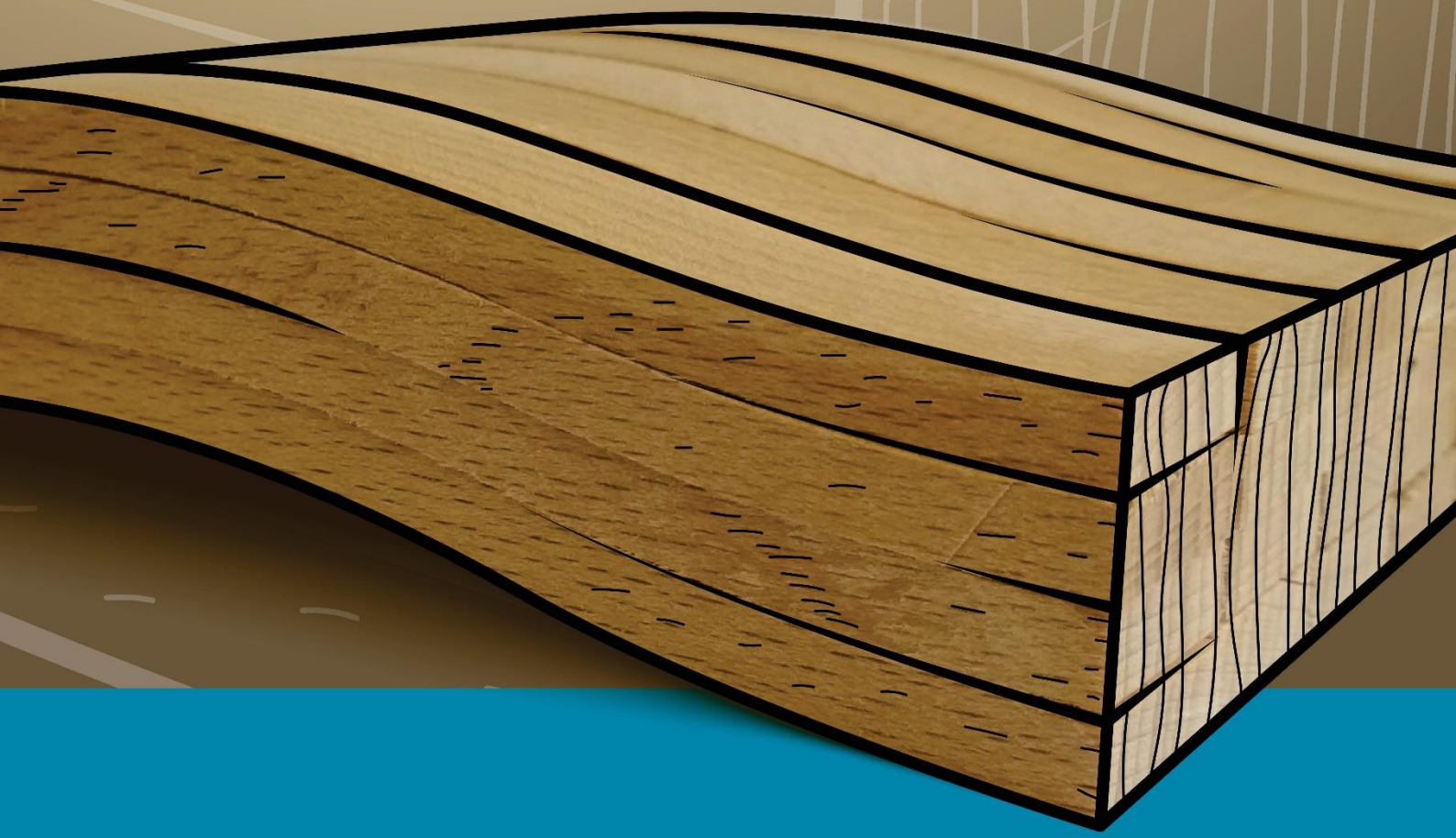

WOOD KPLUS

Mendel University in Brno

10TH HARDWOOD CONFERENCE PROCEEDINGS

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Comparative study of mechanical wood scaling with harvester

