

Results of a 25 Years Provenance Experiment with Larch (*Larix decidua* Mill.)

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As we have mentioned in our former communications, great attention is being paid to the comparison of the quantitative and qualitative production of the different ecotypes of Larch (*Larix decidua* MILL.). The greatest interest abroad is taken in the Larch provenance from the region of the Nizky Jeseník (the Low Ash Mountains) because of its growth properties. It is also called Larch varietas Moravica (Sudetica).

In 1937. G. VINCENT laid out a series of sample plots containing Larch from Moravia, Bohemia, Slovakia, and Austria, in order to compare the growing process of different ecotypes of Larch. Two of these sample plots were laid out in two adjoining forest districts of the School Forest Enterprise of the University of Agriculture and Forestry in Brno. They are situated 480 m. above sea level. Considering that both of these sample plots, containing 4 provenances each, are situated in the same elevation above sea level, the other data being nearly the same as well, we can regard both of them as a single group. One-year-old Larch seedlings were planted there in 1938 on unit areas of 30 X 30 m. at spacings of 2.5 X 2.5 m. The provenances to be compared come from the following regions: one Moravian provenance from the region of Adamov situated 400 m. above sea level; one Bohemian provenance of Kuří Vody 450 m. above sea level; the Slovakian ones of Sabinov 400 m., of Prievidza 600–700 m., of the Nížké Tatry (the Low Tatras) 1100–1200 m. above sea level; the Austrian provenances are represented by the provenances of the Wienerwald 400–500 m. and of the Wechsel 1000 m. above sea level. The soil of both sample plots contains intermediate layers of podsol of Rudice. The mean annual precipitation amounts to 631–634 mm., the mean temperature being 7.4⁰ C. and the rain factor according

to LANG 85–86. The climate formula according to KALELA runs as follows: 5 (14.9 17.4) 3 (–1.6) 20.– 631 (347) for the sample plot of HabrUvka and 5 (14.8 17.2) 3 (–1.5) 19.8 634 (355) for the sample plot of Olomučany. After having reached the age of 25 years both sample plots were fully investigated by means of the thinning method (VYSKOT 1965). Then the sample trees were analysed according to HUBER'S Method. The same sample trees were also used for an analysis determining the mechanical and physical wood properties. All provenances were also evaluated as regards the stem quality, especially the number of the smooth-barked stems, the crookedness of the stems, and self-pruning were considered. The so-called value classification (VYSKOT 1929) was used to express the general quality.

A survey of the principal data is given in Table 1. We can see that the provenance of the Nizke Tatry contains the highest number of stems and the provenance of the Wienerwald the lowest one. The largest mean breast diameter can be found in the provenance of Kuří Vody which is followed by that of the Nížké Tatry. The lowest value occurs in the provenance of the Wechsel. The provenance of the Nizke Tatry reaches the highest mean height, while that of the Wechsel the lowest one. The trees of Adamov have the longest crowns, while those of the Wechsel exhibit the shortest. The crown diameters are the longest in the provenance of the Wechsel and the smallest in that of Sabinov. The crown surface reaches the highest value in the provenance of the Wienerwald on the sample plot of Habrůvka and the lowest one in that of Sabinov. Nearly all trees exhibit very smooth barks in the provenances of Kuří Vody and the Wienerwald on the sample plot of HabrUvka, while the highest percentage of scaly-barked trees can be found in the provenances of the Nížké Tatry and of Sabinov. Crooked stems occur mostly in the provenances of Prievidza and the Wienerwald on the sample plot

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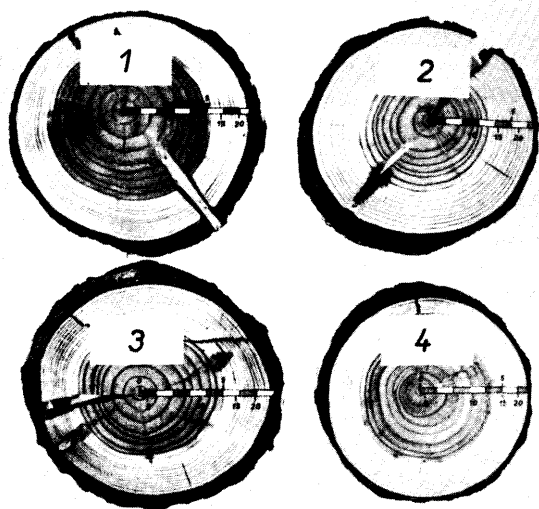


Figure 1 a. — Forest district of Habruvka, compartment 15 a₄.

