

Value production of poplar clones

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ABSTRACT: The results of research on the value production of the stands of poplar clones Robusta and I-214 carried out in Slovakia are presented. Models of value yield tables were constructed separately for each clone. The models simulate gross and net financial yield of wood production in dependence on the site index and age of stand. They were constructed on the basis of the models of assortment yield tables, timber prices according to assortments and the models of own costs of timber felling and processing. The clone I-214 produces a faster and higher proportion of thicker assortments of average and below-average quality, and therefore it has the higher value production at a younger age only. Robusta produces smaller diameter but higher quality assortments and has the higher value production only at an older age. The site index of the stand is the most important factor in the value production of poplar clones. Differences in the production between site indexes are much greater than between the clones.

Keywords: poplar clones; value production; gross and net financial yield; value yield tables

Quality production of wood raw materials with maximal use of natural factors and minimum costs of human labour is the main aim of forest production with regulated management, it means forest cultivation in its whole production framework. Knowledge of the value production of forest stands exists on two levels according to known literary sources. The first level is the individual financial valuation of the stocks of concrete stands with their mensurational characteristics, and the second level represents knowledge in this field for the lifelong development of forest stands and their total production in the form of value yield tables. Gross and net financial yield may be expressed, similarly like traditional yield tables or assortment yield tables, in dependence on the age and site index of stands.

In published works the knowledge of the value production on both levels is available. SCHROEDER and SEEMANN (1987) reviewed the production of Douglas fir, spruce and pine in timber reserve, proportion of assortments, and gross and net yield. They based their own value calculations on standing resources of the studied tree species, their dimen-

sional sorting, financial valuation of assortments and costs of logging operations. BARTELHEIMER (1991) calculated the gross and net yield of quality oak stands using the average prices of timber and costs of logging operations in Bavaria. BRANDL (1986) calculated net yield for beech stands tended by various methods. BRANDL (1989) dealt with the issue of net yield again, but from the whole forest operations, when he analyzed the results of economic activities of selected forest enterprises. Based on their economic records he derived such a minimum height of total mean increment in m³ that the net yield of the whole forest production, including wood production, is still positive. BERGEL (1986) described the procedure of derivation of value yield tables for Douglas fir with various tending intensity, yield level and rotation period. He used yield and assortment tables for their construction. He used the costs of logging and other silvicultural operations, including overhead costs, from the data of forest enterprises. BACHMANN (1967) derived tables for the calculation of net yield from the timber reserve of stands for spruce, fir, pine, larch, beech, ash and maple. He de-

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rived the tables from tree, assortment and tree value tables. HENGST (1971) studied in the greatest detail the problem and procedure of the construction of complete value yield tables with concrete overviews. He emphasised that the value yield tables were not only the issue of natural production in kind but also it was an economic issue as well. Therefore the validity of all similar tables is dependent on the time. NYMBURSKÝ and POLÁK (1972) derived similar value yield tables for spruce, fir, pine, oak and beech. In their construction available yield tables, assortment tables, timber prices according to assortments and average costs of whole logging operations were used. Later PETRÁŠ and HALAJ (1990) derived mathematical models of value yield tables with a possibility of continuous updating of economic data for spruce, fir, pine, oak and beech, and PETRÁŠ et al. (1992) for larch, hornbeam and birch. Recently the models of the natural production of poplar clones Robusta and I-214 have been completed also in Slovakia. PETRÁŠ and MECKO (2001, 2005) and PETRÁŠ et al. (2008b) processed their volume and quality production in the form of models of yield and assortment yield tables. Value yield tables are their continuation.

The aim of this paper is to present the methodology of the construction of the models of value yield tables of poplar clones Robusta and I-214 and to evaluate the production of both clones by help of the tables.

MATERIALS AND METHODS

Value yield tables characterize the value production of tree species very well. They give the financial value in Slovak crowns of timber reserve of the main stand and secondary crop as well as total production $V(SKK)$ in dependence on their site index SI and age t according to the relation:

$$V(SKK) = f(SI, t) \quad (1)$$

Yield tables comprise the gross yield of wood production as the product of the amount of produced assortments and timber prices, own costs of their felling, processing and transportation, and the net yield that is the difference of gross yield and own costs of logging. Value yield tables of poplar clones were constructed by the method of simulation from the models of assortment yield tables, prices of the assortments of raw timber and costs of logging operations.

Models of assortment yield tables

They are in the form of mathematical models (PETRÁŠ et al. 2008b) and they show the structure

of assortments SA (m^3 , %), namely the volume in m^3 or the proportion in % of quality and diameter classes of logs of the standing volume of the stand in dependence on its site index SI and age t according to the relation:

$$SA (m^3, \%) = f(SI, t) \quad (2)$$

Assortment yield tables for poplar clones were constructed by the fusion of models of yield tables and stand assortment tables, models of quality and models of damage to stands.

Models of yield tables (PETRÁŠ, MECKO 2001, 2005) determine the development of mean diameter d_v and standing volume V for the main stand and secondary crop in dependence on the site index SI and age t according to the relation:

$$d_v = f(SI, t) \quad (3)$$

$$V = f(SI, t) \quad (4)$$

Models of stand assortment tables determine the structure of assortments $V\%$ for poplar stands (PETRÁŠ et al. 2008a) in dependence on their mean diameter d_v , quality qua and damage dam to stands according to the relation:

$$V\% = f(d_v, qua, dam) \quad (5)$$

The structure of the assortments is composed of the quality and diameter classes of logs in accordance with the standard of the Slovakia STN 48 0056 for the qualitative classification of broadleaved round wood in 2007. The highest quality classes *I* and *II* are intended mainly for the production of industrial veneers, while class *II* has slightly lower requirements for the quality of wood than class *I*. Class *I* requires a minimum log diameter of 40 cm and class *II* requires 20 cm. Quality classes *IIIA*, *IIIB* and *IIIC* represent high, average and lower quality saw logs with minimum diameter of 20 cm. Pulpwood assortment of class *V* is intended mainly for the pulp industry and class *VI* is fuel wood. Assortment diameter classes 1–6+ are defined pursuant to their mean diameter inside bark.

Models of quality stand are expressed by percentage proportions of the external stem quality classes *A–C* in dependence on the site index. Models of damage to stands are expressed by percentage proportions of damage to stems according to visible symptoms on their surface in dependence on the stand age. Regression models, as regards the model of quality and the model of damage to stands, were derived from the measurements in 87 poplar clone stands.

Table 1. Values according to quality classes and diameter classes (SKK/m³)

Quality class	Diameter class 1–6+					
	1	2	3	4	5	6+
<i>I</i>		–	–	2,717	2,767	2,800
<i>II</i>	–	2,133	2,200	2,233	2,267	2,300
<i>IIIA</i>	1,303	1,406	1,513	1,553	1,553	1,483
<i>IIIB</i>	1,243	1,303	1,369	1,369	1,369	1,303
<i>IIIC</i>	1,250	1,250	1,250	1,250	1,250	1,250
<i>V</i>	1,075					
<i>VI</i>	777					

Prices of raw timber assortments

The price of timber is an important economic category as it markedly influences the gross yield of forest stands. It reflects in money mainly the timber utility value but in market economy it is considerably affected also by the supply of and demand for concrete assortments. The model used average offering prices of timber for the year 2006 in the locality of dispatching wood yard in three for-

est enterprises – Palárikovo, Levice and Sobrance. They have the highest annual cut of poplar wood in Slovakia. Their values according to quality classes and diameter classes given in SKK/m³ are as follows (Table 1).

As we can see, the prices of poplar wood are relatively low. For example in comparison with spruce they are lower by about 500–1,000 SKK for higher quality log assortments and by about 50–400 SKK for lower quality logs. On the contrary, for pulp assort-

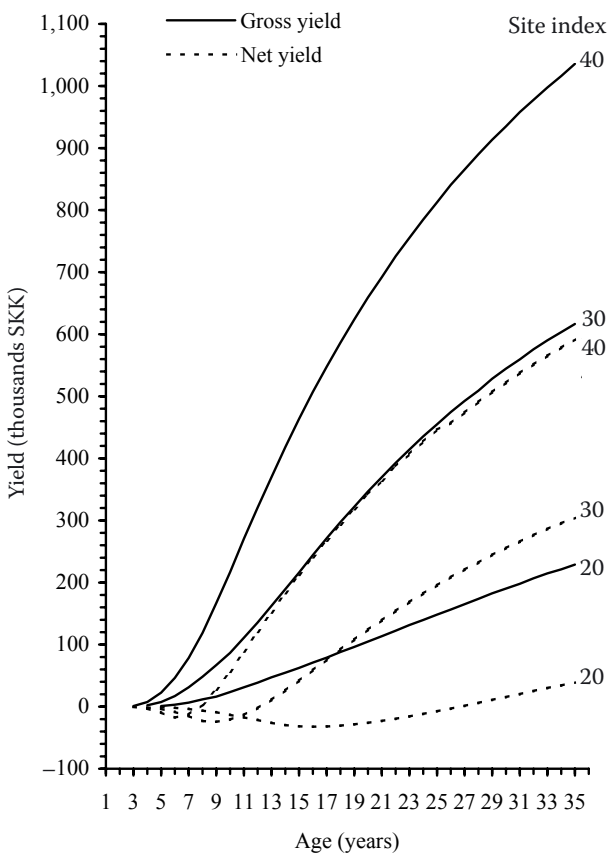


Fig. 1. Robusta – the gross and net yield of the main stand in dependence on site index and age

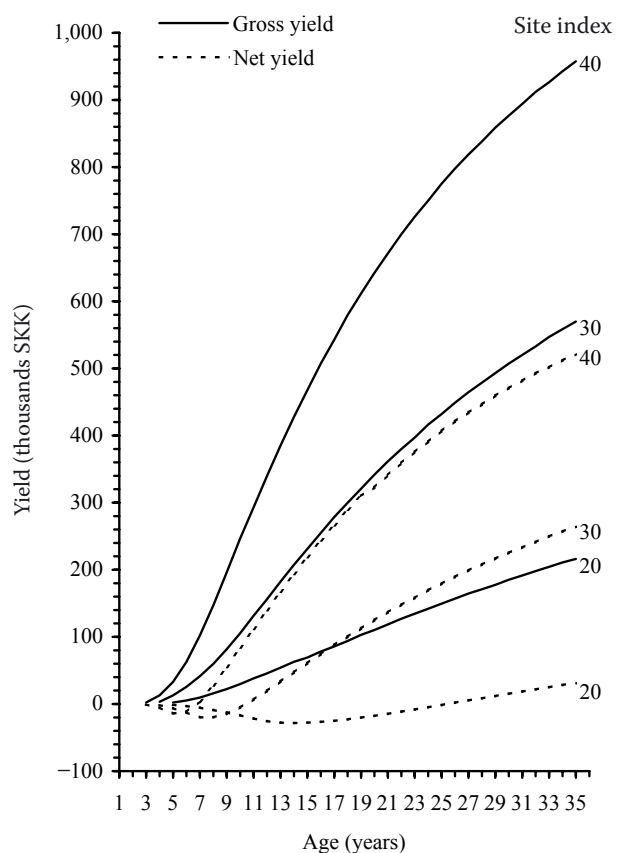


Fig. 2. I-214 – the gross and net yield of the main stand in dependence on site index and age

ments and fuel wood poplar wood has higher price by 200–180 SKK.

Timber felling costs

They are own production costs of whole logging operations, i.e. timber felling, its skidding, handling and transport as well as other logging costs. Own costs consist of direct costs, which are mainly labour costs and material costs for whole logging operations, and indirect costs related with logging organization and securing. Labour costs are based on work standards of 1992 that set the standardized time consumption in standard hours (SH/m³) for the production of 1 m³ of raw wood in a concrete logging operation. In timber felling the time consumption is a function of site index and average volume of exploited trees, in skidding, handling and transportation of wood it is only the average volume of stems or their logs. All other data being necessary for the calculation of logging costs were obtained from records of two forest enterprises Palárikovo and Levice or from accounting records of national state forest enterprise for the year 2006. In timber

skidding extraction of stems to the distance of 40 m and hauling of load to the distance of 300 m are taken into account, while transportation means timber transport to the distance of 27 km. With regard to difficult conditions where concrete working operations are performed, surcharges to the basic standard hours (SH/m³) were added, for timber felling on average 30%, timber skidding 40% and timber handling 20%. The direct costs of the production of 1 m³ of raw wood assortments were derived by means of the product of SH/m³ with the wage schedule and coefficient of recalculation of labour costs to direct costs. Direct costs of other logging activities in SKK/m³, consisting mainly of maintenance and care about the forest road network, were taken from the accounting of national state forest enterprise for the year 2006. Based on these data the coefficient of recalculation of direct costs to own costs was also derived.

RESULTS AND DISCUSSION

Final quantity of value yield tables is the gross and net yield of main stand, secondary crop and total production. Of these three production components

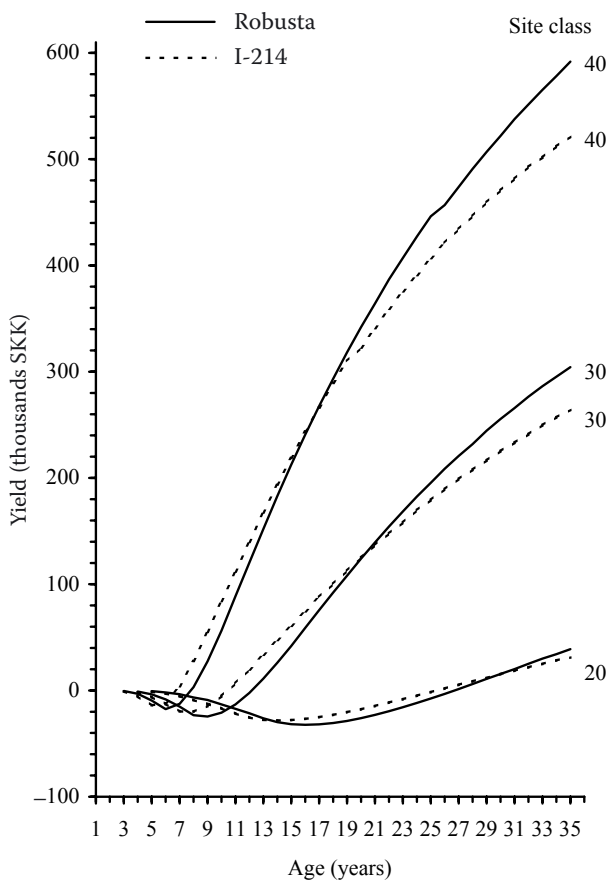


Fig. 3. Comparison of the net yield of the main stand of the clones Robusta and I-214

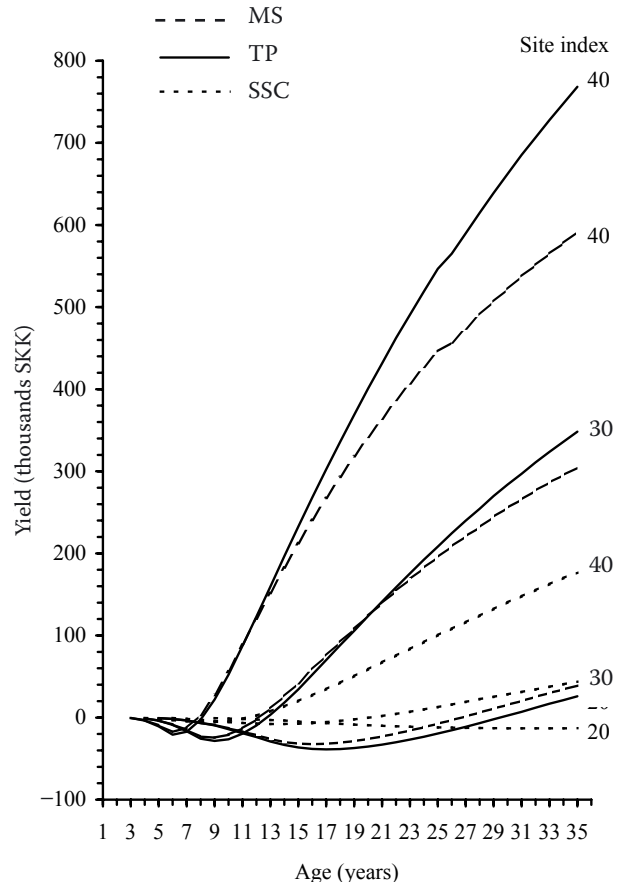


Fig. 4. Robusta – the net yield of total production (TP), main stand (MS) and sum of secondary crop (SSC)

the main stand is decisive (according to the volume). Figs. 1 and 2 illustrate its gross and net yield for both clones. It is obvious that the curves of gross yield have a shape similar to growth curves, according to which Robusta reaches the values higher only by 10% than are the values of I-214. The curves of net yield also have a similar shape with the exception of the sections with lower age. It is so because at a younger age this yield is negative with the values within 20 to 40 thousand SKK. Positive yields are reached for the highest site indexes at the age of 7–8 years, for intermediate site indexes at the age of 11–12 years and for the lowest site indexes at the age of 25–26 years, which is relatively late. At an older age the net yield of both clones also increases fluently according to the typical growth curve. At the age of 35 years and for site indexes 20, 30, 40 the net yield accounts for about 15%, 50% and 55% of the value of gross yield. A more detailed comparison of the net yield of main stands of both clones is presented in Fig. 3. It is obvious that clone I-214 has a slightly higher yield than Robusta only at a younger age. For site indexes 20, 30 and 40 the yields of both clones are equal at the age

of about 30, 20 and 17 years. At the age of 35 years Robusta reaches about 40–590 thousand SKK and I-214 less only by about 10–70 thousand SKK.

Proportions between the net yields of main stand, secondary crop and total production are illustrated in Fig. 4 for Robusta and in Fig. 5 for I-214. It is obvious that the secondary crop has the lowest values, when even for the highest site indexes the yields are only about 300 thousand SKK. Below-average site indexes of secondary crop have the yield negative in their whole age range. Therefore also the yield from total production is lower for these site indexes than is the yield of the main stand. The yields of secondary crop with the average and highest site indexes account for about 15–25% of the yields of total production at the age of 35 years. Remaining 85–75% is the proportion of the main stand.

Total current and total mean increments were derived from total production. Looking at Figs. 6 and 7 we can state that both clones have very similar shapes of increment curves. Robusta has the culmination of increments in several years later as well as it reaches higher increments at an older age than

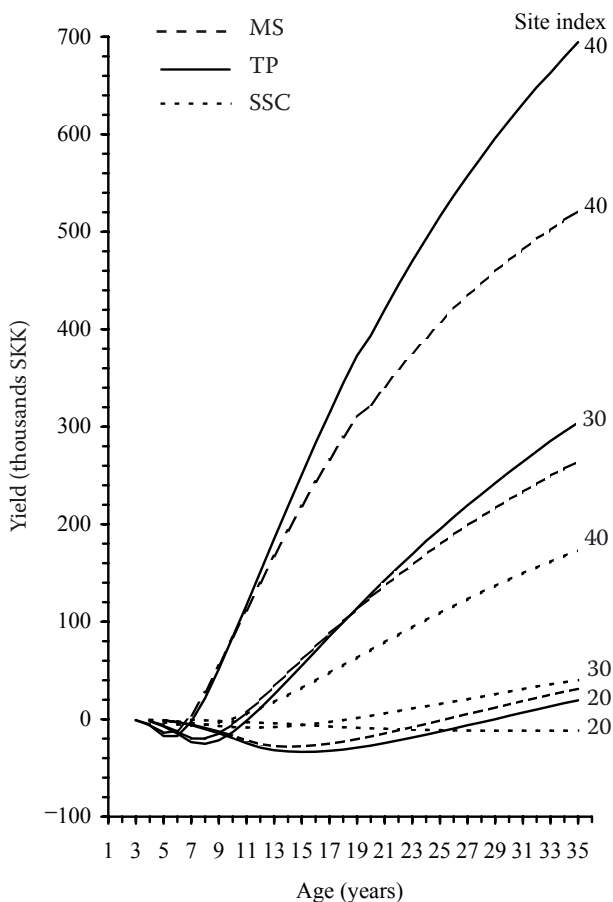


Fig. 5. I-214 – the net yield of total production (TP), main stand (MS) and sum of secondary crop (SSC)

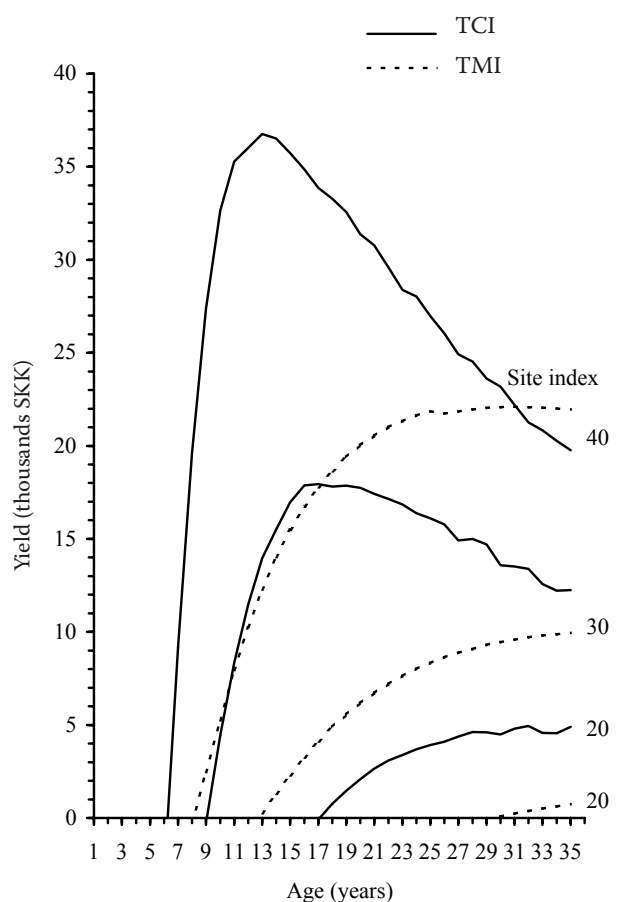


Fig. 6. Robusta – the net yield of total current increment (TCI) and total mean increment (TMI)

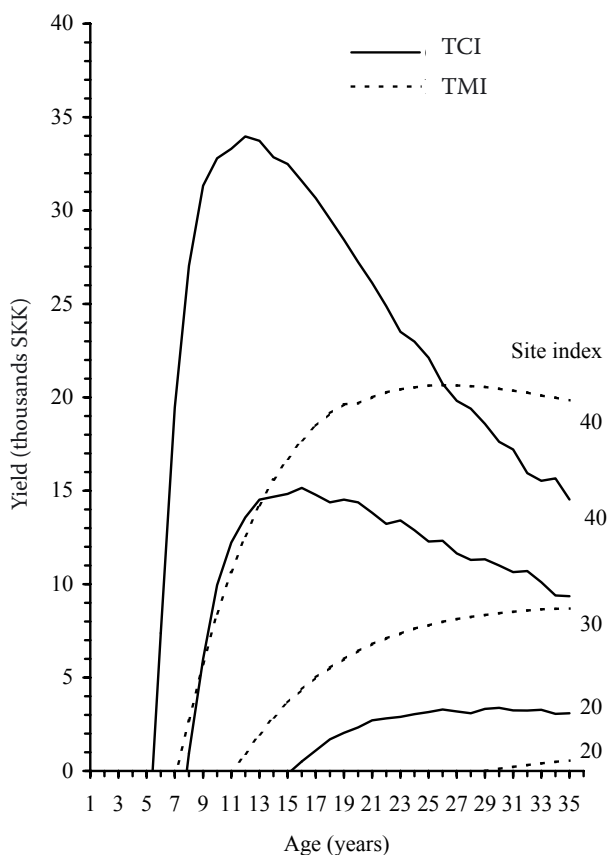


Fig. 7. I-214 – the net yield of total current increment (TCI) and total mean increment (TMI)

I-214. Therefore its increments for the intermediate and highest site indexes are higher by 3–5 thousand SKK. Much greater differences in the increments are between site indexes than between clones. While for the highest site indexes their total current increment culminates at the age of 12–13 years with the value 34–37 thousand SKK, for the lowest site indexes the culmination is at the age of 30–35 years with the value only 3–5 thousand SKK. The culmination of total mean increment is logically at an older age than the culmination of total current increment. For the highest site indexes it is at the age of 25–30 years, for intermediate site indexes it is expected after the limit of 35 years but for the lowest site indexes it is at a considerably older age.

The value production of the stands of poplar clones is the final form of its expression. It integrates volume wood production, structure of timber assortments, wood prices and their proportions for single assortments as well as the costs of the production of final assortments of raw timber from the felling of trees directly in the forest up to the deliveries of assortments for their industrial processing. It is obvious from the overview that

the primary production of raw timber assortments is decisive in the whole technological process. The site index of forest stand as well as the duration of production period affects it markedly. Though we tried to prove more marked differences in the value production of both clones, the results do not confirm our expectations. It is a fact that the clone I-214 has the substantially faster diameter growth than Robusta as well as very high volume production. On the contrary, Robusta produces assortments of higher quality. With regard to relatively low unit prices of the highest quality assortments the substantially higher production of high quality timber of Robusta has not reflected in the value production significantly. Mainly the very fast growth and earlier culmination of the increments of clone I-214 are the reasons for preferring its cultivation to Robusta clone. The range of the highest site indexes is also significant. Both clones reach this range under the conditions of Slovakia. While Robusta reaches maximum site index 42, then I-214 even 46. With regard to net yield the costs of the production of final assortments are not negligible as with average and above-average site index they account for 50–55% of the value of gross yield. Reducing production costs, which concerns direct or indirect costs, can increase their net yields in timber production in poplar stands very significantly. Based on the constructed models it is possible to update very operatively or to simulate the economic part of value production.

The discussion on the accuracy of derived value production models has to respect that yield table models (PETRÁŠ, MECKO 2001) and models of stand assortment tables (PETRÁŠ et al. 2008b) do not have any bias. For that reason neither should value production models have any bias. We anticipate that relatively exact parameters of value production will be achieved in the biggest files of stands. On the contrary, the lowest accuracy will be achieved of individual stands that will be of stand parameters much more different from model parameters.

CONCLUSIONS

Methodology of the construction of the models of value yield tables of poplar clones Robusta and I-214 is presented. Based on them the production of both clones is evaluated as well. According to relation (1) the models of value yield tables give the monetary value of the standing volume of main stand and secondary crop as well as total production in dependence on their site index and age. They were

constructed on the basis of the models of assortment yield tables according to relation (2), timber prices in SKK/m³ and own costs of timber felling, production of assortments and their transportation for industrial processing. These economic data were obtained from the state forest enterprise of the Slovakia for the year 2006.

Robusta reaches only by about 10% higher gross yields of main stand than I-214. Net yield presents a difference between gross yield and the costs of assortment production. Positive values are reached for the highest site indexes at the age of 7–8 years, for intermediate site indexes at the age of 11–12 years and for the lowest site indexes at the age of 25 to 26 years. In the oldest stands with site indexes 20, 30 and 40 the net yield accounts for only 15, 50 and 55% of the value of the gross yield. Clone I-214 has only a slightly higher yield at a younger age than Robusta. For site indexes 20, 30 and 40 the yields of both clones are the same at the age of about 30, 20 and 17 years. Robusta reaches about 40–590 thousand SKK at the age of 35 years and I-214 less by about 10–70 thousand SKK.

It is obvious from the comparison of the net yield of main stand, secondary crop and total production that the secondary crop has the lowest values, when even for the highest site indexes the yield is only 300 thousand SKK. Below-average site indexes have the negative yield of secondary crop in the whole age range. Therefore for these site indexes also the yield from total production is lower than the yield of the main stand. Yields of the secondary crop for the average and highest site indexes account for about 15–25% from the yields of total production at the age of 35 years. The remaining 85–75% is the proportion of main stand.

Robusta has higher total current increments for the intermediate and highest site indexes. While for the highest site indexes their total current increment culminates at the age of 12–13 years with the value 34–37 thousand SKK, then for the lowest site indexes the culmination occurs at the age of 30–35 years with the value only 3–5 thousand SKK. The culmination of total mean increment is logically at an older age than the culmination of total current increment. With the highest site indexes it is at the age of 25 to 30 years, for intermediate site indexes it is expected immediately after the limit of 35 years but for the lowest site indexes it is at a considerably older age.

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Hodnotová produkcia topoľových klonov

ABSTRAKT: V práci sa prezentujú výsledky, ktoré sa dosiahli pri výskume hodnotovej produkcie porastov topoľových klonov Robusta a I-214 na Slovensku. Skonstruovali sa modely hodnotových rastových tabuliek osobitne pre každý klon, ktoré simulujú hrubý a čistý finančný výnos z produkcie dreva v závislosti od bonity a veku porastu. Podkladom pre ich konštrukciu boli modely sortimentačných rastových tabuliek, cien dreva podľa sortimentov a modely vlastných nákladov na ťažbu a spracovanie dreva. Klon I-214 produkuje rýchlejšie a väčším podielom hrubšie sortimenty priemernej a podpriemernej kvality, a preto má vyššiu hodnotovú produkciu v nižšom veku. Robusta produkuje tenšie, ale kvalitnejšie sortimenty a má vyššiu hodnotovú produkciu len vo vyššom veku. Najvýznamnejším faktorom v hodnotovej produkcii topoľových klonov je bonita porastu. Rozdiely v produkcii medzi bonitami sú oveľa väčšie ako medzi klonmi.

Kľúčové slová: topoľové klony; hodnotová produkcia; hrubý a čistý finančný výnos; hodnotové rastové tabuľky

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