Caspian Journal of Environmental Sciences
Online ISSN: 1735-3866
Print ISSN: 1735-3033

Identification of promising types of shrubs suitable for introduction in Astana, Kazakhstan

A. Shaldybayeva[1]*, D. Sarsekova[2], S. Mukhtubayeva[3]

1. Seifullin Kazakh Agrotechnical Research University, Zhenis Avenue, Astana, Kazakhstan
2. Kazakh National Agrarian Research University, Abay Avenue, Almaty, Kazakhstan
3. Astana Botanical Garden, Orynbor str, Astana, Kazakhstan

** Corresponding author's E-mail: aiman.darhan@mail.ru*

ABSTRACT

In the course of the study, a comparative analysis was carried out on the various types of shrubs that may be potentially interesting for introduction in Astana, Kazakhstan. Their phenological and botanical features, such as height, shape of the bush, colour and size of flowers, seasonal flowering and decorative foliage, were studied. Special attention was paid to the adaptation of these species to local conditions, such as climate, soil and water availability. Observations of their growth and development over several years were carried out to determine their stability and suitability for acclimatization in an urban environment. The possibility of using these types of shrubs in the landscape design of Astana was also evaluated. The issues of combining them with other plants, creating compositions and also aesthetically attractive plant ensembles were considered. The results of the study allowed us to identify the most promising local types of shrubs suitable for introduction in Astana, as well as to highlight recommendations for their use in landscaping the city. The obtained data and conclusions will be useful for specialists involved in the planning and creation of public and private spaces, as well as for local governments. Thus, this study will be a comprehensive analysis and the introduction of promising local species of shrubs in Astana, taking into account their suitability for local conditions and the possibility of use in the landscape design of the city.

Keywords: Plant, Shrub, Phenological, Botanical, Landscape design.
Article type: Research Article.

INTRODUCTION

Akmola region (North Kazakhstan) is located in steppe hilly and desert regions belonging to the category of dry territories (Nysanbayev 2009). The climate of Akmola region is sharply continental, as well as water scarcity. Lack of moisture and poor development of moisture-saving technologies have a significant impact on the modern assortment of gardening (Zhumagulov 2010). The modern concept of urban and industrial environments necessarily involves the placement of green spaces such as squares, parks in a linear and group planting format (Bulygin 2000). In the urban environment, tree and shrub plantings perform a number of important: aesthetic, protective, sanitary as well as hygienic and recreational functions, i.e., they allow you to create a favourable microclimate, reduce the concentration of harmful gases and dust, protect against noise, dust, and reduce the concentration of pathogenic microorganisms (Frolova 2001). In the arid conditions of the Akmola region, the problem of creating green spaces is acute, which is associated with water scarcity, high summer and low winter temperatures, and poor soil cover. Therefore, it is important not only to choose a stable assortment, but also to use planting material grown in local soil and climatic conditions (Gusev 2002; Nassif *et al.* 2023). The arid territories of Akmola region are represented by the Stepnogorsk and Yereimentau industrial regions. The previously proposed range (Baitulin 2010) is outdated, contains few ornamental plants, so in the last 5 years a new

Caspian Journal of Environmental Sciences, Vol. 21 No. 4 pp. 955-963 Received: March 12, 2023 Revised: June 16, 2023 Accepted: Aug. 28, 2023
DOI: 10.22124/CJES.2023.7154

