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QUALITY OF WILD CHERRY STEMS AND THEIR USE IN WOOD-PROCESSING INDUSTRY

Jana Škvareninová
Arboretum of the Technical University in Zvolen, Slovakia

Ivan Kováčik
Brezno, Slovakia

Jaroslav Škvarenina
Technical University in Zvolen, Slovakia

ABSTRACT

In this study, an analysis of the variability of qualitative traits of wild cherry (*Cerasus avium* (L.) Moench.) stems and crowns is presented. The studied trees were classified into quality classes following the Standard STN 480056. The highest-quality trees belonging to the class A are characterised by thin branches, uniform branching angle and conic crowns beginning in the uppermost quarter of the stem. They grow at altitudes from 150 to 320 m a.s.l. (in the region of Matra-Slaná up to 500m a.s.l.), management set of forest types 311 – fertile oak-beech mixed forests, on foothills and at localities with favourable moisture and soil conditions.

KEY WORDS: wild cherry, *Cerasus avium* (L.)Moench., stem quality, qualitative traits, selection

INTRODUCTION

Human activities associated with air pollution and risk of climate change represent a danger to forest stands concerning their stability and species composition. The stability of forest ecosystems can be strengthened using the principles of ecological and economical development, implementing such tree species that are less frequent, but have some virtues in comparison with the other woody plants (resistance against damage by pollutants, high growth rate, high quality of wood mass production). Wild cherry seems to be a highly promising woody plant from the point of view of stand regeneration and restoration.

In Slovakia, wild cherry is a very rare species. Consequently, cherry wood was used inefficiently in the past, mostly as fuel. Inappropriate utilisation of cherry stems was mainly related to difficulties in supply and subsequent processing. Recently, in association with the development of small-scale forestry and timber industry, there are emerging perspectives for more complex use and utilisation of wild cherry wood.

The species has already been given a special attention in the developed industrial countries of Western Europe. Since the end of the 19-th century, wild cherry wood has been used for manufacturing of furniture and picture frames, primarily in Austria and Germany. Since the 1980s, the wild cherry wood has been high demanded, mainly for the manufacture of style furniture, wooden bricks, marquetry and decorative things. Selection of high-quality stems and a wider utilisation of this woody species in furniture industry can be facilitated through recognising the relations between tree qualitative characteristics and environmental factors.

MATERIAL AND METHODS

Material for the evaluation of qualitative characteristics of stems and crowns was collected from 114 plots belonging to 9 orographic areas according to the Geomorphologic Classification of Slovakia (Kolektív 1986). Wild cherry trees are sporadic or very rare in forest stands, reaching the maximum proportion of 5%. Consequently, the plots with 25 wild cherry trees were selected such that they cover the whole horizontal and vertical occurrence zone of this woody plant. Details about the selection criteria can be found in Škvareninová (1997b).

Methods for the assessment of stem and crown quality

The methods for assessment of stem and crown traits were elaborated according to own field data and verified on a series of 825 cherry trees (Škvareninová 1993). They were supplemented with corresponding evaluations made for other tree species (Laffers 1988, Pagan 1985, Piovarči 1984, Šindelář 1990). Were classified 2850 cherry trees.

The tree stems in forest stands were assessed according to the following characteristics: stem growth - GS, stem form - FS, type - TS, occurrence of spiral grain - OS, surface - SS, cross-section shape - CS, natural pruning - PS. For the tree crowns we evaluated: hight - HC, shape - SC, density - DS, thickness of primary branches - TC, branching angle - BC (the abbreviations are used in Tab. 2-5). In the case of the damage to stem surface, only directly observable traits were assessed: frost cracks, fungi, tumors, rotting burls and sap flow. A more detailed classification of these traits is given in Škvareninová (1997a).

Quality classes according to the evaluated characteristics

A high number of the assessed qualitative traits does not allow direct comparisons among the stems, and, consequently, an appropriate assessment of the wood quality. Therefore, we defined four qualitative classes A to D based on the assessed traits, which corresponded to the quality requirements as defined by the Standard STN 480056 – Qualitative Assortment of Broadleaved Round Wood:

Class A – represents the stems of the highest quality. This class corresponds qualitatively to the wood from the buttress log, used for veneer logs, and special logs for manufacturing of musical instruments and technical facilities. An tree of the class A is characterized by a straight stem without forking, spiral grain and knots, smooth or bird's eyed stem surface, at the same time very good natural pruning, and regular round shape of the cross section. Only a surface stem damage is acceptable.