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ABSTRACT

In recent years, we have witnessed the increasing spread of multi-purpose logging machines. These machines (harvesters and processors) are characterized by the fact that they are not only capable of felling wood, but at the same time they are also capable of determining the cubic content of the produced assortments. It records the measured and calculated data, so the inventory data is available digitally.
The cubic meter value recorded by harvesters is already accepted in several places abroad. Even today, these data are not accepted in Hungary, after the harvesting work, the wood is collected in the traditional way, by hand-tooled cubage.
Sooner or later, machine cubed data will be accepted in our country, so in this article we examine to what extent harvester stock data differs from the accepted manual survey.

INTRODUCTION

In practice, the most common method for recording (appraisal) wood is manual measurement and the subsequent volume calculation, i.e. manual cubage.
In recent years, we have witnessed the increasing spread of multi-purpose logging machines. These machines (harvesters and processors) are characterized by the fact that they are not only capable of felling wood, but at the same time they are also capable of determining the cubic content of the produced assortments. During work with harvesters and processors, the machine continuously measures the diameter and length of the produced assortments, calculating from this the volume of extracted timber. It records the measured and calculated data, so the inventory data is available digitally. Even today, these data are not accepted in Hungary, after the harvesting work, the wood is collected in the traditional way, by manual cubing. In many countries, however, these data are accepted and form the basis of inventory management. If these measurement data serve as the basis for stock management, on the one hand, we facilitate the work of the often overworked foresters, and on the other hand, it provides the opportunity to eliminate many possible errors that occur during data recording, digitization and data processing. The growing labor shortage in forestry work can only be solved by mechanization.

DESCRIPTION OF TESTS

The tests were carried out in two forest subcompartments: in the forests of Mátraszentimre 24/A and Gyöngyöspata 26/C. There were several tree species in the stands. Most of the data collection covered pine species, oak species were also present in a larger proportion, and other deciduous tree species in a small proportion.
In both places, the forester carried out the recording - in the manner accepted in Hungary - by manual scaling, and the data were also extracted from the on-board computer of the harvester. In the Gyöngyöspata 26/C forest subcompartment, in addition to this, the assortment pieces found in the stacks were also recorded individually with an accuracy of cm. We measured the diameters and the length of the assortment. The diameters were measured from two directions and the average diameters were recorded.
The scaling method for harvesters is as follows: There is a measuring wheel with a spiked surface in the harvester head, which calculates the length of the journey, i.e. the length of the wood assortment, based on

the revolutions made. Meanwhile, the diameter is also measured. This can happen in different ways depending on the machine type, or the software calculates it from the pair of curved knives in the upper part of the harvester head, or from the angular rotation of the drive cylinders.
During the measurement, the teeth of the metal measuring wheel in the harvester head sink into the trunk of the tree. Depending on the tree species, the tooth penetration depth varies, as the hardness and thickness of the bark can vary greatly. In addition, not only the tree species can influence this, but also weather conditions or the site. A very good example of this can be the muddy conditions that occur after the rainy season, or the frost effect present during the winter minuses. In both cases, the measuring cylinder can easily measure an incorrect value, and it can also produce inaccuracy due to its natural wear. That is why regular calibration is important, which must be done every time a new production is started.
In the case of today's modern harvesters, stock data can be saved from the machine via a USB connection, or it can be sent to a selected computer via a WIFI or GPS connection. In the case of older harvester types, we can print them out with the printer connected to the machine, or they can simply be written out from the on-board computer screen.

TESTS RESULTS

In the Gyöngyöspata 26/C forest subcompartment, the harvested wood volume was recorded separately for each lot, the amount of which was determined by each scaling method is shown in Table 1. Here, the wood volume recorded by the forester differs significantly from the results of the other two methods. The difference between the volume of the harvester under bark and measured over bark is minimal (less than 0.5%).
Table 2 shows the differences in cubic meters and percentages. During the comparisons, we compared the other two methods to the mechanical scalings of the harvester. The upper part of the table contains the comparison with the data under bark, while the lower part includes the differences of the data measured over bark. Smaller values compared to the machine (negative deviations) are marked in red, and positive deviations in green. The latter occurred only in the case of one pile, namely when the forester measured about 5 m3, i.e. 9% more than what the pile actually contained.
Similar results were obtained in the Mátraszentimre 24/A forest subcompartment (Table 3). Here, however, the scaling of the forester does not differ significantly from the result of the scaling of the harvester. The cubic meter data of the three different recording (scaling) methods are very consistent. The differences between them do not even reach 4 m3, even though it is a wood volume of nearly 300 m3. Expressed as a percentage, this difference is not quite 1.3% (Table 4).

Table 1: The recorded volume of wood in Gyöngyöspata 26/C forest subcompartment

Gyöngyöspata 26/C	Harvester's recording		Forester's manual scaling	Own manual scaling
	under bark	over bark		
	[m^3]	[m^3]	[m^3]	[m^3]
Total	**275,7**	**276,87**	**237,96**	**267,92**
one by one stack	29,49	29,62	23,00	28,66
	27,52	27,63	20,00	26,74
	58,84	59,09	47,00	57,18
	102,17	102,61	85,00	99,29
	57,68	57,92	62,96	56,05

Table 2: The difference between the recorded volume of wood in Gyöngyöspata 26/C forest subcompartment

Gyöngyöspata 26/C	The difference between a harvester's under bark scaling and a forester's manual scaling	The difference between a harvester's under bark scaling and a my own manual scaling	The difference between a harvester's under bark scaling and a forester's manual scaling	The difference between a harvester's under bark scaling and a my own manual scaling
	[m^3]	[m^3]	%	%
Total	**-37,74**	**-7,78**	**-13,69**	**-2,82**
one by one stack	-6,49	-0,83	-22,01	
	-7,52	-0,78	-27,32	
	-11,84	-1,66	-20,12	
	-17,17	-2,88	-16,81	
	5,28	-1,63	9,16	

Gyöngyöspata 26/C	The difference between a harvester's over bark scaling and a forester's manual scaling	The difference between a harvester's over bark scaling and a my own manual scaling	The difference between a harvester's over bark scaling and a forester's manual scaling	The difference between a harvester's over bark scaling and a my own manual scaling
	[m^3]	[m^3]	%	%
Total	**-38,91**	**-8,95**	**-14,05**	**-3,23**
one by one stack	-6,62	-0,96	-22,35	
	-7,63	-0,89	-27,63	
	-12,09	-1,91	-20,46	
	-17,61	-3,32	-17,16	
	5,04	-1,87	8,69	

Table 3: The recorded volume of wood in Mátraszentimre 24/A forest subcompartment

Mátraszentimre 24/A	Harvester's recording		Forester's manual scaling
	under bark	over bark	
	[m^3]	[m^3]	[m^3]
Total	**301,40**	**301,59**	**297,80**
one by one stack	165,98	166,09	164,00
	121,37	120,45	119,92
	2,41	2,41	2,38
	11,64	11,65	11,50

Table 4: The difference between the recorded volume of wood in Mátraszentimre 24/A forest subcompartment

Mátraszentimre 24/A	The difference between a harvester's under bark scaling and a forester's manual scaling	The difference between a harvester's under bark scaling and a forester's manual scaling
	[m^3]	%
Total	**-3,79**	**-1,26%**
one by one stack	-2,09	-1,26%
	-0,53	-0,44%
	-0,03	-1,24%
	-0,15	-1,29%

Mátraszentimre 24/A	The difference between a harvester's over bark scaling and a forester's manual scaling	The difference between a harvester's over bark scaling and a forester's manual scaling
	[m^3]	%
Total	**-3,60**	**-1,19%**
one by one stack	-1,98	-1,19%
	-0,45	-1,19%
	-0,03	-1,24%
	-0,14	-1,20%

EVALUATION OF RESULTS

On the basis of the tests, it can be stated that the wood material recording (scaling) carried out with the harvester can be accurate and acceptable if properly calibrated.
Due to the spread of multi-purpose logging machines and the worsening labor shortage, it is inevitable that sooner or later the volume of wood harvested by harvesters will become accepted in domestic forestry and serve as the basis of our stock management.

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