Publisher: University of Guilan,

composition of species for green construction has been created (Orlov *et al.* 1969, Arestova 2003), among which are bush introducents such as the *Tamarix ramosissima* Ledeb, *Berberis vulgaris* L., *Salix purpurea* L. However, there are no practical recommendations for growing these crops to obtain planting material, and the issue of creating modern nurseries on the territory of the Akmola region has not been resolved to date. Mass landscaping allows not only to improve the ecology, create places for the city residents to spend time, but also to alleviate the climatic conditions of the capital. From year to year, the bar for creating environmentally friendly green areas of the city will be raised. So, it is necessary to create a base of more adapted plastic species as well as varieties of tree-shrub and flower-ornamental plants adapted to the climate of Northern Kazakhstan as soon as possible. Also, in order to analyse and identify the possibility of using high-quality and modern varieties in the green construction of the capital, it is necessary to conduct an introductory study of varietal material, species coming to the modern gardening market, thereby expanding the range of introductions for the zone of risky farming (Nysanbayev 2009). The most important task in large-scale gardening is the production of high-quality planting material. To do so, it is necessary to work out low-cost methods of accelerated reproduction based on their own seed material and studied introductions (Christen *et al.* 2006, Ishmuratova *et al.* 2013, Chai *et al.* 2015). This, in turn, contributes to the development of working collections of seeds and the genetic bank of seeds of botanical gardens, industrial and scientific dendrological nurseries, etc. (Bespalenko 2006; Ouedraogo *et al.* 2021). At the same time, the flora of the North Kazakhstan region is a valuable source for the selection and introduction into culture of farm-valuable and highly ornamental plants with the high frost and heat resistance. The introduction of woody plants in Akmola region makes a significant contribution to solving one of the most important problems of this region, i.e., improving the comfort of northern and industrial cities. Currently, the range of woody plants recommended for landscaping the cities of Akmola region has been developed, however, the introduction of introducers is limited by the lack of specialized nurseries for growing planting material. In the landscaping of these cities, both local- and introduced- seeds are actively used (Nysanbayev 2009; Wolch *et al.* 2014; Dubenok *et al.* 2019). Among the external factors limiting the growth and development of introduced plants in the conditions of Akmola region, the main one is air temperature. Due to the lack of heat, tree-shrub introductions here do not reach their maximum height. Although they are in a uniform life stage, however, are low compared to natural growth areas and southern areas of introduction (Zhumagulov 2010). Unlike trees, a number of shrubs successfully grow and reach the same height as at suitable points for their cultivation, and some species in the Akmola region have even higher indices. Most bushes reach their maximum height at the age of 15-20 years. As for the conditions of the Akmola region, many of their species are good, however, grow more slowly than in the other geographical regions. In winter-hardy species, seasonal development occurs in a short time and usually ends at a period with a temperature above +5 °C (Baitulin 2010; Giyasov 2019; Sturiale & Scuderi 2019). The district is mainly covered by spruce, to a lesser extent pine, birch, rare Aspen, Willow, Mountain Ash, rosehip, bird cherry, juniper and does not differ in a wide variety of tree and shrub species. As an assortment of studied localized shrub plants used in the landscaping of Astana, *Berberis vulgaris* L., *Tamarix ramosissima* Ledeb., *Salix purpurea* L. were selected based on their decorative value and cold resistance. Shrub plants, which are the objects of our research, grow along the roads in the form of linear plantings, forming plantings of parks, squares, courtyards. The purpose of the study was to study the flora of the Akmola region, sow the most decorative types of shrubs for a number of economically valuable characteristics, examine them in culture and introduce them into gardening.

MATERIALS AND METHODS

The climate in Akmola region is sharply continental, dry, with hot summers and cold winters, belonging to the West Siberian climatic condition of the temperate zone. The daily and annual temperature amplitudes are very large. Spring and autumn look weak. There are many sunny days, and the amount of solar heat that the Earth receives in summer is as much as in the tropics. Cloudiness is negligible. Annual rainfall decreases from the North to the South, with a maximum in June and a minimum in February. The snow cover lasts an average of 150 days. The wind is very strong. On the territory of the region, the lowest air temperature values for the whole of Kazakhstan were observed (Atbasar -57 °C, Astana -52°C; Baitulin 2010). The duration of sunlight is 2100-2400 hours per year, which makes the duration of the growing season from 176 to 210 days: the average temperature in July is 30 OS, while in January is - 24 OS (Fig. 2). The minimum temperature reaches -42 to -52 ºC, the maximum -57 ºC. Precipitation falls from 90 to 170 mm, on average up to 131 mm, the main part occurs in the autumn and winter. The dryness of the climate manifests itself for a long time without precipitation. In some years, precipitation does not occur for 50-60 days. The relative humidity of the air is 65-70%; in summer it drops to

40%. Snow cover is formed in November-December. The height of the snow cover is 15 - 30 cm, while in some winters it may not exceed 10 cm. The spring period begins in March, the beginning of the growing season can be considered April 1. Spring frosts can occur until mid – May, and in early autumn-late September. In winter, many thaws are possible.

