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## Study of the water regime of plants in the conditions of Zhezkazgan city

Results of researches on assessment of a water regime of leaves and water-retaining ability of some woody and shrubby plants in the conditions of the city of Zhezkazgan relating to three ecological groups in relation to moistening conditions are given in article. Results have shown that the greatest water-retaining ability xerophytes plants, the smallest to mesophytes possess. Following the results of researches all species have been divided into 3 groups: with low (from 0 to 40 %), average (from 40 to 70 %) and high (over 70 %) water-retaining ability. *Syringa josikaea* has entered into the first group; in the second — *Populus alba*, *Malus sieversii*; in a third — *Berberis vulgaris*, *Elaeagnus oxycarpa*, *Amygdalus nana*, *Betula pendula*, *Crataegus sanguinea*, *Acacia alba*, *Pinus sylvestris*, *Juniperus sabina*, *Juniperus vulgaris*. It should be noted that among mesophytes one species — *Syringa josikaea* has entered into group with low indicators of the water mode, then *Amygdalus nana* has entered into the second groups and *Crataegus sanguinea* — in the third the steadyest. Among mesoxerophytes in the 2nd group of stability are *Malus sieversii* and *Populus alba*, the others have entered into the third group. Among xerophytes all species have appeared in the third group of stability. We recommend to enter plants from the third group into mass gardening of the Zhezkazgan region, the second group — it is limited on condition of regular watering, the first group — only for private gardening on plentiful watering.

*Keywords:* woody and shrubby plants, Zhezkazgan, water regime, introduction, stability, water-retaining ability, rating.

Green plantings are the most important element of town planning, the factor which is of great importance in the sanitary and hygienic, architectural and planning and social relation [1–3]. The most important hygienic feature of green plantings is expressed in regulation of the thermal and radiation modes, in creation of the microclimate providing comfortable environmental conditions. They exert impact on change of microclimatic environmental conditions, improving the temperature and moist and radiation modes, promote purification of atmospheric air of pollution [4–7], favorably influence a human body. In the presence of green plantings in the city of people it is protected from direct solar radiation thanks to a big surface of leaves, trunks, and also the soil having lower temperature than air temperature. In this regard thermos lysis conditions are facilitated, heat exchange and health of the human improves.

Climatic conditions of the Zhezkazgan zone of the Karaganda region differ extremely in a low rainfall during the summer period and high dryness of air [8]. Therefore when planning green plantings, practical gardening there is a question of selection of cultures capable to transfer high summer temperatures, low humidity of air and constant deficiency of moisture. And, a number of cultures can well grow on poor watering, a row — demand regular irrigation, some — are exacting to plentiful moistening. One of factors of resistance of plants to adverse conditions is the ability to transfer high summer temperatures and deficiency of moisture that is in many respects connected with physiological features of leaves, in particular, ability of leaves to hold moisture [9].

Proceeding from the aforesaid, the purpose of the real research was — to define a water regime of leaves and water-retaining ability of various ecological groups of woody and shrubby plants in the conditions of the city of Zhezkazgan.

### *Materials and methodology*

Researches were conducted during 2015–2017 in the territory of the city of Zhezkazgan and also on sites of dendrology of the Zhezkazgan botanical garden.

Objects of researches were woody and shrubby plants of various ecological groups:

- mesophytes (*Syringa josikaea*, *Amygdalus nana*, *Crataegus sanguinea*);
- mesoxerophytes (*Berberis vulgaris*, *Betula pendula*, *Populus alba*, *Pinus sylvestris*, *Juniperus communis*, *Malus sieversii*);
- xerophytes (*Elaeagnus oxycarpa*, *Acacia alba*, *Juniperus sabina*).

Studying of content of water in leaves and water-retaining ability was carried out to the periods of the greatest tension of stressful factors: June, July and beginning of August.

Assessment of water regime and water-retaining ability of plants was carried out according to «The program and a technique of a sort breeding of fruit, berry and nut bearing crops» [10, 11]. Leaves collected in the morning at ten o'clock from different tiers. Later we made a weight after collecting (crude weight). After that leaves of plants left for 3 hours with repeated weighing. Final weighing was made after drying in a drying cabinet within a day at a temperature of 50 °C.

The water regime of leaves was counted as a difference between crude and dry weight.