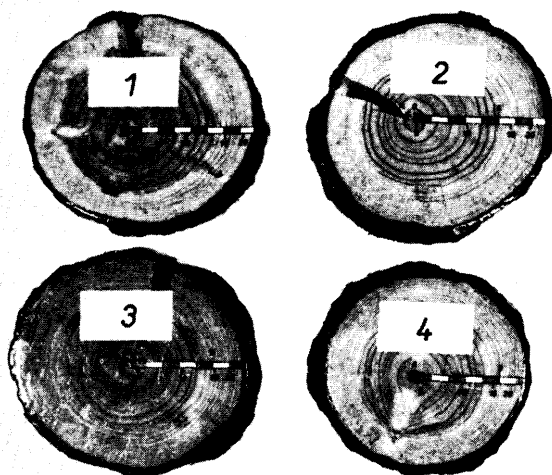


Figure 1 b. — Forest district of Olomučany, compartment 63 b.

Table 1. — Provenance sample plots with larch (*Larix decidua* MILL.).

Provenance of the mother stand		Locality	Altitude above sea level	Age	Sample plot	Tree number	Breast height of the tree m. ∅	Height of the tree m. ∅	Length m. ∅	Crown		Bark		Crook-			Selfpruning			Value number	Value class	Basal area m. ²	Volume		Percent. mortality in 1938-1963 %
Locality	Age									Radius m. ∅	Surface m. ² ∅	Smooth %	Scaly %	Good %	Satisfactory %	Bad %	Sample m. ³	1 ha m. ³							
Sample plot of Habrůvka																									
Kuří Vody (Bohemia)	450	I	149	16.32	14.17	6.27	1.54	8.1495	99.0	1.0	70.0	12.0	27.0	61.0	7.84	II	3.338	22.597	251.0	12					
Wienerwald (Austria)	400-500	—	141	15.66	13.87	6.51	1.59	8.7212	99.0	1.0	15.0	22.0	41.0	37.0	5.60	II	2.898	19.358	215.0	17					
Sabinov (Slovakia)	400	III	148	14.96	13.55	5.48	1.40	6.9417	78.0	22.0	39.0	20.0	32.0	48.0	7.87	II	2.706	18.248	203.0	13					
Nížké Tatry (Slovakia)	1100-1200	IV	151	16.14	14.28	5.68	1.50	7.7810	74.0	26.0	76.0	6.0	36.0	58.0	8.79	III	3.290	22.552	251.0	11					
			589	15.75	14.02	5.98	1.51	7.9173	87.0	13.0	50.4	15.0	33.0	52.0	7.33	II	12.232	82.755	229.0	13					
Sample plot of Olomučany																									
Prievidza (Slovakia)	600-700	I	147	15.71	13.37	6.43	1.51	7.5218	92.0	3.0	98.6	2.0	35.0	63.0	8.66	III	3.021	19.675	218.6	13					
Wienerwald (Austria)	400-500	—	134	15.98	13.67	6.41	1.52	7.6952	94.8	5.2	97.8	17.0	62.0	21.0	8.85	III	2.794	18.774	208.6	21					
Wechsel (Austria)	1000	—	146	14.68	12.35	5.42	1.61	8.7138	93.0	7.0	93.0	8.0	68.0	24.0	9.78	III	2.671	15.817	175.7	14					
Adamov (Moravia)	400	IV	147	15.37	14.00	6.60	1.51	7.1126	90.5	9.5	96.6	18.0	61.0	21.0	8.60	II	3.100	21.539	239.3	14					
			574	15.42	13.34	6.21	1.54	7.9108	93.9	6.1	96.5	11.3	56.5	32.2	8.97	III	11.586	75.905	210.5	15					

*) Above = the whole volume. Below = the average volume per 1 tree.

Table 2. — Survey of promising trees — state in the year 1963.

Partial sample plot	Provenance	Number of promising trees	% of the whole number	Basal area m. ²	% of the basal area	Merchantable wood m. ³	% of the merch. wood
Sample plot of Habrůvka:							
I	Kuří Vody (Bohemia)	8	5.4	0.169	5.1	1.106	4.9
II	Wienerwald (Austria)	15	10.6	0.393	13.6	2.856	14.7
III	Sabinov (Slovakia)	5	3.4	0.091	3.4	0.624	3.4
		28	6.4	0.653	7.3	4.586	7.6
Sample plot of Olomučany:							
II	Wienerwald (Austria)	2	1.5	0.043	1.5	0.284	1.5
III	Wechsel (Austria)	7	4.8	0.149	5.6	0.952	6.0
IV	Adamov (Moravia)	2	1.4	0.032	1.0	0.241	1.1
		11	2.6	0.224	2.6	1.477	2.6

of Olomučany, while very few stems are crooked in the provenance of the Wienerwald on the sample plot of Habrůvka; their crookedness is even the least of all the investigated provenances. The stems prune naturally best in the provenance of the Wienerwald on the sample plot of Habrůvka. The same stems prune relatively well, too, on the sample plot of Olomučany. The worst natural pruning occurs in the larch of Prievidza and of Kuří Vody. The provenance of the Wienerwald on the sample plot of Habrůvka features the best value number expressing the general stem quality; the ecotype of the Wechsel is the worst. The basal area is the largest in the provenance of Kuří Vody, the smallest being found in the Wechsel. The volume per 1 hectare is maximum in the provenances of Kuří Vody and the Nížké Tatry and minimum in the provenance of the Wechsel.

The analysis of the promising trees presents a more detailed picture (see Table 2). On the sample plot of Habrůvka, there is the highest part of promising trees in the provenance of the Wienerwald, while not a single tree of the Nížké Tatry has satisfied the criterion of the promising tree. The relatively highest percentage of promising trees appears in the provenance of the Wechsel on the sample plot of Olomučany, while Prievidza features altogether no promising trees.

The sample tree analyses of individual provenances present very interesting results, too. Figures 1a, 1b show the cuts of the sample trees from a breast height of 1.3 m. arranged according to the individual dimensions on the sample plots of Habrůvka and Olomučany.

The diagrams of growth (Fig. 2) show the highest dimensions in the provenance of the Wienerwald on the sample plot of Habrůvka which is followed by the sample trees of the Nížké Tatry and Kuří Vody. On the sample plot of Olomučany, the sample trees are lower; the sample tree of Adamov exhibits the lowest value. It is followed by the sample tree of Prievidza.

The graphical expressions of the breast height diameters and of their increments (Fig. 3) show that the trend of individual provenances is considerably even. The provenance of the Wechsel reaches the lowest value on the sample plot of Olomučany. The development of the current breast height diameter shows a downward tendency, the largest amplitude being in the provenances of the Nížké Tatry (the

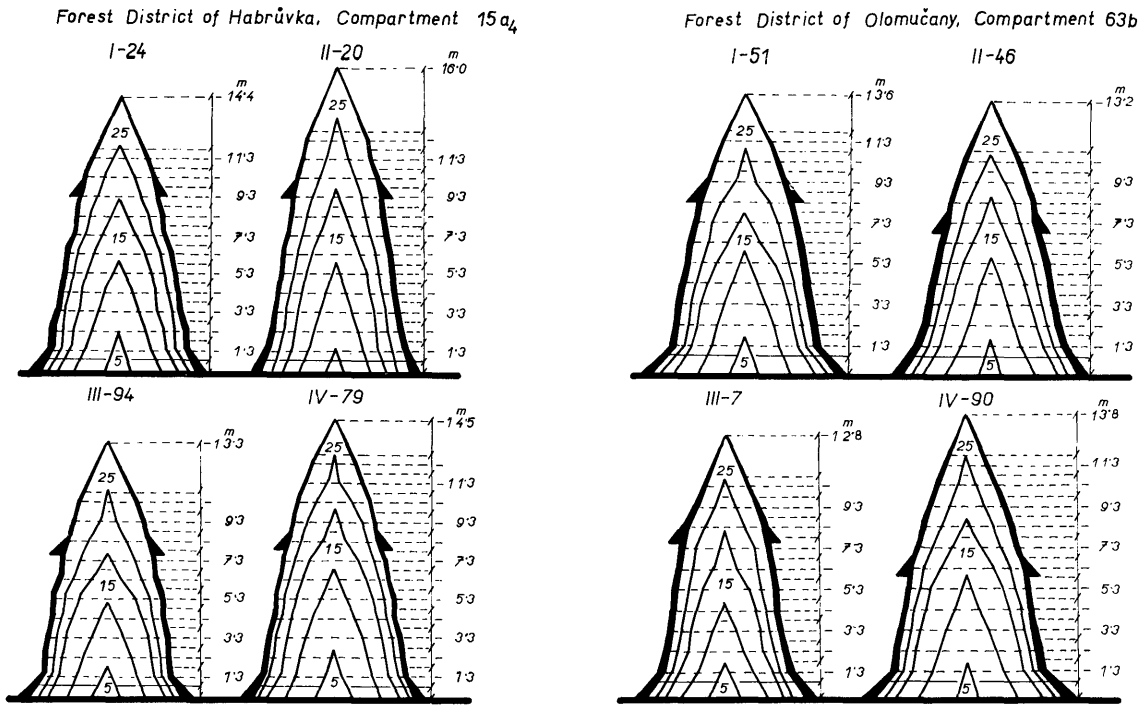


Figure 2. — Graphs of growth of the 25-years old larch.

sample plot of Habrůvka) and Adamov (the sample plot of Olomučany). The highest current increment over the past five years can be found in the provenance of the Wienerwald on the sample plot of Habrůvka. The mean increments of the breast height diameters differ very little and lie between 5 and 6 mm.

The graphical expressions of the heights and of their increments (Fig. 4) show the greatest values in the provenance of the Wienerwald on the sample plot of Habrůvka. The sample trees of the Nizké Tatry and Kuří Vody follow next to it. All the provenances show a downward tendency over the last period, with the exception of the provenance

of the Wienerwald on the sample plot of Olomučany. The provenance of the Wienerwald on the sample plot of Habrůvka shows the greatest value of the mean height increment over the last period (more than 0.6 m.).

The development of the basal areas and their increments (Fig. 5) displays the most favourable tendency in the provenance of the Nizké Tatry on the sample plot of Habrůvka. The provenance of the Wechsel on the sample plot of Olomučany reaches the lowest value.

Fig. 6 presents the development of volumes and their increments. The greatest effect can be found in the provenance of the Nizké Tatry (on the sample plot of Habrůvka),

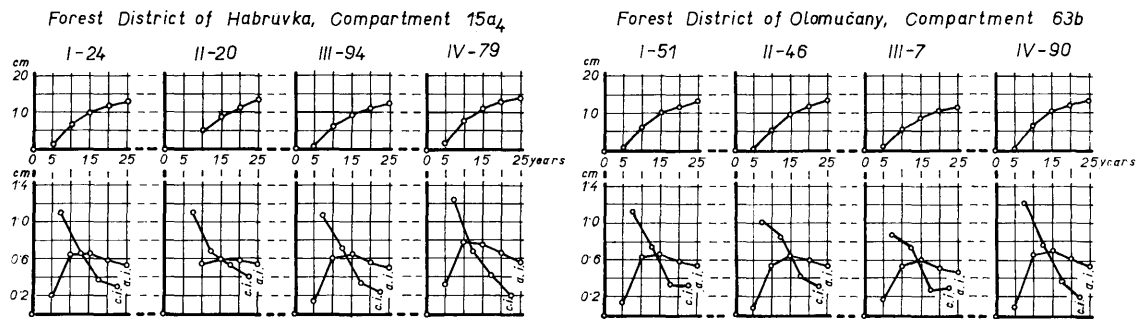


Figure 3. — Graphs of breast height diameters and their increments.

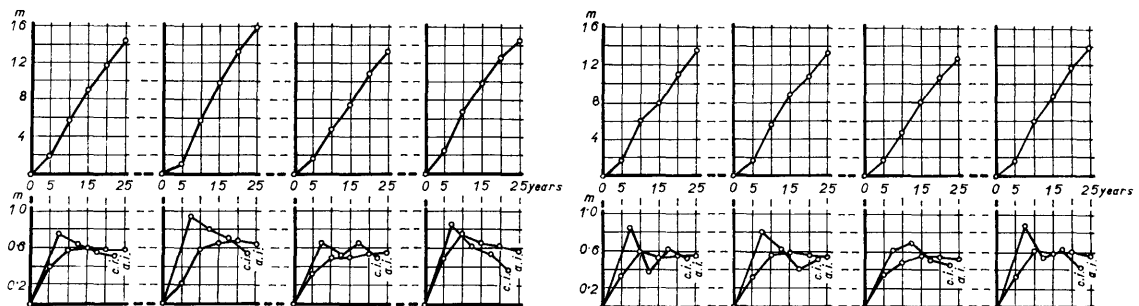


Figure 4. — Graphs of heights and height increments.

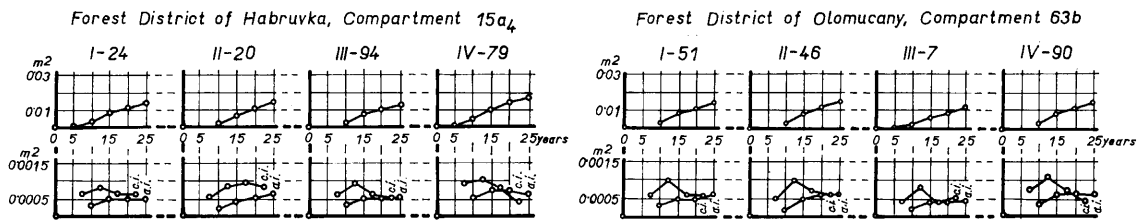


Figure 5. — Graphs of basal areas and their increments.

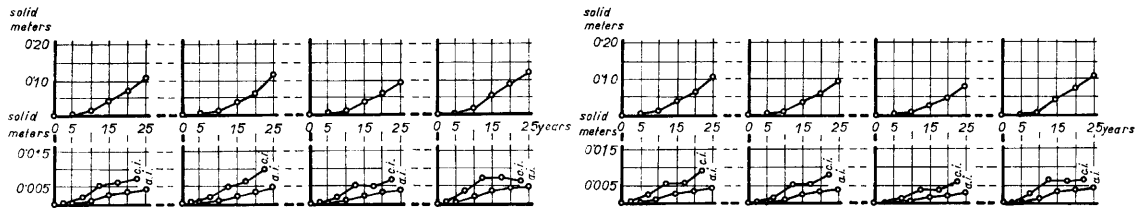


Figure 6. — Graphs of tree volumes and volume increments.

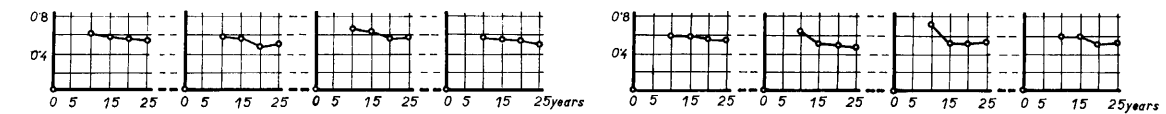


Figure 7. — Graphs of form factors.

the provenance of the Wechsel (sample plot of Olomučany) showing the lowest one. The current increment has an upward tendency in most provenances with the greatest values in the provenances of the Wienerwald on the sample plot both of Habruvka and Olomučany and in the prove-

nance of Prievidza on the sample plot of Olomučany. The current volume increment has decreased only in the provenance of the Nížké Tatry over the last period, but the final value of the mean increment is in this case the highest.

Table 3. — Comparing table of individual provenances in volume weight, resistance to compression and to flexure.

Provenance (Sample tree)	Wood property		
	Volume weight g/cm ³	Resistance to:	
		Compression kp/cm ²	Flexure kp/cm ²
Sample plot of Habruvka:			
Kuří Vody (Bohemia) 24	0.405 0.502 0.610	327 513 621	774 985 1186
Wienerwald (Austria) 20	0.365 0.496 0.590	259 492 675	940 1051 1132
Nížké Tatry (Slovakia) 79	0.335 0.461 0.610	305 430 543	672 901 992
Sabinov (Slovakia) 94	0.320 0.409 0.510	243 376 528	755 844 923
Sample plot of Olomučany:			
Prievidza (Slovakia) 51	0.370 0.515 0.640	355 516 637	774 984 1251
Adamov (Moravia) 90	0.375 0.446 0.560	350 438 536	707 795 886
Wechsel (Austria) 7	0.430 0.526 0.670	385 525 658	860 914 994
Wienerwald (Austria) 46	0.430 0.521 0.690	380 527 619	939 1050 1158
Comparing data according to KOLLMANN	0.40 0.55 0.82	350 470 670	540 960 1323

The diagram of the form factor presented in Fig. 7 shows that the provenance of the Wechsel (sample plot of Olomučany) reached the greatest value at first, but at the age of 10–15 years, it decreased abruptly. The provenance of Prievidza (the sample plot of Olomučany) features a relatively even polygon of the form factor.

The sample trees which had been analysed in 1-m-sections were also subjected to an analysis determining the physical and mechanical wood properties. One-metre-long logs from a height of 1.3 m. to 2.3 m. and 6-cm-thick cuts in the sections of 1 m. were used for this purpose. The analysis was made at the State Timber Research Institute in Bratislava according to international usage. The principal results are presented in Table 3. The sample tree of Kuří Vody on the sample plot of Habruvka exhibits the highest value of the mean volume weight, and is followed by those of the Wienerwald and the Nížké Tatry. On the sample plot of Olomučany, the sample tree of the Wechsel has the greatest volume weight and is followed by those of the Wienerwald and Prievidza. It is interesting that the volume weights of most sample trees are greater on the sample plot of Olomučany. The volume weight is in agreement with the greater resistance to compression in most cases. The provenance of the Wienerwald on the sample plot of Olomučany reaches the greatest value and is followed by the provenances of the Wechsel and Prievidza, while the absolutely lowest value can be found in the provenance of Sabinov on the sample plot of Habruvka. The provenance of the Wienerwald exhibits the greatest resistance to flexure on both sample plots. The sample tree of Adamov displays the lowest value and is followed by that of Sabinov.

Summary

We can summarize the comparison of the individual provenances on the sample plots of Habruvka and Olomučany

as follows: The provenances of Kuří Vody, the Nížké Tatry (the Low Tatras), and Adamov feature a maximum wood production per 1 hectare. These provenances, especially those of Kuří Vody and Adamov, display the highest percentage of smooth-barked trees, yet they are considerably crooked, especially in the provenance of Adamov. The trees prune relatively best in the provenance of Adamov. As regards the wood properties, the best results in volume weight and resistance to compression can be found in the provenances of the Wechsel and the Wienerwald (the sample plot of Olomučany). Those of Kuří Vody, the Nížké Tatry, and Adamov reach mean values, Adamov registering relatively the lowest one. The provenance of the Wienerwald features the best resistance to flexure.

Resumé

Titre de l'article: *Les résultats de vingt-cinq ans d'expérience avec les provenances du mélèze (Larix decidua Mill.)*.

Cet ouvrage veut mettre en valeur les résultats des recherches sur les différentes provenances du mélèze (*Larix decidua* MILL.) aux places d'essai de Habrůvka et Olomučany, de l'Entreprise Ecole de la Faculté Forestière de l'Université d'Agriculture, Brno. Les places d'essai se trouvent à l'altitude de 480 m, la température moyenne y est 7,4° C, les précipitations annuelles environ 630 mm, le facteur de pluie d'après LANG 85—86. On a fait une comparaison mutuelle des provenances de la Bohême, de la Moravie, de la Slovaquie et de l'Autriche aux altitudes de 400—1200 m. La semence était récoltée en 1937 des populations des peuplements maternels âgés de 70 à 120 ans. Les places d'essai unitaires 30 × 30 m de superficie avec espacement des plantes 2,5 × 2,5 m étaient fondées en 1938. Vingt-cinq ans après, en 1963, les places d'essai étaient soumises à une recherche biométrique complétée par une analyse des arbres-échantillons et des épreuves mécaniques et physiques des qualités du bois.

