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COMPARATIVE ANALYSIS OF PERENNIAL WOOD OF SOME SPECIES OF PLANTS

Akynbek Tajibaev, *Professor of Osh State University, Kyrghyzstan*
Zhanylbu Rakhmanovna Berdibaeva, *Postgraduate student of Kyrghyz- Ozbek international university, Kyrghyzstan*

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ABSTRACT

The article presents data from the study of perennial wood of woody-shrub plants in the mountainous regions of the southwestern Tien Shan of Central Asia. It was found that, despite the common opinion about the aridity of the region's climate, among the studied species, there are a variety of adaptive characteristics of the studied organ.

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Introduction. One of the topical issues in the study of the flora of any region is the establishment of signs of adaptation of species to habitat conditions. To address these issues, the study of the structural features of various plant organs plays an important role, since these organs, especially perennial stems, retain the structural features formed during the evolution of the species [13; 20]. Lots of work have been devoted to these problems and, different authors studied the question from different positions. So, for example, A.A. Yatsenko-Khmelevsky, M.S. Gzyryan [20] identified 10 structural types of mature wood and according to it, the evolutionary position of the studied taxa was assessed. M.I. Kolosova [6], using the indicated types in the structure of wood, writes that evolutionarily advanced 1X-X types are characteristic of woody plants of Central Asia, which raises certain doubts. In her opinion, in the arid places of Central Asia, primitive V-VII types are found only in tugai. Z.A. Novruzova [9, 10], who studied the influence of environmental conditions on the structure of wood, believed that homogeneous rays are characteristic of such xerophytic plants as Amygdalus L., Lycium L. At that time, according to her, xerophytoid species (representatives of the genera Cotoneaster Medik., Pyrus L., Hippophae L., Malus Mill., Mespilus L., Rhamnus L., etc.) are characterized mainly by square-homogeneous ones, while mesophytes (Acer L., Lonicera L., Juglans L., Euonymus L., etc.) - heterogeneous rays. The wood of species of the genus Lonicera is characterized by many signs of primitiveness: scattered vessels, fibrous tracheids, narrow segments of vessels with oblique transverse walls [11].

Another large group of work is devoted to individual plant organs, which aims at elucidating the adaptation of individual taxonomic groups of plants to various environmental factors, issues of species evolution [13, 14; 19; 22; 23]. However, special work devoted to the study of the wood of plants of Central Asia, with the exception of A. Tazhibaev [12], has not been carried out.

Materials and methods. The objects of study were perennial wood of the following species. Family - Caprifoliaceae Juss. Genus Abelia R. 1. A. corymbosa Rgl. et Schmalh. - large shrub, endemic to Central Asia. Genus: Lonicera L. 2. L. microphylla Willd. ex Roem. et Schult. - shrub,

3. L. simulatrix A. Pojark. (synonym L. microphylla auct. fl. pro parte. non Willd.) - shrub, 4. L. karelinii Bge. ex P. Kir (syn. L. heterophylla Decne.). large shrub, 5. L. hispida Pall. ex Roem. et Schult. - small shrub, 6. L. bracteolaris Boiss. et Buhse –shrub, 7. L. stenantha A. Pojark. (syn. L. coerulea auct. fl. As Med.) - shrub, 8. L. corolkovii Stapf –large shrub, 9. L. paradoxa A. Pojark. - shrub, endemic to Central Asia, listed in the "Red Book of the Kyrgyz Republic", 10. L. nummulariifolia Jaub. et Spach. (syn. L. arborea auct. fl.As. Med) is a large shrub.

II. Family Rosaceae Juss. 1. Subfamily. Spiraeoideae Agardh.: Genus: Exochorda Lindl. 11. E.tianschanica Gontsch. - shrub, endemic to Central Asia. Genus: Spiraea L. 12. *S. hypericifolia* L., 13. *S. lasiocarpa* Kar. et Kir. - small shrub, 14. S.pilosa Franch.-small shrub, endemic to Central Asia. 2. Subfamily. Pomoideae Focke.: Genus: Sorbus L. 15. S.tianschanica Rupr. (syn. Pyrus tianschanica Franchet.) - large multilateral shrub, 16. S. persica Hedl. is a large small-stemmed tree-like shrub, listed in the “Red Book of the Kyrgyz Republic”. 17. S. turkestanica (Franch.) Hedl. (syn. Pyrus turkestanica Franchet.) - a large, small-stemmed tree-like shrub, listed in the "Red Book of the Kyrgyz Republic". Genus: Crataegus L. 18. C.pontica C. Koch. (syn. C.azarolus Fedtsch.) - a small tree, 19. C.turkestanica Pojark. (syn. C. monogyna Fedtsch.) - tree, 20. C. altaica Lge. - tree, or tree-like shrub, 21. C. songorica C. Koch. (syn. C. fisheri C.K.Schneid.) - tree, 22. C.tianschanica A. Pojark.- tree. Genus: Cotoneaster Medik. 23. C.oligantha A. Pojark. - shrub, 24. C. melanocarpa Lodd. (syn. C.vulgaris Ldb., C.integerrima var. melanocarpa Kryl.) - shrub, 25. C. multiflora Bge. - shrub, 26. C.insignis Pojark. - shrub. Genus: Malus Mill. 27. M. kirghisorum Al. et An. Theod. - tree, 28. M.niedzwetzkyana Dieck.- tree, listed in the Red Book of the Kyrgyz Republic. Genus: Pyrus L. 29. P. korshinskyi Litw. - tree, 30. P. regelii Rehd. (Syn. P. heterophylla Rgl. Et Schmalh.) - a small tree. 3. Subfamily. Prunoideae Focke.: Genus: Amygdalus L. 31. A.communis L. - large shrub or small tree, 32. A. petunnicovii Litw. (syn. Prunus petunnicovii Rehder.) - a small shrub, listed in the «Red Book of the Kyrgyz Republic». Genus: Armeniaca Mill. 33. A. vulgaris Lam. - tree. Genus: Prunus Mill. 34. P.sogdiana Vass. - a large shrub, or small tree. 35. P. ferganica Lincz. (syn. P. silvestris M. Pop.). Genus: Cerasus Juss. 36. C.alaica A. Pojark. (syn. Prunus prostrate auct.fl. As. Med.p.p) - cushion shrub, 37. C.erythrocarpa Nevski (syn. Prunus prostrate auct.fl. As. Med. p.p) - small shrub, 38. C verrucosa (Franch.) Nevski (syn. Prunus verrucosa Franch., Prunus verrucosa auct.fl. As. Med. p.p) - cushion shrub. 39. C.mahaleb (L.) Mill. (syn. Prunus mahaleb L., Padus mahaleb L. Mill.) - small tree, 40. C.tianschanica A. Pojark. (syn. Prunus prostrate auct.fl. As. Med.p.p) - shrub, Genus: Padus Mill. 41. P. racemosa (Lam.) Gilib. (Syn. Padus avium Mill.) - tree, or tree-like shrub. Genus: Aflatunia Vass. 42. A.ulmifolia (Franch.) Vass. (syn. Amygdalus ulmifolia (Franch.) M. Pop., Prunus ulmifolia Franch.) - shrub.

III. Family Elaeagnaceae Juss. Genus: Elaeagnus L.43. E. angustifolia L. - tree, 44. E. orientalis L. - tree, cultivated. Genus: Hippophae L. 45. H. rhamnoides L. - shrub.

IV. Family - Berberidaceae Juss. Genus: Berberis L. 46. B. oblonga (Rg.) Schneid. (Syn. B. integgerima Bunge) - shrub.

V. Family - Grossulaceae Juss. Genus: Ribes L. 47. R. meyeri Maxim. - shrub. 48. R.heterotrichum C.A.M. - shrub.

VI. Family - Anacardiaceae Lindl. Genus: Pistacia L. 49. P. vera L.-small-stemmed shrub.

VII. Family - Tamaricaceae Lindl. Genus: Tamarix L. 50. T. leptostachys Bge. (syn. T.ramosissima Bong.et Mey., T.gallica var.micrantha Ldb.) - shrub, 51. T. hispida Willd.-shrub. Genus: Myricaria Desv. 52. M.elegans Royle - shrub. 53. M. alopecuroides Schrenk. (syn. M. germanica C.A.M.) - shrub.

VIII. Family - Ulmaceae Mirbel. Genus: Celtis L. 54. C. caucasica Willd. - a small tree.

IX. Family Celastraceae Lindl. Genus: Euonymus L. 55. E. semenovii Rgl. et Herd. is a shrub.

X. Family Aceraceae Juss. Genus Acer L. 56. A. semenovii Rgl. et Herd. (syn. A. tataricum var.semenovii Rgl.) - tree, or large shrub, 57. A. turkestanicum Pax. - tree.

X1. Family - Juglandaceae A. Rich. ex Kunth. Genus: Juglans L. 58. J.regia L. – large tree.

XII. Family Solanaceae Juss. Genus: Lycium L. 59. L. dasystemum A. Pojark. - shrub.

The taxonomic affiliation of the studied species was determined according to the sources "Flora of the Kirghiz SSR" (vols. 1-X1), "Flora of the USSR" (vols. 1-XXX).

The subject of the research was the fixed materials of the wood of the specified species of trees and shrubs.

The wood has been studied according to the methods of A.F. Hammerman et al. [1940], A.A. Yatsenko-Khmelevsky [1954] and A.A. Fedorov [1962]. It was studied on preparations carried out in three projections - transverse, longitudinal-tangential and longitudinal-radial, and to measure the

elements of the organ, part of the material was macerated in nitric acid according to the generally accepted method [2; 21]. When describing the studied organs, we were guided by "Atlases" [16] and others. The results obtained were processed statistically with the calculation of the arithmetic mean value (M), the mean error (± m).

Results and discussion. The general plan of the structure of wood in the studied species is similar and it consists of vessels, tracheids, libriform fibers, and radial and traction parenchyma. The structure of perennial wood of the studied species differ in the nature of the location and the ratio of certain elements and their quantitative indicators (table 1). Analysis of the structure of perennial wood has shown that in many species it is correlated with habitat conditions and the origin of the species. So, in species of the genera Celtis, Pistacia, Amygdalus (A.communis), Lycium, Cereasus (C.alaica, C.erythrocarpa), Tamarix, Myricaria, which are representatives of the ancient Mediterranean flora, the wood structure is xeromorphic. This structure of perennial wood confirms the opinion about their formation in arid areas. For most other species (Juglans, Acer, Euonymus, Ribes, Prunus, Lonicera), which are relict tertiary mesophilic [1], and migrating from the boreal flora, which at the present stage of development also remained in more mesomorphic conditions, a mesomorphic type of organ structure is characteristic [13, 14]. Some representatives of these genera (Euonymus, Ribes, Lonicera), specializing in narrow ecological shady conditions, provided with moisture, have retained ancient characters.

Juglans regia is distinguished by its high plasticity in the restructuring of organs during relocation to new climatic regions. According to V. I. Tkachenko [15], it is at the peak of his biological development. The xerophilized mesophyte Acer semenovii, introduced in Moscow, feels good, which indicates its mesomorphic origin.

Table 1. Anatomical indicators of wood stems of some plant species

Taxa	Diameter of vessels with a wall, µm	Thickness of vessel walls µm	Number of vessel lumens per 1 mm2	Length of vascular segments, µm	Diameter of fibers with a wall, µm	Length of individual fibers, µm	Core rays				
							Quantity per mm	Max. vertic. Layering in cells	Height, µm	Row in cells	Width, µm
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Lonicera	33±0.8	2,7-3,5	572+0.5	457±1.3	13-15	796±0.9	17-19	22	497±0.9	1-2	38±0.2
L. simulatrix	26±1.0	4-4,8	210+0.9	486±1.0	12-14	847±1.0	16-18	20	527±0.9	1-2	38±02.
L. stenantha	33±1.1	2,5-3,1	169+0.5	444±1.0	15-16	820±1.0	17-19	28	562±0.8	1-2	36±0.2
L. hispida	36±1.1	3,6-4	197+0.5	316±1.0	15-17	617±1.0	17-19	45	1000±0.8	1-4	48±0.2
L. bracteolaris	42±1.2	2,4-3,4	182+0.6	373±1.0	10-12	866±10.	15-17	24	491±0.9	1-4	47±0.3
L. karelinii	44±1..0	3,8-3,0	176+0.5	428±1.0	15-17	759±1.0	12-14	20	528±0.8	1-2	41±0.3
L. korolkovii	45±1.2	3,1-4,5	194+0.9	412±1.0	14-16	797±1.1	16-18	20	535±0.8	1-2	37±0.2
L.nummulariofolia	44±1.0	3-4,9	187+0.9	490±1.0	13-15	745±1.0	17-19	22	697±0.8	1-3	39±0.3
L. paradoxa	33±0.6	2,8-3,8	500+1.0	152±10	15-16	463±1.1	18-20	38	1290±0.8	1-3	23±0.2
Abelia corymbosa	28±1,1	2,2-3,4	340+0.9	225±1,0	14-16	520±1.0	18-20	22	385±0.8	1-3	400±0.9
Spireae hypericifolia	25±0.9	2-3	125+1.0	170±0.9	8-10	430±0.9	10-13	325	3400±0.9	1-8	75±0.3
S. pillosa	30±0.8	2-3	88+1.0	195±0.9	9-14	570±0.9	10-15	340	5400±0.9	1-16	100±0.4
S. lasiocarpa	25±0.9	2-3	155+1.0	170±0.9	8-13	370±0.9	12-14	350	2550±0.9	1-8	56±0.3
Exochorda	64±1.0	2-3,0	266+0.9	215±1.0	13-17	577±1.0	10-14	48	460±0.8	1-3	65±0.4
Armeniaca vulgaris	52±0.9	2-4	200+1.0	249±0.9	14-16	475±0.9	11-14	36	486±0.9	1-8	172±0.3
Amygdalus	59±1.0	3,8-4,0	276+1.0	234±1.0	14-16	806±1.0	9-13	72	1172±0.9	1-4	66±0.3
A. petunnicovii	29±0,5	3,2-0,5	429+1.3	207±0,6	7-11	481±1.0	9-15	38	132±1.1	1-2	19±0,4
Pyrus korshinskyi	34±0.6	2.9=06	320±0.6	164±0.8	14-16	408±1.0	10-17	25	375±0.6	1-4	23±0.4
P. regelii	22±0.9	2,5=04	760±0.5	260±1,0	10-12	397±1,0	12-18	18	253±0,5	2-3	57±0.4
Crateagus pontica	37±1.0	3,1-3,4	171±08	460±1.0	15-17	679±1.0	21-28	24	292±1.4	1-4	47±0.4
C. altaica	30±0.6	2,7-3,2	158±0.7	452±0.9	1315	677±1.1	8-12	20	209±1.0	1-3	36±0.3
C. ferganensis	36±1.0	1,3-3,3	165±0.9	435±0.5	13-14	475±1.2	21-35	19	230±1.0	1-3	27±0.2
C.tianshanica	30±1.0	2,7-3,6	131±0.5	412±0.9	16-18	836±1.0	97-11	27	200±0.9	1-3	44±0.6
C. turkestanica	49±1.2	3,0-3,4	131±0.5	412±1.0	16-18	836±1.0	9-11	27	270±1.0	1-3	43±0.3

Continuation of table 1.

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*
Padus racemosa	34±1.0	2,3-3,1	150+1.2	260±1.1	15-17	451±1.3	11-18	26	150±1.2	1-2	400±0.4
Prunus sogdiana	35±0.9	2,2-3,6	126+1.0	150±1.3	11-15	415±0.5	10-14	47	506±0.8	1-5	39±0.3
P. ferganica	39±1.0	2-3,2	257+1.0	294±1.0	12-14	460±1.0	12-14		775±1.0	1-5	44±0.4
Aflatunia ulmifolia	37±0.8	1,5-2,0	287+0.8	263±1.0	7-11	502±09	11-16	38	354±0.8	1-4	45±.0.5
Juglans regia	90±1.4	2,8-4,1	16+0,3	165±1.2	4-7	446±0.9	6-14	18	322±1.0	1-3	30±0.5
Cerasus	35±0.6	2,6-29	360+0.9	260±1.0	11-13	624±0.9	18-22	49	233±0.9	1-3	66±0.4
C. verrucosa	29±0.6	2,6-2,9	400+0.9	227±1.0	11-13	624±0.8	18-19	18	233±0.9	1-2	18±0.3
C. alaica	44±0.8	2,5-2,9	367+0.9	260±1.0	10-12	926±0.9	18-20	90	540±0.8	1-4	46±0.3
C. tianshanica	45±0.9	3,4-3,5	208+0.6	240±1.0	9-10	522±0.9	14-155	33	500±0.8	1-4	39±0.5
C. mahaleb	33(60)	3,7-40	337+0.9	227±1.0	15-17	787±0.9	12-15	47	625±0.8	1-3	46±0.2
Sorbus tianshanica	41±1.0	2,7-4	315±0.8	320±1.0	26-28	668±1.0	11-12	26	144±0.8	1-2	18±0.5
S. persica	48±1.3	2,5-4	242±1.0	455±1.0	27-28	1055±1	14-16	26	273±0.8	1-2	27±0.4
S. turkestanica	31±0.9	24-4	262±0.8	467±1.0	24-25	1000±1.	14-16	26	285±0.8	1-2	30±0.8
Cotoneaster	31±0,9	2,4-3,7	306±0.6	265±0.5	11-1,7	469±0.7	9-13	18	240±0.7	1-3	37±0.4
C. oligantha	28±1.0	2,4+3	247±0.5	239±0.4	1215	474±1.0	9-12	17	221±0.7	1-3	39±0.2
Malus kirghisorum	20±1.0	2,0-4,2	138±0.9	200±1.0	16-18	390±1.5	9-13	22	200±0.9	1-3	145±0.4
M. niedzwetskyana	34±1.0	2-4	135±0.8	180±1.0	18-20	460±1.0	9-15	18	135±0.8	1-3	149±0.4
Hippophae	45±1.1	2-3,3	350+1.1	248±1.3	9-12	396±0.4	8-14	18	210±1.1	1-4	31±0.4
Eleagnus	85±1.0	2,4-4	240+0.3	120±0.8	18-19	450±0.9	9-15	68	144±1.1	1-12	47±0.3
E. orientalis	82±1.0	3-3.3	205+0.8	138±0.9	17-19	495±0.9	10-13	50	527±0.9	2-12	52±0.3
Berberis oblonga	46±1,2	2,4-3,1	255+0.8	146±1.1	13-14	414±1.2	13-17	23	200±0.9	1-6	555±0.4
Ribes meyeri	34±1.1	1,6-3,6	100+0.9	230±1.0	13-15	495±1.0	15-17	122	1415±1	1-24	168±0.3
R. heterotrichum	33±1.1	2,4-5	105+0.5	190±1.0	12-14	431±0.5	13-15	110	1034±1.	1-17	177±0.4
Pistacia vera	70±0.6	2,8-3,7	224+1.2	300±1.0	9+11	478±0.3	7-11	33	295±0.8	1-5	56±0.4
Tamaryx	34±0.8	4,4	53+0.9	90±0.7	11-13	385±0.6	13-17	76	610±0.7	1-7	95±0.4
T.hispida	49±0.9	2,4	96+0.9	93±0.8	13-15	381±0.9	15-17	66	354±0.8	5-7	79±0.3
Myricaria	34±0.9	2,5	75+0.9	116±0.8	12-14	364±0.8	12-17	41	487±0.7	1-5	39±0.4
M.elegans	39±0.9	3	55+0.8	152±0.8	15-17	326±0.8	13-17	48	461±0.8	3-5	48±0.3
Celtis caucasica	81±1.1	2,6-4	40+1.0	143±0.3	8-11	448±0.5	13-18	22	387±0.5	1-6	67±0.7
Euonymus semenovii	30±1.2	2-2,9	336+1.1	160±1.2	12-14	409±.0.6	8-12	12	155±1.4	1-2	30±0.5
Acer semenovii	36±1.2	2,2-3,2	198+1.1	240±1.3	12–14	335±0.4	10-12	20	185±1.1	1-4	30±0.6
A.tuerkestanicum	34±0.9	2.4-2.6	170+0.9	179±1.1	9-11	433±0.9	11-14	34	212±0.9	1-4	21±0.4
Lycium dasystemum	53±0.4	2.7-1.0	92-0.6	160±0.7	10-1.7	339±0.4	14-19	36	240±1.0	1-2	54±0.6

The species of the genera Cerasus, Spiraea, Lonicera are characterized by great diversity. Many shrub or cushion Cerasus species are common in arid places and have a typical xeromorphic structure of organs (C.tianschanica, C.alaica, C.erythrocarpa), tree species (C. mahaleb), on the contrary, spreading in more favorable forest conditions, have a more mesomorphic structure. Species of the genus Spiraea are also characterized by opposite characters - in S. hypericifolia and S. lasiocarpa the wood is ring-vascular, which is associated with unfavorable habitat conditions than in S. filosa, in which the wood is disseminated. Among the species of the genus Lonicera L. paradoxa, due to the spread of arid conditions in sunny and rocky places, it has a more highly specialized structure - a circular arrangement of vessels, a sharp transition from large early spring vessels to late ones, etc., while the structure of this organ in other species kind of diffuse vascular or with a tendency to annular vascularity. Some endemic species of the genera Amygdalus, Pyrus, Malus also have distinctive features. Thus, in Amygdalus petunnicovii the wood is scattered vascular (in A.communis it is annular), in Pyrus regelii, on the contrary, it is annular (in other pear species it is scattered), etc. Rare endemic species of monotypic genera of mixed forests occupied different positions in terms of wood structure. The signs of the structure of this organ of the species Aflatunia ulmifolia, Exochorda tianschanica do not correspond to the modern conditions of the broadleaf forest - they are more xeromorphic than other species of the same forest. Other rare species from the same forest (Abelia corymbosa, Sorbus persica), are characterized by wood features inherent in mesophytes. The discrepancy between the wood structure of these rare species and that of closely related taxa of the

genus and species in the community can be explained as preserved remains of ancient flora with ancestral features.

It is known that starting from the Pliocene, due to mountain-forming processes, as well as the cooling that began in connection with the onset of the ice age, the intensity of development of some species is delayed in the flora of Central Asia. Thus, the extinction of certain elements of this flora, the transformation towards greater mesophilicity of others and the transition to a relict state of the third [3, 4, 5, 8].

Based on the study of perennial wood of trees and shrubs in the south of Kyrgyzstan, the following conclusions can be drawn.

1. The signs of a perennial stem for each species have a stable structure and are conservative, and reflect the adaptations of the plant not only to the conditions of modern habitat, but also the history of their formation.

2. The traits of wood in many species correlate with environmental factors of their current range, which indicates their autochthonous origin. The signs of the studied organs of rare and endemic species from more or less the same habitat conditions often do not correlate with the conditions of the present habitat. Thus, the plants of Abelia corymbosa from the walnut forest of the mountains are mesophytic in terms of the structure of the studied organs, while in the species Aflatunia ulmifolia and Exochorda tianschanica from the same forest, they are xeromorphic, which indicates their origin from different places with different ecological factors of existence.

Consequently, the plants of Abelia corymbosa from the walnut forest of the mountains are mesophytic in terms of the structure of the studied organs, while in the species Aflatunia ulmifolia and Exochorda tianschanica from the same forest, they are xeromorphic, which indicates their origin from different places with different ecological factors of existence.

3. The structure of wood in the studied species correlates with their life form - in large trees it is characterized by primitive features (long elements of conductive and mechanical tissues, oblique connection of xylem elements, etc.), in small shrubs it is more advanced (elements of xylem, sclerenchyma are short, their direct or slightly oblique connection, etc.). The exception is the species of the genera Ribes, Lonicera, which are small shrubs, the wood of which is characterized by primitive traits. This is due to their habitation for a long time in a narrow ecological niche and a small change in the structure of wood in the course of evolution.

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