Class B - stems of average to high quality for the manufacturing of veneers by peeling, logs for sport, technical purposes and barrel manufacture. The difference from the class A is that some spiral growth is accepted and the cross section can be prolonged by 15% from the ideal round shape. Simple curvature of stem is allowed up to 2%. Stem surface is smooth or bird's eyed and the stem natural pruning good or there may be knots with diameter smaller than 1.5 cm in average number by one knot per one meter of stem length, stem pruning very good.

Class C – stems of lower quality or less valuable, suitable for saw logs and construction wood. Here belong forked stems, in the lower part sickle-shaped or twisted. The stem surface can be either smooth, curly, birds eyed with poor pruning, or with knocks and good natural pruning. Accepted is eccentric pith, cracks along pith rays, peeling cracks and star-shaped cracks. Tumours are also allowed, however, only when they do not distort the log. Accepted is also mechanical damage, cracks included, in accordance with the valid Standard.

Class D – stems of the worst quality, suitable for fuel wood only. Here belong all stems with qualitative traits worse than in the class C, occurrence unlimited.

Presence of additional characteristics means a decrease in quality and shift to a lower class. The final classification is determined by the lowest value of the trait allowed in the given class.

Mathematical and statistical traeatment

Mathematic and statistical analyses of the studied qualitative characteristics of wild cherry stems and crowns were carried out using the program Statistika. We used contingency tables with nominal variables. The dependence between the variables was tested using the Pearson's χ^2 test calculated as

$$\chi^2 = \sum \sum n^2_{ij} / \acute{n}_{ij} - n$$

In the case the dependence was found with the significance of $\alpha = 0.05$, an analysis of components χ^2 was performed, with the aim to find positive and negative interactions among factors.

RESULTS AND DISCUSSION

The results of quality assessment of the individual trees according to the defined quality classes is shown in Tab. 1.

Among 2850 assessed trees, 6% (167 trees) were classified to the class A, i.e. the class with trees of the highest quality. The highest proportion of these stems (12%) was found in the area Matra - Slaná.

From the viewpoint of a more complex utilisation of the highest-quality trees for stand reproduction and wood-processing industry, it is important that the proportion of trees belonging to the classes A and B is exceeds 12% in all regions.

Tab. 1: Counts and percentages of wild cherry quality classes according to geographic areas

Area	Presence	Quality classes				Total
		A	B	C	D	
1 Slovak-Moravian Carpathians Mts.	n	19	44	220	167	450
	%	4	10	49	37	100
2 Fatransko-tatranská area	n	15	41	156	38	250
	%	6	16	63	15	100
3 Slovenské stredohorie Mts.	n	34	54	293	94	475
	%	7	11	62	20	100
4 Slovenské rudohorie Mts.	n	26	43	273	83	425
	%	6	10	64	20	100
5 Lučensko-košická depression	n	11	33	100	31	175
	%	6	19	57	18	100
6 Podhôľno-magurská area	n	10	25	96	19	150
	%	7	17	64	12	100
7 Nízke Beskydy Mts.	n	18	36	270	126	450
	%	4	8	60	28	100
8 Matransko-slanská area	n	26	47	116	36	225
	%	12	21	51	16	100
9 Vihorlatsko-gutinská area	n	8	48	145	49	250
	%	3	19	58	20	100
Total	n	167	371	1669	643	2850
	%	6	13	58	23	100

Tab. 2: Probability of the dependence between individual qualitative charateristics and the influence of orographic area on qualitative characteristics