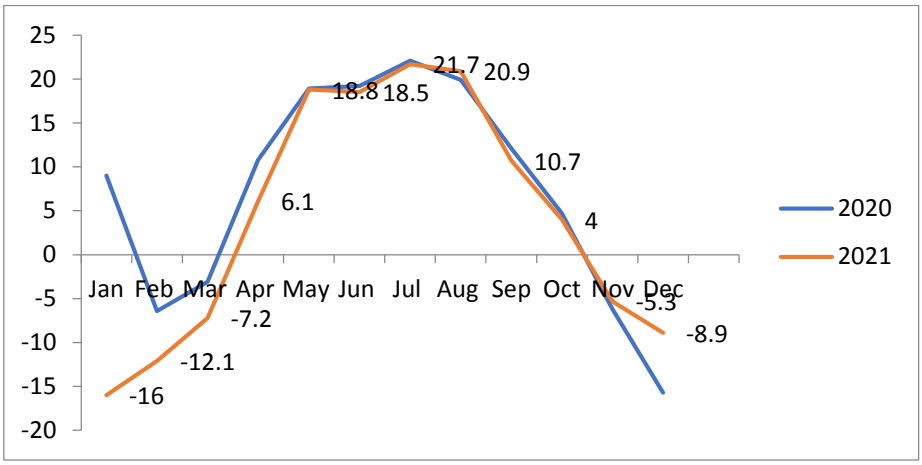

Fig. 1. Average monthly and annual air temperature in Akmola region in 2020-2021.

Negative aspects of climate:

- High summer and low winter temperatures;
-Lack of precipitation and short spring period;
- Insufficient water reserves in the snow cover;
- Low relative air humidity during the growing season;
- Wind activity;
- Poor soil, heavy mechanical composition, low humus content and often with a salty sub-horizon;
- Pollution of industrial regions (on the example of the cities of Stepnogorsk and Ereymentau).

Based on the foregoing, when choosing an adaptive assortment and creating green devices in settlements, it is necessary to comply with the following requirements:

- Application of frost-resistant and heat-resistant plant species, forms and varieties;
- Selection of taxa resistant to atmospheric pollution;
- As using coating materials, hydrogels and drip irrigation, it is necessary to use regular irrigation and moisture-saving technologies;
- Organization of local nurseries for the production of permanent planting material;
- Improving the structure of the soil (partial replacement, introduction of loosening materials, loosening to reduce evaporation);
- Growing seedlings with a closed root system to ensure the possibility of planting during the growing season;
- Alteration in the timing of sowing seeds depending on winter or early spring.

Introductory analysis primarily involves an inventory of collection funds, which serves as the basis for a step-by-step analysis of taxa, their growth dynamics, stability and other parameters of introduced plants. So, an inventory of the woody and shrub plants in the Astana Botanical Garden was carried out. The objects of the study included the shrub (*Berberis vulgaris* L., *Tamarix ramosissima* Ledeb. and *Salix purpurea* L.) introductions from the nursery of this garden and grafting to the organizations of Astana, grown in open and closed ground. The scientific names of plants are given according to the reference platform http://www.theplantlist.org/. The experiments were carried out on open (nursery) and closed (greenhouse) soil. The following options for the experiment were studied: (i) using drip irrigation; (ii) type of reproduction-sowing in fields or seedlings; (iii) using hydrogels; and (iv) using fillers in the form of perlite, verminculite, gravel to structure the soil and retain moisture. The *Berberis vulgaris* L., *Tamarix ramosissima* Ledeb. and *Salix purpurea* L. seeds material and seedlings of plants were obtained from the Botanical Garden of Astana, Collection – 3 decades of October 2021, shelf life – 6 months. Experiments to evaluate and optimize methods for cultivation of the studied plant species are based on standard methods in laboratory conditions (Christen *et al.* 2006, Chai *et al.* 2015). Field experiments were carried out to monitor the