#### Results and discussion

Assessment of water-retaining ability of plants of different groups has shown an essential difference between water-retaining ability of leaves of these cultures. At the beginning of summer the greatest resistance to the hot period coniferous trees, *Acacia alba* and *Elaeagnus oxycarpa* have shown (Table), and the lowest indicators of the water mode are revealed for *Syringa josikaea* and *Amygdalus nana*.

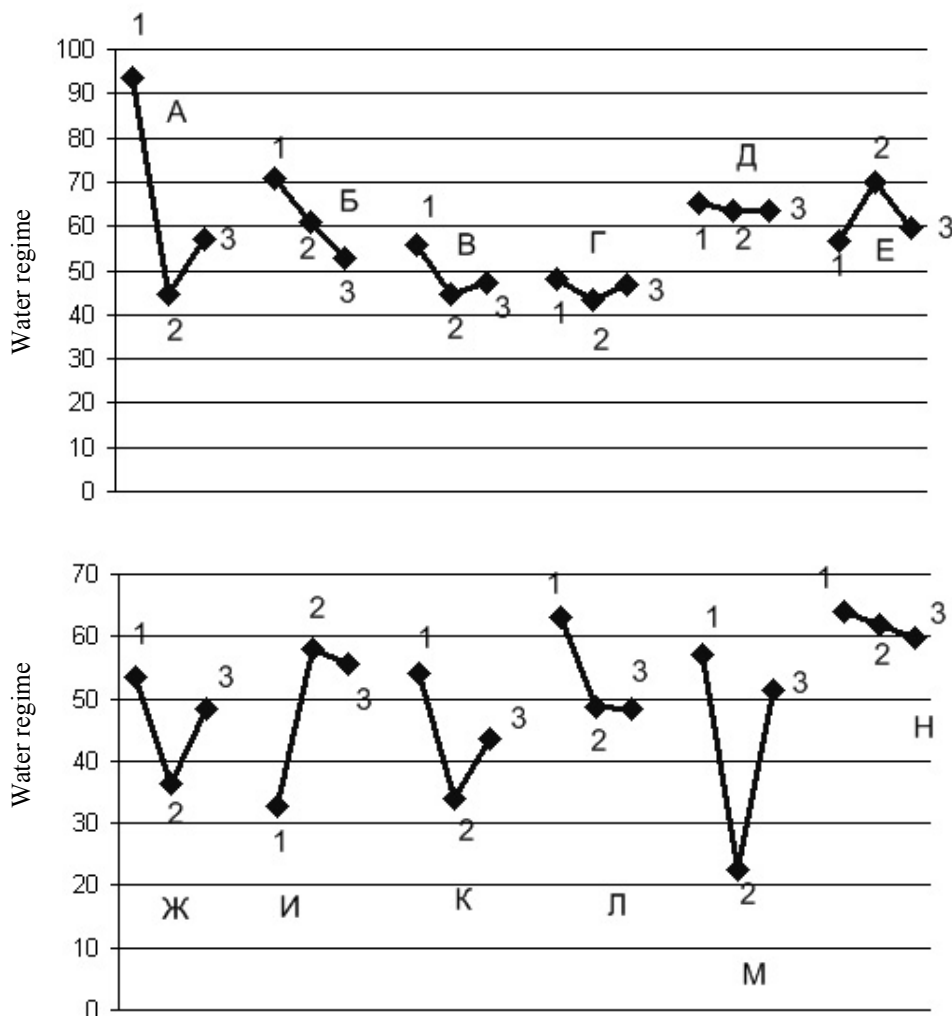
Table

**Water regime and water-retaining ability of leaves of some woody and shrubby introduced plants in the conditions of Zhezkazgan city (average indicator of 2015–2017)**

Species / life form	Months of observation	Water regime, %	Water-retaining ability, %
<i>Syringa josikaea</i> / shrub	June	93.36±2.3	18.72±0.05
	July	44.53±0.9	83.65±3.5
	August	56.90±2.1	88.91±4.1
<i>Berberis vulgaris</i> / shrub	June	70.91±3.0	83.82±4.0
	July	61.15±2.4	83.30±3.8
	August	52.78±1.8	63.32±2.9
<i>Elaeagnus oxycarpa</i> / tree	June	55.81±1.4	88.82±4.3
	July	44.70±1.0	94.28±4.5
	August	47.05±1.1	92.40±4.7
<i>Amygdalus nana</i> / shrub	June	47.89±1.3	77.04±3.3
	July	43.41±1.2	89.04±2.7
	August	46.75±0.8	91.52±4.0
<i>Betula pendula</i> / tree	June	65.07±2.2	85.05±3.6
	July	63.68±2.6	74.80±2.9
	August	63.50±3.0	92.09±4.2
<i>Crataegus sanguinea</i> / tree, shrub	June	56.53±1.9	65.66±3.0
	July	69.99±2.1	79.16±2.8
	August	59.60±2.0	78.58±3.1
<i>Populus alba</i> / tree	June	53.33±1.6	85.37±3.3
	July	36.31±0.5	70.37±2.1
	August	48.25±0.7	79.19±2.3
<i>Acacia alba</i> / shrub	June	32.60±0.4	76.19±2.4
	July	57.93±1.5	82.19±3.4
	August	55.58±1.2	91.18±4.5
<i>Pinus sylvestris</i> / tree	June	54.20±1.6	95.46±4.6
	July	34.09±0.4	84.50±4.0
	August	43.48±0.7	92.68±4.3
<i>Juniperus sabina</i> / shrub	June	62.94±3.1	93.40±4.4
	July	48.64±1.1	87.18±3.7
	August	48.48±0.6	86.11±3.1
<i>Juniperus communis</i> / shrub	June	57.17±1.3	85.62±3.4
	July	22.61±0.2	90.63±3.2
	August	51.34±2.0	90.13±3.9
<i>Malus sieversii</i> / tree	June	64.14±2.5	72.34±3.4
	July	61.81±2.4	53.83±2.2
	August	59.70±2.1	59.71±2.0

It is noted that at the beginning of summer (June) the water regime of leaves of woody and shrubby plants was rather high that is explained by long spring rains and rather low temperatures during this period. Further (July–August) the water regime decreases.

By data T.N. Barabash [12], at plants at the beginning of vegetation a water regime of tissues of leaves the greatest — from 60 to 90 %, and at the end of August when plants adapt to droughty conditions, in process of aging of leaves, this indicator decreases by 15–30 % [13, 14]. For all studied wood and shrubby cultures the content of water in June and August has appeared higher than 50 % (Fig. 1) that demonstrates sufficient providing with water at irrigation.



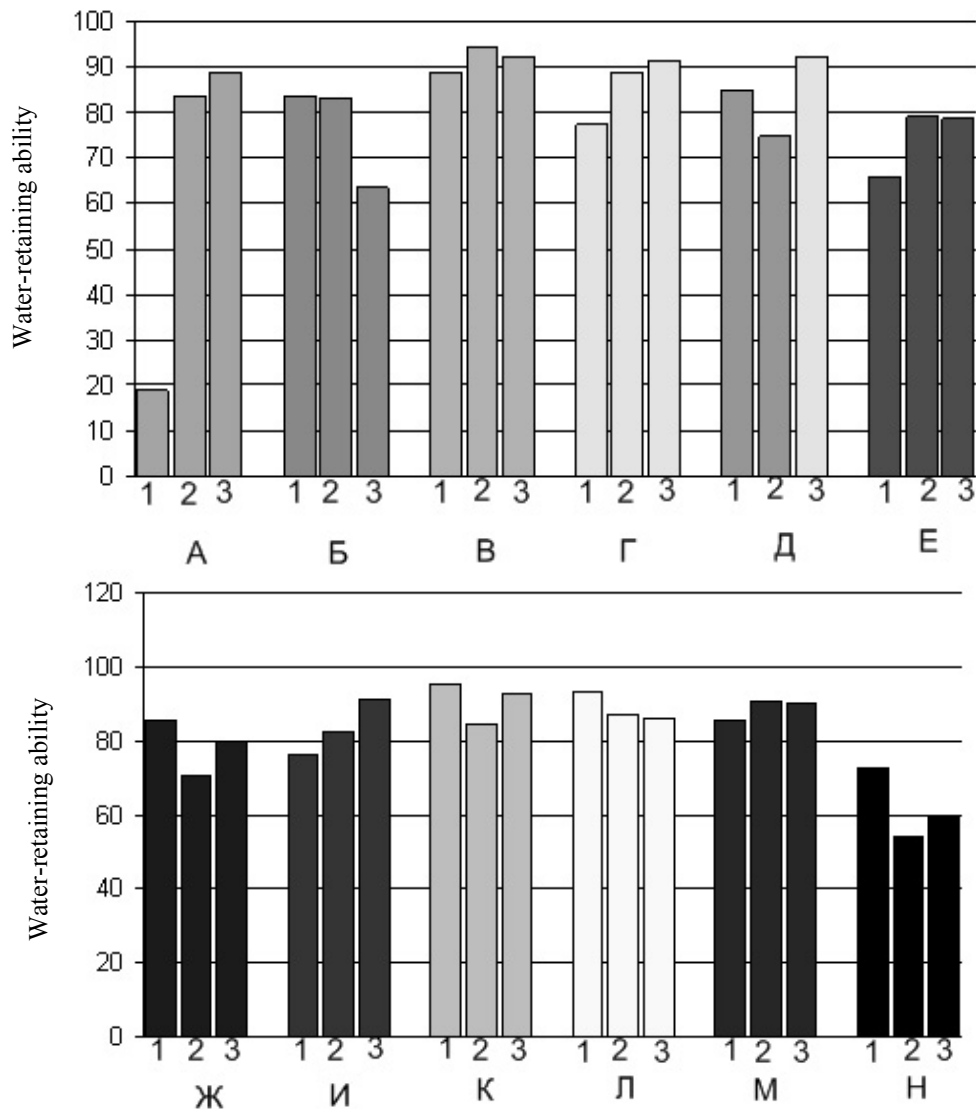
Woody and shrubby plants: A — *Syringa josikaea*; Б — *Berberis vulgaris*; В — *Elaeagnus oxycarpa*; Г — *Amygdalus nana*; Д — *Betula pendula*; Е — *Crataegus sanguinea*; Ж — *Populus alba*; И — *Acacia alba*; К — *Pinus sylvestris*; Л — *Juniperus sabina*; М — *Juniperus communis*; Н — *Malus sieversii*; months: 1 — June; 2 — July; 3 — August

Figure 1. Water regime of some woody and shrubby plants in the conditions of Zhazkazgan region

Low indicators in July for some cultures are explained by hot weather, lack of rainfall and deficiency of water for watering.

The analysis of water-retaining ability has shown that during the spring and summer period indicators at a part of plants were minimum, whereas in the middle and the end of the summer period — is higher (Fig. 2).

Content of water in leaves depends on their age state. The minimum amplitude of fluctuations and also the bigger amount of the general water in leaves during vegetation is considerable are noted at optimum humidity of the soil [15]. The lack of water of the soil leads to fall of the contents of water in leaves. Content of the general water in a plant and its separate bodies decreases during the vegetative period. In leaves there is a decrease in content of the general water in process of their aging.



Woody and shrubby plants: A — *Syringa josikaea*; Б — *Berberis vulgaris*; В — *Elaeagnus oxycarpa*; Г — *Amygdalus nana*; Д — *Betula pendula*; Е — *Crataegus sanguinea*; Ж — *Populus alba*; И — *Acacia alba*; К — *Pinus sylvestris*; Л — *Juniperus sabina*; М — *Juniperus communis*; Н — *Malus sieversii*; months: 1 — June; 2 — July; 3 — August

Figure 2. Water-retaining ability of some woody and shrubby plants in the conditions of Zhezkazgan region

Results have shown that the greatest water-retaining ability xerophytes plants, the smallest — mesophytes possess.

So, all cultures on water-retaining ability have been divided into 3 groups:

- with low (from 0 to 40 %);
- average (from 40 to 70 %);
- high (over 70 %) water-retaining ability.

*Syringa josikaea* has entered into the first group; in the second — *Populus alba*, *Malus sieversii*; in a third — *Berberis vulgaris*, *Elaeagnus oxycarpa*, *Amygdalus nana*, *Betula pendula*, *Crataegus sanguinea*, *Acacia alba*, *Pinus sylvestris*, *Juniperus sabina*, *Juniperus vulgaris*.

It should be noted that among mesophytes one species — *Syringa josikaea* has entered into group with low indicators of the water mode, then *Amygdalus nana* has entered into the second group, and *Crataegus sanguinea* — in the third the steadiest. Among mesoxerophytes in the 2nd group of stability *Malus sieversii* and *Populus alba*, the others have entered into the third group. Among xerophytes all types have appeared in the third group of stability.

### Conclusion

Thus, it has been established that during the spring and summer period indicators of deduction of moisture at a part of plants were minimum whereas in the middle and the end of the summer period these indicators increase.

We recommend to enter plants from the third group into mass gardening of the Zhezkazgan region, the second group — it is limited on condition of regular watering, the first group — only for private gardening on plentiful watering.

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### Жезқазған қаласының жағдайында өсімдіктердің су режимін зерделеу

Мақалада Жезқазған қаласы жағдайында экологиялық үш топқа жататын кейбір ағаш-бұталы өсімдіктердің суды ұзақ уақыт ұстау қабілеті және жапырақтарының ылғал күйі бойынша жүргізілген зерттеулер нәтижесі келтірілген. Нәтижелер ксерофитті өсімдіктер жоғары ылғалдылықты, ал мезофитті өсімдіктер төмен көрсеткішті көрсетті. Зерттеу қорытындысы бойынша өсімдік түрлері суды ұстау қабілеті үш топқа бөлінді: төмен (0-ден 40 % дейін), орташа (40-тан 70 % дейін) және жоғары (70 % жоғары). Бірінші топқа *Syringa josikaea* кірді, екіншіге *Populus alba*, *Malus sieversii*; *Elaeagnus oxycarpa*, *Amygdalus nana*, *Betula pendula*, *Crataegus sanguinea*, *Acacia alba*, *Pinus sylvestris*, үшінші топқа — *Berberis vulgaris*, *Juniperus sabina*, *Juniperus vulgaris* енді. Сонымен қатар мезофиттер тобына — венгр бозқараған, екінші топқа — *Amygdalus nana*, ал үшінші ең тұрақты топқа — *Crataegus sanguinea* енді. Екінші тұрақты мезофиттер арасында *Malus sieversii* және *Populus alba*, басқалары үшінші топқа жатқызылды. Ксерофитті арасындағы барлық түрлер тұрақтылық қасиеті бойынша үшінші топқа енгізілді. Үшінші топқа енген өсімдіктерді Жезқазған өңірін абаттандыруға ұсынамыз, екінші топқа жатқызылған өсімдіктерді үнемі суару жағдайында қолдануға болады, ал бірінші топтағы өсімдіктерді үнемі суару жағдайында жеке бау-бақшаларда егуге болады.

*Кілт сөздер:* ағаш-бұталы өсімдіктер, Жезқазған, су режимі, орнықтылығын, интродукциялау, су ұстау қабілеті, саралау.

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**Изучение водного режима растений в условиях города Жезказгана**

В статье приведены результаты исследований по оценке оводненности листьев и водоудерживающей способности некоторых древесно-кустарниковых растений в условиях города Жезказгана, относящихся к трем экологическим группам по отношению к условиям увлажнения. Результаты показали, что наибольшей водоудерживающей способностью обладают ксерофитные растения, наименьшей — мезофитные. По итогам исследований виды были разделены на 3 группы: с низкой (от 0 до 40 %), средней (от 40 до 70 %) и высокой (свыше 70 %) водоудерживающей способностью. В первую группу вошла *Syringa josikaea*; вторая группа представлена *Populus alba*, *Malus sieversii*; третья — *Berberis vulgaris*, *Elaeagnus oxycarpa*, *Amygdalus nana*, *Betula pendula*, *Crataegus sanguinea*, *Acacia alba*, *Pinus sylvestris*, *Juniperus sabina*, *Juniperus vulgaris*. Стоит отметить, что среди мезофитов в группу с низкими показателями водного режима вошел один вид — сирень венгерская, во вторую группу — *Amygdalus nana*, а в третью, самую устойчивую, — *Crataegus sanguinea*. Среди мезоксерофитов 2-ю группу устойчивости составили *Malus sieversii* и *Populus alba*, остальные вошли в третью группу. Среди ксерофитов все виды оказались в третьей группе устойчивости. Растения из третьей группы рекомендуется вводить в массовое озеленение Жезказганского региона, второй группы — ограниченно при условии регулярного полива, первой группы — только для частного садоводства при обильном поливе.

*Ключевые слова:* древесно-кустарниковые растения, Жезказган, водный режим, интродукция, устойчивость, водоудерживающая способность, ранжирование.

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