	GS	FS	TS	OS	SS	CS	PS	TC	BC	HC	SC	DS
GS	x											
FS	**0.001**	x										
TS	0.7917	0.0672	x									
OS	**0.0001**	**0.0001**	**0.0045**	x								
SS	0.0534	**0.0001**	0.9816	**0.0001**	x							
CS	**0.0001**	**0.0001**	0.8921	**0.0001**	**0.0001**	x						
PS	**0.0001**	**0.0001**	**0.0383**	**0.0125**	**0.0001**	**0.0002**	x					
TC	**0.0001**	**0.002**	0.7524	**0.0001**	**0.0107**	**0.0001**	**0.0001**	x				
BC	0.4882	**0.0001**	0.7854	**0.0001**	**0.0001**	**0.0208**	**0.0286**	**0.0001**	x			
HC	**0.0001**	**0.0001**	**0.0149**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0002**	x		
SC	**0.0001**	**0.0059**	0.6993	**0.0004**	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0003**	**0.0001**	x	
DS	**0.0001**	**0.0001**	0.8354	0.6459	0.4918	**0.0001**	**0.0001**	**0.0001**	**0.0238**	**0.0001**	**0.0001**	x
Area	**0.0001**	**0.0001**	0.4538	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0002**	**0.0001**	**0.0001**	**0.0001**	**0.0001**

Characteristics: stem growth - GS, stem form - FS, type - TS, occurrence of spiral grain - OS, surface - SS, cross-section shape - CS, natural pruning - PS. For the tree crowns we evaluated: hight - HC, shape - SC, density - DS, thickness of primary branches - TC, branching angle – BC.

The statistical evaluation of dependences between the individual qualitative characteristics (Tab. 2), comprising the results of the χ^2 test, revealed several dependences. From the viewpoint of selection of trees of the highest quality, the following were found statistically significant:

- Dependence between the trees without forking and the stems without spiral growth, with regular round-shaped cross-section, very good natural pruning,
- Stems with straight growth were also characterized by round-shaped cross section, very good natural pruning, thick branches, conic crown, beginning high above the ground, absence of spiral grain,
- Full-boled stems were without spiral growth, with very good natural pruning and the crown beginning in the upper quarter of the stem,
- Stems with smooth surface also had round-shaped cross-section, very good natural pruning, thin branches of the first degree, conic, short crowns,
- Stems with round-shaped cross section exhibited mostly very good pruning, thin branches and crowns beginning high above the ground,
- Stems with very good pruning had in most cases thin branches and a considerably high beginning, dense crowns.

After the trees were categorised to the individual classes, the dependence between the quality class and the presence of certain qualitative traits was assessed within the whole studied set of trees as well as according to geographic areas. The analysis of contingency tables showed that the trees belonging to the class A had thin branches and very thick crowns beginning in the uppermost quarter of the stem. The poor-quality trees belonging to the class D had thick branches, asymmetrical hemispherical crowns beginning within the upper three quarters of the stem.

In addition to the genetic background, qualitative traits of trees are also influenced by the whole complex of site factors. The most important are: altitude, management set of forest types (MSFT) and the tree position in the terrain (mountain ridge, slope, valley). Table 3 summarises the probability of dependence between the quality classes, studied characteristics and site factors.

Tab. 3: Probability of the dependence between qualitative traits and the studied characteristics

	TC	BC	HC	SC	DS	Altitude	MSFT	Terrain
Qual. Tot.	**0.0001**	0.4635	**0.0001**	**0.0001**	**0.0068**	**0.0001**	**0.0001**	**0.0001**
Qual. Ar. 1	**0.0001**	**0.0026**	**0.0001**	**0.0001**	0.1211	**0.0001**	**0.0001**	**0.0001**
Qual. Ar.2	**0.0446**	0.9692	0.2953	**0.0289**	0.1091	0.1861	**0.0021**	**0.0035**
Qual. Ar.3	**0.0292**	0.3165	**0.0001**	**0.0001**	**0.0431**	**0.0001**	**0.0001**	**0.0023**
Qual. Ar.4	**0.0001**	**0.0217**	**0.0001**	**0.0191**	0.5867	**0.0111**	**0.0208**	**0.0251**
Qual. Ar.5	**0.0326**	0.1851	**0.0001**	**0.0355**	0.1753	**0.0001**	**0.0001**	**0.0001**
Qual. Ar.6	**0.0062**	0.0525	**0.0001**	**0.0001**	**0.0001**	**0.0001**	**0.0332**	**0.0005**
Qual. Ar.7	**0.0001**	**0.0132**	**0.0001**	**0.0001**	0.0933	0.8083	0.1364	**0.0064**
Qual. Ar.8	**0.0001**	**0.0496**	**0.0001**	**0.0001**	0.3794	**0.0298**	**0.0002**	0.1178
Qual. Ar.9	**0.0001**	**0.0139**	0.6079	**0.0001**	**0.0375**	0.2971	**0.0197**	0.9127

Characteristics: For the tree crowns we evaluated: hight - HC, shape - SC, density - DS, thickness of primary branches - TC, branching angle – BC.

The research plots were situated at 150-850 m a.s.l. To obtain objective results, there were this range was divided into equidistant altitudinal intervals. The analysis of contingency tables revealed that in the interval 150-320 m a.s.l. trees with a number of traits indicating high quality of stem and crown predominate: absence of forking, straight stem without spiral grwoth, round-shaped cross section, straight branching angle, conic crown. With increasing altitude increased occurrence of curved stems with poor natural pruning and uniform branching angle.

Management sets of forest types (MSFT) are units with uniform natural and production conditions within the framework of the unit. Testing of dependence of quality class on MSFT revealed that the highest-quality trees of the class A mostly occurred in the MSFT 311 – fertile oak-beech mixed stands. Cambisols on these sites have a favourable nutrient and moisture content. Wild cherries of high quality were found to grow on foothills; low quality trees grew at mountain ridges and in adjacent-to-ridge sites.

In the region Matra - Slaná (region 8), trees of the highest quality were predominating. A more detailed analysis of the dependence between the qualitative characteristics and site factors influencing the quality of stems is given in Tables 4 and 5.

Tab. 4: Probability of the dependence between qualitative traits in the Matra – Slaná region

	GS	FS	TS	OS	SS	CS	PS	TC	BC	HC	SC	DS
GS	x											
FS	0.5276	x										
TS			x									
OS				x								
SS	0.1791	0.1137			x							
CS	**0.0001**	0.6947			0.3183	x						
PS	**0.0130**	**0.0127**			**0.0001**	0.1418	x					
TC	**0.0001**	0.3405			0.5147	0.1045	**0.0132**	x				
BC	**0.0020**	0.3689			0.2931	0.5330	0.4887	**0.0008**	x			
HC	**0.0001**	0.6505			**0.0010**	0.5824	**0.0001**	**0.0001**	0.1918	x		
SC	**0.0001**	0.9546			0.8448	0.3920	0.4968	0.5173	**0.0001**	**0.0015**	x	
DS	0.1157	0.2292			0.7439	0.2570	0.0743	0.2309	0.8251	0.6768	0.1503	x

Characteristics: stem growth - GS, stem form - FS, type - TS, occurrence of spiral grain - OS, surface - SS, cross-section shape - CS, natural pruning - PS. For the tree crowns we evaluated: hight - HC, shape - SC, density - DS, thickness of primary branches - TC, branching angle – BC.

Tab. 5: Probability of the dependence between qualitative characteristics and site factors in the Matra – Slaná region

Stem characteristic	Altitude	MSFT	Position in terrain
Growth	**0.0075**	**0.0009**	0.4734
Presence of forking	**0.0349**	0.1306	0.0527
Type			
Spiral growth			
Surface	0.3557	**0.0163**	0.6459
Cross-section shape	**0.0153**	**0.0003**	**0.0007**
Natural pruning	**0.0364**	**0.0071**	**0.0299**
Branch thickness	**0.0001**	**0.0003**	**0.0005**
Branching angle	**0.0001**	0.0616	0.3301
Crown heigth	**0.0001**	**0.0002**	**0.0004**
Crown shape	**0.0001**	**0.0001**	**0.0052**
Crown density	**0.0004**	0.1703	**0.0150**

Analysis of the results revealed that the highest quality trees in this region have thin branches, uniform branching angle, and conic crowns beginning in the upper quarter of the stem. The trees grow at altitudes from 330 to 500 m a.s.l., MSFT 311 – fertile oak-beech stands, on foothills with favourable water and nutrient supply.

The quality of trees is also influenced by human factor, which is associated with silvicultural interventions. They can favourably affect growth and natural pruning of stems, height, length and shape of crowns. Because of a low presence of cherry trees in forest stands and different levels of silvicultural management, we only can hypothesise about partially favourable impact of this management. Nevertheless, the dependence between stem pruning and other qualitative characteristics was found significant.

The studied problem is complex and the literature only summarises incomplete knowledge about the occurrence and variability of characteristics of this woody plant. Some traits of high-quality wild cherry trees relevant for wood processing, primarily furniture industry, have already been discussed by several authors. According to Meier (1984), straight full-boled stems with good natural pruning and short crowns should be preferred, whereas Otto (1988) emphasized round-shaped cross section of stem.

Diez (1989) considered crown shape to be an important trait predisposing formation of straight stems with regular annual rings pattern. The author does not give any other characteristics for a comprehensive description of highest-quality stems. The evaluation of tree quality according to the valid standard does not consider crown shape. It has been found that there exists a dependence between the shape of crown and the shape of the stem cross-section. This dependence was evident on trees with irregular cross-section shape occurring in trees with multiple-forked crowns only. In the case of a circular or ovate cross section, no dependence on the crown shape was found.

Concerning the dependences among other characteristics, it is necessary to emphasize that the stems with smooth surface had round-shaped stem cross-section, very good natural pruning, thin primary branches and conic crowns beginning within the uppermost quarter. Some of the presented relationships were also indicated by other authors (Otto 1988, Spiecker and Spiecker 1988, Diez 1989).

It is a complicated matter to assess the impact of site factors on a paritcular qualitative trait, because all the factors take effect at almost synchrinically but with different intensities. The results showed that most wild cherry trees of the class A are situated at altitudes below 330 m a.s.l. and on foothills. With increasing altitude, the number of such trees decreases and it is also low at mountain ridges. This is in concordance with the observations of Pryor (1985) and Zeitlinger (1990) who found a decrease in wild cherry trees quality at altitudes above 600 m a.s.l.

CONCLUSIONS

We studied variability of qualitative characteristics of stems and crowns of wild cherry (*Cerasus avium* (L.) Moench.) trees on 114 plots in 9 orographic areas in Slovakia. A comprehensive quality assessment based on the studied traits was elaborated by the classification of trees into quality classes according to the Standard STN 480056 for qualitative sorting of broadleaved roundwood. From the total of 2850 evaluated individuals, 6% (167 trees) belonged to the class A – stems of the highest quality. Most of trees of this quality (12%) were growing in the region Matra -Slaná.

The dependence between characteristics was tested using the Pearson's χ^2 test. In the case where the dependence was found significant at the level $\alpha = 0.05$, analysis of the components of χ^2 was performed with the aim to find positive and negative interactions.

The analysis of dependence between the quality class and qualitative traits within the whole studied set as well as within individual geographic regions showed that the trees belonging to the class A have thin branches and very dense crowns beginning in the upper crown quarters. In addition to the genetic properties, the qualitative characteristics are also influenced by the whole complex of site factors. The tests revealed that the most significant were: altitude, management set of forest types (MSFT) and the tree position in the terrain (ridge, slope, valley).

The highest-quality trees of the class A are characterised by thin branches, uniform branching angle and conic crowns beginning in the uppermost stem quarter. They are growing from 150 to 320m a.s.l. (in the region Matra-Slaná up to 500m), MSFT 311 – fertile oak-beech stands, on foothills with favourable water and nutrient conditions.

Wild cherry provides a high-quality timber. Yellowish-rose coloured sapwood and deep-red heartwood is inquired for furniture industry and manufacturing of wooden decorative objects. The wood is fairly elastic, with good machining properties and very smooth surface. Consequently, the final surface treatment of the products can be completed by glazing or applying lacquers. A high growth rate and timber quality of this woody species can encourage its broader utilisation in forest stands and wood-processing industry in the future.

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Ing. Jana Škvareninová, PhD.
Arboretum Borova hora
Technical University in Zvolen, Slovakia
T.G. Masaryka 24
960 53 Zvolen
Slovak Republic
E-mail: janask@vsld.tuzvo.sk

Ing. Ivan Kováčik, PhD.
9 mája 33
977 01 Brezno
Slovak Republic

Prof. Ing. Jaroslav Škvarenina, CSc.
Technical University in Zvolen, Slovakia
T.G. Masaryka 24
961 53 Zvolen
Slovak Republic
E-mail: jarosk@vsld.tuzvo.sk