state of planting material in the nursery and Greenhouse Complex provided by the Botanical Garden of Astana, at landscaping facilities after planting in a permanent place by educational organizations of Astana in secondary school No. 60 and kindergarten No. 52 (Astana; Fig. 1). Experiments and observations were carried out according to standard methods (Ishmuratova *et al.* 2013). Experiments were carried out to develop and optimize the conditions for growing planting material using fillers, moisture absorbers and drip irrigation. Experiments were carried out in closed and open ground. Options for growing seedlings with an open and closed root system for closed ground were tested separately. Experimental options were evaluated by the height of the seedlings, the size of the leaf plates, the amount of annual growth and the timing of obtaining standard planting material.

Fig. 1. Experiments on the cultivation of the studied plant species.

At the first stage, experiments were carried out on the optimal timing of sowing plant seeds in the conditions of Astana, using direct sowing, obtaining seedlings and subsequent planting in field conditions. Sowing in the field was carried out in two terms: Winter (October 2, 2021) and spring (April 3, 2022). Sowing by the method of growing seedlings was practiced in December 2021 – January 2022 and March 2022.

RESULTS

According to the results of the inventory, it was found that 14,408 trees and shrubs grew on the territory of the scientific zones of the Botanical Garden in Astana, Kazakhstan. The total collection of woody and shrub plants included 127 species belonging to 59 genera of 25 families (together with 149 taxon varieties). Tree-shrub plants used in the landscaping of Astana are presented in Table 1. Thus, the inventory made it possible to identify 1,697 woody and shrub plants belonging to 50 species on the territory of the scientific zones of the garden. Among the studied shrubs, foreign species predominate (93.5 %). In gardening, shrubs are especially valuable, they grow well, grow quickly, their shoots quickly recover easily, are frost-resistant, undemanding to soil and external conditions. Live fences are made from a bush carapace. The effectiveness of the created landscape images is enhanced by the introduction of flowering shrubs. It blooms from June to September. Pink flowers are collected in cylindrical broomstick inflorescences up to 12 cm long at the tops of the branches. The medium-sized Thuja retains the dark green colour of the leaves until late autumn, the flowers are whitish with an umbrella-shaped fringe.In Astana City, most of the common barberry plants often have yellowing of the leaves, which may be due to the proximity of some objects to the industrial zone of the city and the insufficient gas resistance of this breed. The passage of plants through a full cycle of ontogenetic development indicates their successful introduction. Fruiting of introverts is an important indicator of their adaptation to new conditions, since in the process of ontogenesis, the ability to consolidate the acquired adaptive properties opens up. The generative sphere is most sensitive to alterations in the environment (Arestova 2003; Baitulin 2010). Flowering and fruiting are especially important in urban conditions, which ensures an attractive decorative appearance. In the conditions of the Akmola region, the juvenile stage of ontogenesis increases in most of the introverts. So, the entry into the fruiting period of foreign seeds in Nur-Sultan occurs later than in their homeland and southern introduction points (Table 2).

Seeds introduced in the first 3-4 years after entering the generative phase are often not completely identical (Orlov *et al.* 1969).

Table 1. List of plants used for landscaping the city of Astana.

№	Relative, type	Family	Number of plants
1	*Acer platanoides* L.	*Aceraceae*	8
2	*Amelanchier ovalis* Medikus	*Rosaceae*	4
3	*Amygdalus nana* L.	*Rosaceae*	66
4	*Berberis vulgaris* L.	*Berberidaceae*	10
5	*Betula kirghisorum* Sav. -Rycz.	*Betulaceae*	251
6	*Betula pendula* Roth	*Betulaceae*	20
7	*Betula pubescens* Ehrh.	*Betulaceae*	47
8	*Caragana frutex* (L.) K. Koch	*Fabaceae*	43
9	*Cerasus* sp	*Rosaceae*	2
10	*Cerasus fruticosa* Pall.	*Rosaceae*	3
11	*Cotoneaster melanocarpus* Fisch. ex Blytt	*Rosaceae*	2
12	*Crataegus sanguinea* Pall.	*Rosaceae*	12
13	*Elaeagnus angustifolia* L.	*Elaeagnaceae*	5
14	*Genista tinctoria* L.	*Fabaceae*	5
15	*Hippophae rhamnoides* L.	*Elaeagnaceae*	14
16	*Juniperus pseudosabina* Fisch. & C.A. Mey.	*Cupressaceae*	13
17	*Juniperus pseudosabina* '*Albo Variegata'*	*Cupressaceae*	6
18	*Juniperus sabina* L.	*Cupressaceae*	9
19	*Juniperus sabina* 'G*lauca'*	*Cupressaceae*	3
20	*Larix sibirica* Ledeb.	*Pinaceae*	86
21	*Lonicera tatarica* L.	*Caprifoliaceae*	94
22	*Padus virginiana* (L.) Mill.	*Rosaceae*	21
23	*Philadelphus* sp	*Hydrangeaceae*	4
24	*Philadelphus coronarius* L.	*Hydrangeaceae*	12
25	*Philadelphus microphyllus* A. Gray	*Hydrangeaceae*	8
26	*Picea glauca* (Moench) Voss.	*Pinaceae*	61
27	*Picea obovata* Ledeb.	*Pinaceae*	2
28	*Picea pungens* Engelm.	*Pinaceae*	3
29	*Pinus sylvestris* L.	*Pinaceae*	328
30	*Populus alba* L.	*Salicaceae*	9
31	*Populus italica* (Du Roi) Moench	*Salicaceae*	4
32	*Populus laurifolia* Ledeb.	*Salicaceae*	19
33	*Populus tremula* L.	*Salicaceae*	2
34	*Pyrus ussuriensis* Maxim.	*Rosaceae*	23
35	*Quercus macranthera* Fisch. et C.A. Mey. ex Hohen.	*Fagaceae*	11
36	*Quercus robur* L.	*Fagaceae*	99
37	*Quercus suber* L.	*Fagaceae*	14
38	*Ribes aureum* Pursh	*Grossulariaceae*	16
39	*Rosa acicularis* Lindl.	*Rosaceae*	1
40	*Salix* × *fragilis* L.	*Salicaceae*	167
41	*Sorbaria sorbifolia* (L.) A.Braun	*Rosaceae*	5
42	*Sorbus aucuparia* L.	*Rosaceae*	63
43	*Spiraea media* Schmidt	*Rosaceae*	3
44	*Swida alba* (L.) Opiz	*Cornaceae*	6
45	*Syringa vulgaris* L.	*Oleaceae*	5
46	*Tamarix* sp	*Tamaricaceae*	2
47	*Tilia cordata* Mill.	*Malvaceae*	7
48	*Ulmus glabra* Huds.	*Ulmaceae*	16
49	*Ulmus pumila* L.	*Ulmaceae*	24
50	*Betula pendula f.dalecarlica* (L.fill.) Schneid	*Betulaceae*	55

Phenological observations found that in comparison with flowering, the fruiting intensity of foreign plants is lower and changes over the years. In the dry conditions of the Akmola region, the optimal timing for sowing *Tamarix*

ramosissima and *Salix purpurea* in the form of seedlings is December-January, then harvesting and planting in open (nursery) or closed (greenhouse) soil. The best results for Jinx were obtained in the winter period of sowing in open ground (Table 3). Thus, we found that the maximum germination (64.2%) of *Tamarix ramosissima* seeds was recorded during winter sowing, and to obtain seedlings with a closed root system, it is better to plant seedlings in winter (Fig. 4).

Table 2. Results of phenological control of introductions in the conditions of Akmola region for the period from 2021 to 2022.

Plant	years	the appearance of plant buds	budding	Seedling of sprouts		Flowering		Fruiting	
				At the beginning	At the end	At the beginning	At the end	At the beginning	At the end
Berberis vulgaris L.	2021	09.04	20.04	24.04	05.06	10 ± 3.05	23 ± 5.05	02 ± 3.06	02 ± 5.09
	2022	03 ± 5.04	12.04	-	-	05.04	-	-	-
Caragana frutex L.	2021	14.04	26.04	03.05	10.06	05 ± 5.05	28 ± 3.05	15 ± 3.05	11 ± 5.07
	2022	03 ± 3.04	06.04	-	-	28.04	03.04	-	-
Euonymus europaeus L.	2021	14.04	28.04	30.04	20.06	18 ± 3.05	30 ± 3.05	11 ± 5.06	25 ± 5.09
	2022	-	-	-	-	-	-	-	-
Spiraea media Schm.	2021	07.04	24.04	06.05	21 ± 5.07	07 ± 5.05	18 ± 3.07	22 ± 3.07	27 ± 3.09
	2022	03 ± 3.04	14.04	-	-	08.05	-	-	-
Tamarix ramosissima Ledeb.	2021	02 ± 5.04	10 ± 3.04	24 ± 3.05	02.07	-	-	-	-
	2022	-	-	-	-	-	-	-	-

Analysis of 2-year observations and experimental plantings of plants in the nursery (2021-2022) in Astana and the village of Talapker (using shelters with agrofibre and moisture absorbers) showed that by external signs all individuals are characterized as healthy trees, without damage, with normal growth of shoots (Table 4). In the nursery, we compared individual bushes with traditional watering in furrows and automated drip irrigation when using covering material (agrofibre) as well as introducing moisture absorbers into the sowing and planting holes. The current growing season was characterized by abnormal drought in the early and short spring and hot summer, as a result, the data for two control options differed in points. So, *Tamarix ramosissima* and *Salix purpurea* in traditional irrigation on individual bushes, the indicators of winter hardiness, heat resistance and decorativeness were one point less than on plants grown using moisture-saving technologies. In both versions of the experiments, ordinary jingle individuals showed the same points. Based on the rating points, the best stability indicators were fixed for ordinary barberry plants, the second place was occupied by *Tamarix ramosissima*, and the third place by *Salix purpurea*. At the experimental planting sites, it was noted that the plants felt satisfactory, no signs of significant damage were detected, and in certain areas (School-gymnasium No. 60 in Astana) there was a loss of turgor of *Salix purpurea* leaves due to lack of watering for two weeks. Former plantings, 2021-2022 in Astana on the territory of kindergarten No. 52, *Tamarix ramosissima* showed that individuals are in good conditions, successfully *Berberis vulgaris*, although traditional watering was used, while moisture-saving technologies were not employed.

Fig. 4. *Tamarix ramosissima* seedlings.

Table 3. Germination of seeds *Tamarix ramosissima*, *Salix purpurea* and *Berberis vulgaris* and seedling height in various sowing methods in the conditions of Astana.

Experience version	*Tamarix ramosissima*		*Salix purpurea*		*Berberis vulgaris*	
	Germination of seeds (%)	Seedling height at the end of the growing season (cm)	Germination of seeds (%)	Seedling height at the end of the growing season (cm)	Germination of seeds (%)	Seedling height at the end of the growing season (cm)
1	2	3	4	5	6	7
Winter sowing in open ground	64.2 ± 2.5	34.5 ± 0.8	0	0	56.8 ± 1.3	95 ± 21
Spring sowing in open ground	48.5 ± 1.2	25.0 ± 0.4	32.5 ± 0.6	32.5 ± 0.6	28.4 ± 0.6	75.2 ± 3.5
Seedlings, sowing-January-December, planting in open ground	55.4 ± 1.2	20.6 ± 0.5	44.6 ± 0.8	124 ± 19	34.5 ± 0.8	22.0 ± 0.4
Seedlings, sowing-March, planting in open ground	45.4 ± 1.2	15.4 ± 0.2	37.2 ± 0.8	98.4 ± 4.5	34.5 ± 0.8	18.6 ± 0.2
Seedlings, sowing-January-December, planting in closed ground	55.4 ± 1.2	22.4 ± 0.6	44.6 ± 0.8	175 ± 22	34.5 ± 0.8	0
Seedlings, sowing-March, planting in closed ground	45.4 ± 1.2	16.5 ± 0.3	37.2 ± 0.8	125 ± 30	34.5 ± 0.8	0
Seedlings, sowing-January-December, planting in containers	55.4 ± 1.2	0	44.6 ± 0.8	84.0 ± 4.2	34.5 ± 0.8	0
Seedlings, sowing-March, planting in containers	45.4 ± 1.2	0	37.2 ± 0.8	68.5 ± 3.0	34.5 ± 0.8	0

Table 4. Assessment of plant resistance for the control period 2021-2022.

Көрсеткіштер	*Tamarix ramosissima*		*Salix purpurea*		*Berberis vulgaris*	
	Traditional irrigation	Drip irrigation	Traditional irrigation	Drip irrigation	Traditional irrigation	Drip irrigation
Visual assessment of bushes by external signs	1	1	1	1	1	1
N. K. Wekhov scale, winter hardiness	4	5	4	4	5	5
Drought resistance on the scale of S. S. Pyatnitsky	4	5	3	4	5	5
I. A. Dobrovolsky and T. M. Ilkun gas resistance scale	4	4	3	4	5	5
Resistance to the pathogens of pests and diseases according to A. N. Kalinichenko, points	3	4	4	4	4	5
Decorativeness of plants according to visual assessment, points	4	5	3	4	4	4
Application in local gardening	1		0		2-3	
Assessment of the reproductive capacity of plants according to the modified scale of P. I. Lapin S. B. Sidnev, score	4		1		4	

To confirm the resistance of test plants to summer drought, we evaluated the indicators of water retention capacity from May to September 2022 (Tables 5-6).

Table 5. Morphological indicators of *Salix purpurea* leaves in the context of various irrigation methods (open ground).

Watering method	Leaf length (cm)	Leaf width (cm)	Root length (cm)	Leaf plate area (cm^2)
Traditional irrigation	5.3 ± 0.6	2.97 ± 0.29	1.18 ± 0.16	11.48 ± 1.61
	4.5 – 6.0	2.5 – 3.4	1.0 – 1.5	9.2 – 14.8
Drip irrigation	6.6 ± 0.5	4.07 ± 0.31	1.54 ± 0.10	20.40 ± 1.97
	6.0 – 7.4	3.5 – 4.7	1.4 – 1.7	18.0 – 25.1

* * in the numerator- M ± m; in the denominator-the minimum and maximum value of the sign

Table 6. Morphological indicators of *Tamarix ramosissima* leaves in the context of various irrigation methods (open ground).

Watering method	Leaf length (cm)	Leaf width (cm)	Root length (cm)	Leaf plate area (cm^2)
Traditional irrigation	16.40 ± 0.46	13.76 ± 0.49	9.25 ± 0.34	350.43 ± 41.83
	14.1 – 19.0	12.3 – 16.2	7.5 – 11.0	238 - 534
Drip irrigation	18.62 ± 0.52	15.12 ± 0.54	15.91 ± 0.71	389.44 ± 50.17
	16.0 – 21.4	14.3 – 19.8	13.4 – 17.4	268 - 586

* in the numerator- M ± m; in the denominator-the minimum and maximum value of the sign

In all versions of the experiment, it can be observed that the morphological indicators of the leaves were higher in drip irrigation than in the traditional type of row-by-row irrigation. So, the comparison of the size of the leaves of the gentian was 1.4-1.8 times and *Tamarix ramosissima*-1.1-1.7 times, while *Salix purpurea* showed a difference of 1.6-2.4. The difference between the minimum and maximum values of leaf length, width and petiole length increases. At the same time, *Salix purpurea* seedlings were the most responsive to watering, the least difference will be in the seedlings. According to the results of observations, it is possible to recommend using *Berberis vulgaris* for mass planting in all types of green devices in dry conditions of the Akmola region: *Tamarix ramosissima* in parks, squares, along offices and educational institutions, in alleys and in private areas closed from strong winds; *Salix purpurea* for individual group planting in parks, around offices and educational institutions providing regular irrigation (Orlov *et al*. 1969). The height of *Tamarix ramosissima* and *Salix purpurea* seedlings, the size of the leaves, the diameter of the root collar and the annual growth rate were also higher in the indoor area with drip irrigation than in the open field with drip irrigation. However, keeping a nursery indoors required more costs. Thus, in order to increase germination during the research period, methods of pre-sowing processing of seed material were developed. Stability indicators of *Tamarix ramosissima* and *Salix purpurea* seedlings in the arid climate of the Akmola industrial zone were determined, stability points were determined for open soil conditions using traditional irrigation and drip irrigation. For equipment and consumables for the production of planting material, in dry conditions, we should take into account the composition of soil mixtures, the optimal volume of containers for growing seedlings with a closed root system (containers with a volume of 12 L), the technical parameters of drip irrigation, methods for obtaining seedlings, the width of row spacing and the optimal distance between plants in the nursery, care measures, the optimal, survival rate of seedlings with a closed and open root system when planting in a permanent place.

CONCLUSION

Based on the results of the study, the following conclusions were made:

The climatic conditions of the arid zone of the Akmola region are characterized by unfavourable winter and summer temperatures, lack of precipitation, the presence of industrial air pollution, poor soil and wind throughout the year. Therefore, when creating green devices, it is necessary to use adaptive planting material of local reproduction, use moisture-saving technologies, container cultivation and improve the soil structure. Studies of plant development rhythms and resistance to climatic factors and industrial pollution are recommended for mass gardening of *Berberis vulgaris* to all types of devices, *Tamarix ramosissima* and *Salix purpurea* – limited gardening protected from the wind. The best morphological indicators of the planting material of plants were noted against the background of drip irrigation, using moisture absorbers and covering materials. For *Berberis vulgaris*, winter sowing in open ground can be recommended, while for *Tamarix ramosissima* and *Salix purpurea*, sowing for seedlings in winter, and then planting in a nursery.

REFERENCES

Arestova, EA 2003, Introduction of eastern and western tui biota in Saratov, Krasnoyarsk, Russia.

Baitulin, IO 2010, Theoretical foundations and methodological approaches to plant introduction in regions with extreme climatic conditions. Izvestiya NAS RK. Biological and Medical series, 2 (278): 18-25.

Bespalenko, ON 2006, The use of pine seed-bearing as a bioindicator, Krasnoyarsk, Russia.

Bulygin, NE 2000, Dendrology, St. Petersburg, Russia.

Chai, Q, Gan, Y, Zhao, C, Xu, HI, Waskom, RM, Niu, Y & Siddique, KHM 2015, Regulated deficit irrigation for crop production under drought stress: A review. *Agronomy for Sustainable Development,* 36: 1-22.

Christen, E, Ayars, J, Hornbuckle, J & Hickey, M 2006, Technology and practice for irrigation in vegetable. Yanco, Australis, 63 p.

Dubenok, NN, Kuzmichev, VV & Lebedev, AV 2019, Ecological functions of forest stands in urbanized environment of Moscow. *RUDN Journal of Agronomy and Animal Industries*, 14: 154-161,

Frolova, VA 2001, Investigation of the structure of plantings at citywide landscaping facilities (on the example of Moscow boulevards), Moscow, Russia.

Giyasov, A 2019, System of greening of urban spaces and its role in optimization of the micro- and bioclimate environment, Web of Conferences. