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Study of resistant peculiarities of *Juniperus sabina* and *Juniperus communis* in the conditions of Zhezkazgan industrial region

At the article the results of assessment of winter-resistant, drought-resistant and gas-resistant of *Juniperus sabina* and *Juniperus communis* in the conditions of cities Zhezkazgan and Satpayev are conducted. Winter resistance indicators for kazak juniper were 5 points, for common juniper — 4 points; drought resistance of kazak juniper — 5 points, common juniper from 3 to 4 points. The results are shown that in the territory of the Zhezkazgan copper plan there is more damage to the leaf plates of wood plants than in the experimental comparison site of the Zhezkazgan Botanical Garden (the main arboretum). Thus, the percentage of damage was 2–2.5 times different. Kazak juniper is classified as highly gas-resistant culture, while common juniper is classified as weakly gas-resistant. This fact can be explained by the fact that the first species grows in the local natural flora — in the mountains of Ulytau, while the second species — introduced from the Main Botanical Garden (Almaty city). According to the results of many years of research kazak juniper is classified as very promising plants, that is, it can be widely used in mass greening of settlements of the Zhezkazgan region. Juniper common will be classified as promising species suitable for greening with squirrel and parks under the condition of regular watering.

Keywords: Zhezkazgan industrial region, Zhezkazgan, Satpayev, woody and shrub flora, green building, resistant, kazak juniper, common juniper.

Introduction

Studying the state of green building in an urbanized environment is currently relevant. The concept of a modern urban environment implies ecological planning of sanitary and hygienic conditions for the person, most of which are provided by competent green construction.

Green building is the most important element of urban development, a factor of great importance in sanitary, architectural, planning and social terms [1–7]. The sanitary and hygienic importance of green buildings is great and multilateral. The most important hygienic feature of green plantations is expressed in the regulation of heat and radiation regimes, in the creation of a microclimate providing comfortable conditions of the external environment. Equally important is green buildings, which are a powerful means of protecting populated areas from dust, gases, wind and noise. In addition, they positively affect the central nervous system of a person through the senses, improving his/her well-being.

Trends of modern green construction are oriented not only for formation of a stable and adaptive, but also to a decorative assortment [1]. Coniferous crops are of interest for the greening of settlements, characterized in their majority by evergreen, high decorative properties and isolation of useful phytoncides [7].

However, the climatic and ecological conditions of industrial cities located in desert conditions, such as Zhezkazgan and Satpayev, are not favorable to them. Plants of pine, spruce, fir, biota, tuya quickly fall out of the urban territories [7] due to high summer temperatures, dry temperatures, low relative humidity of the air, acid rains.

Therefore, we have proposed the genus juniper (*Juniperus* L.), whose species are characterized by high ecological plasticity, resistance to industrial pollution [8, 9].

The aim of this study was to study the stability indicators of two juniper species in the industrial cities of Satpayev and Zhezkazgan.

Methodology

The subjects of the research were young landings of kazak juniper (*Juniperus sabina* L.) and common juniper (*Juniperus communis* L.). The assessment of success of an introduction was carried out on the basis of the analysis of a condition of green plantings of various characters (city landings, landings of country massifs, landings and collections of the Zhezkazgan botanical garden, landing in private houses and in the territory of the industrial enterprises).

Research was carried out during 2015–2018 in the territory of the cities of Zhezkazgan and Satpayev, as well as in the areas of dendrology of the Zhezkazgan Botanical Garden.

The assessment of plant resistance to different environmental conditions was carried out according to the «Program and methodology of fruit, berry and nut crops» [10]. Thus, winter resistance was evaluated on the basis of the scale of N.K. Vekhov (Table 1), drought resistance — on the scale of S.S. Pyatnisky (Table 2), gas resistance — on the scale of I.A. Dobrovolsky and T.I. Ilkun (Table 3), resistance to diseases and pests — on the scale of A.N. Kalinichenko (Table 4).

Table 1

Scale of winter-resistant of N.K. Vekhov (1957)

Reaction of plant on low winter temperatures	Valuated point
The plant is quite winter-hardy, remain top buds	5
Only tops of sprouts are damaged	4
Sprouts are damaged more than half of their lengths	3
Sprouts are damaged until level of snow cover	2
Sprouts are damaged until level of artificial warmings (earthing up by the earth)	1
Full destruction by frost of a plant	0

Table 2

Assessment of drought resistant of woody plants by scale of S.S. Pyatnisky (1961)

Reaction of plant to drought	Valuated point
Plants don't react on drought	5
In day hours some loss of turgor of leaves is observed	4
The most leaves have partial damage of leaf body and lost of turgor	3
The most leaves and tops of young sprouts dried completely	2
Leaves fell, but axial bodies remain	1
Plant died	0

Table 3

Scale of gas resistant of plants of I.A. Dobrovolsky and T.I. Ilkun (1971)

Reaction of plant to influence of dangerous gases	Valuated point
High gas resistant	5
Gas resistant	4
Rather gas-resistant	3
Low gas resistant	2
Non gas resistant	1
Plant die after influence of polluted air	0

Table 4

Scale of resistance to diseases and pests according of A.N. Kalinichenko (1977)

Reaction of plants to influence of pathogen fauna and micro flora	Valuated point
Not damaged — «healthy plante»	5
High resistant — plant does not damage of breeders and diseases or damage, but all the period observations the maximum degree of damage of the anatomic organs was not more than 10 %	4
Average — damage is average, 11–25 % of cover, hard-damaging organs didn't observed	3
Low — damage is average, 25–50 % of cover, some organs damaged in high degree	2
Very low — plants are often hard damaged, that lead to death more than 50 % of samples	1
Plants died after damaging of breeders and diseases	0

Statistic treatment of received results was conducted according to methodology of N.L. Udolskaya [11].

Results and their discussion

Visual assessment of winter resistance was carried out twice per season: at the beginning of vegetation, when winter damage is well visible, as well as in the middle of summer, when the degree of recovery of lost parts of the plant can be determined.

It is worth noting that weather conditions differ during the winter seasons, which is due to the duration of the freezing period, the minimum and maximum values of winter temperatures and the presence of throws. The most severe winter conditions were noted for the winter period 2014–2015, characterized by severe frost in January and early February, and weak snow cover. The winter period of 2015–2016 was in line with the average annual multi-year values, while the winter period of 2016–2017 was relatively warm, practically without severe freezes. However, the earlier onset of cold (in the 2 decade of October) and a protracted long spring were noted.

Analysis of the survey results showed that the kazak juniper had higher winter resistance, both for Satpayev and Zhezkazgan cities (Table 5).

Table 5

**Results of visual assessment of winter resistant of junipers
in the conditions of cities Zhezkazgan and Satpayev (2014–2017)**

Species	Points of winter resistant							
	Parameters in Zhezkazgan city				Parameters in Satpayev city			
	2014– 2015	2015– 2016	2016– 2017	Average for three seasons	2014– 2015	2015– 2016	2016– 2017	Average for three seasons
<i>Juniperus sabina</i> L. — kazak juniper	5	5	5	5	5	5	5	5
<i>Juniperus communis</i> L. — common juniper	3	5	5	4	3	4	5	4

Over the whole period of observations of winter resistance of this species was maximum 5 points. The common juniper was characterized by a significant freezing of branches in certain years, but, in general, the average winter resistance score is 4.

This fact can be explained by the following, that the first species grows in the local natural flora — in the mountains of Ulytau, while the second species — introduced from the Main Botanical Garden (Almaty city).

Industrial centers of Kazakhstan are characterized by a difficult environmental situation due to the location of industrial enterprises. The Zhezkazgan industrial region is characterized by copper ore mining, its enrichment and cathode copper smelting. The main pollutants are sulphur oxides, carbon oxides and sulphur anhydride [12]. These gases have negative effects on plant cover in general, and on shrub crops in particular [13, 14].

We analyzed the state of sheet plates of the tested plants as a result of observations for 2015–2017 on the basis of the degree of damage to sheet plates. Observations were conducted during the growing period from May to October. The comparison of gas stability was carried out on the example of plant planting in the territory of the Zhezkazgan copper plan and the Zhezkazgan botanical garden (Table 6).

Table 6

Gas resistant of junipers in surrounding of Zhezkazgan copper plan and Zhezkazgan botanical garden

Species	Degree of damaging of sheet plates, %					
	2015		2016		2017	
	ZCP	ZBG	ZCP	ZBG	ZCP	ZBG
<i>Juniperus sabina</i> L. — kazak juniper	10	5	15	5	15	5
<i>Juniperus communis</i> L. — common juniper	50	10	45	15	45	10

Note. ZCP — Zhezkazgan copper plan; ZBG — Zhezkazgan botanical garden.

The results shown that in the territory of the Zhezkazgan copper plan there was more damage to the leaf plates of wood plants than in the experimental comparison site of the Zhezkazgan Botanical Garden (the main dendarium). Thus, the percentage of damage was 2–2.5 times different.

As a result of the observations, kazak juniper is classified as highly gas-resistant culture, while common juniper is classified as weakly gas-resistant.

The assessment of the drought resistance of the species was carried out for 3 seasons, and visual examination allowed estimating different degree of resistance in drought (Table 7).

Table 7

**Results of visual assessment of drought resistant of junipers
in the conditions of cities Zhezkazgan and Satpayev (2015–2017)**

Species	Ball of winter resistant							
	Parameters in Zhezkazgan city				Parameters in Satpayev city			
	2015	2016	2017	Average for three seasons	2015	2016	2017	Average for three seasons
<i>Juniperus sabina</i> L. — kazak juniper	5	5	5	5	5	5	5	5
<i>Juniperus communis</i> L. — common juniper	3	3	4	3	3	4	4	4

This indicator ranged from 3 to 5 points. The results are indicators that kazak juniper is characterized by a high degree of drought resistance — 5 points according to the results of all observations. This species is capable of withstanding significant periods of drought (15 to 20 days).

Drought resistance of common juniper is estimated from 3 to 4 points, so it is classified as drought-resistant, that is, it is able to carry short droughts and breaks in watering (not more than 10–12 days).

Conclusion

Thus, based on the results of many years of research kazak juniper is classified as very promising plants, that is, it can be widely used in mass greening building of the Zhezkazgan region. Common juniper will be classified as promising species suitable for greening with square and parks under the condition of regular watering.

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Жезқазған өнеркәсіптік аймағы жағдайында *Juniperus sabina* және *Juniperus communis* тұрақтылығының ерекшеліктерін зерттеу

Мақалада Жезқазған мен Сәтбаев жағдайындағы қазақ аршасы мен кәдімгі аршаның қысқа төзімділігін, қуаншылыққа төзімділігі мен газға төзімділігін бағалау нәтижелері келтірілген. Қысқа төзімділікке қазақ аршасы — 5 балл, кәдімгі арша — 4 балл; қуаншылыққа төзімділікке қазақ аршасы — 5 балл, кәдімгі арша 3-тен 4 балға дейін көрсетті. Зерттеу нәтижесі көрсеткендей, Жезқазған ботаникалық бағының тәжірибелік алаңына қарағанда Жезқазған мыс балқыту зауытының аймағында ағаш өсімдіктерінің жапырақ пластиналары көп зақымдалатыны байқалды. Осылайша, зақымдану айырмашылығы 2–2,5 есе. Қазақ аршасын жоғары газға төзімді дақыл ретінде жіктеуге болады, ал кәдімгі аршаны газға төзімділігі әлсіз түріне жатқызуға болады. Факті бойынша бірінші түр — жергілікті табиғи өсімдік флорасы — Ұлытау тауында, ал екіншісі — бас ботаникалық бақтан әкелінген (Алматы қ.).

Кілт сөздер: Жезқазған өнеркәсіптік аймағы, Жезқазған, Сәтбаев, ағаш-бұталы өсімдік, жасыл құрылыс, өсімдіктер дүниесі, төзімділік, қазақ аршасы, кәдімгі арша.

Г.Т. Максутбекова

Изучение особенностей устойчивости *Juniperus sabina* и *Juniperus communis* в условиях Жезказганского промышленного региона

В статье приведены результаты оценки зимостойкости, засухоустойчивости и газоустойчивости можжевельника казахского и можжевельника обыкновенного в условиях гг. Жезказгана и Сатпаева. Показатели зимостойкости у можжевельника казахского составили 5 баллов, у можжевельника обыкновенного — 4 балла; зимостойкости у можжевельника казахского — 5 баллов, у можжевельника обыкновенного — от 3 до 4 баллов. Результаты исследования показали, что на территории Жезказганского медеплавильного завода наблюдается большее повреждение листовых пластинок древесных растений, чем на опытном участке Жезказганского ботанического сада (главный дендрарий). Таким образом, процент повреждений отличался в 2–2,5 раза. Можжевельник казахский можно классифицировать как высокогазоустойчивый вид в культуре, в то время как можжевельник обыкновенный отнесен к слабогазоустойчивому виду. Данный факт можно объяснить тем, что первый вид произрастает в местной природной флоре — в горах Улытау, а второй — завезен из Главного ботанического сада (г. Алматы).

Ключевые слова: Жезказганский промышленный регион, Жезказған, Сатпаев, древесно-кустарниковая флора, зеленое строительство, устойчивость, можжевельник казахский, можжевельник обыкновенный.

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