La comparaison des différentes provenances de ces places d'essai fait un résumé suivant: Le maximum de la production en volume à 1 ha était atteint sur les provenances Kuří Vody, Nížké Tatry (la basse Tatra) et Adamov. Les provenances mentionnées, surtout Kuří Vody et Adamov, comprennent pour la plupart des arbres à l'écorce lisse, naturellement avec une cambrure du tronc (en forme de sabre) considérable qui se fait voir le plus sur la provenance Adamov. L'élagage naturel du tronc s'effectue relativement le mieux sur la provenance Adamov. Quant à la qualité de l'intervalle des arbres au total, de trois provenances des plus productives, relativement la meilleure est celle de Kuří Vody, puis Adamov et Nížké Tatry. Quant aux qualités du bois, les résultats les meilleurs en volume total d'arbre et en résistance à la pression étaient atteints sur les provenances Wechsel et Wienerwald (place d'essai d'Olomučany). Aussi la résistance à la flexion est la plus grande sur la provenance Wienerwald.

Zusammenfassung

Titel der Arbeit: *Ergebnisse des 25jährigen Provenienzversuchs mit Lärche (Larix decidua Mill.)*.

Die Studie bringt Ergebnisse von Untersuchungen bei verschiedenen Lärchenprovenienzen (*Larix decidua* MILL.) auf den Versuchsflächen Habrůvka und Olomučany des Schulbetriebs der forstlichen Fakultät der Hochschule für Landwirtschaft in Brno. Die Versuchsflächen befinden sich in einer Seehöhe von 480 m mit einer durchschnittlichen Temperatur von 7,4° C; die durchschnittliche Jahresniederschlagsmenge beträgt ca. 630 mm, der Regenfaktor nach LANG 85—86. Der Samen wurde im Jahre 1937 aus Populationen 70- bis 120jähriger Mutterbestände gewonnen. Auf den Versuchsflächen, von denen jede 30 × 30 m groß ist, wurden im Jahre 1938 1-jährige Sämlinge im Verband 2,5 × 2,5 m gepflanzt. Im Jahre 1963, als die Versuchsflächen das Alter von 25 Jahren erreichten, wurden sie den biometrischen Untersuchungen unterzogen, die durch die Analyse von Probestämmen und die Prüfung der mechanischen und physikalischen Holzeigenschaften ergänzt wurden.

Den Vergleich einzelner Provenienzen auf diesen Versuchsflächen können wir in folgende Fakten zusammenfassen: Die höchste Produktion von Holzmasse per 1 ha wurde bei den Provenienzen Kuří Vody, Nížké Tatry und Adamov erreicht. Bei diesen Provenienzen, besonders bei Kuří Vody und Adamov, findet man die meisten Bäume mit glatter Rinde, aber mit ziemlich großer Säbelwüchsigkeit, welche am meisten bei der Provenienz Adamov ersichtlich wird. Die Bäume dieser Provenienz reinigen sich aber relativ am besten. Was die Gesamtqualität des Bauminventars betrifft, ist die Provenienz Kuří Vody relativ die beste von den 3 am meisten produktiven Provenienzen. Ihr folgen Adamov und Nížké Tatry. Hinsichtlich Holzeigenschaften findet man die besten Ergebnisse bei der Rohwichte und der Druckfestigkeit bei den Provenienzen Wechsel und Wienerwald (Versuchsfläche Olomučany). Die Provenienzen Kuří Vody, Nížké Tatry und Adamov haben mittlere Werte erreicht, wobei Adamov relativ die niedrigsten aufweist. Die Biegefestigkeit ist bei der Provenienz Wienerwald ebenfalls am höchsten.

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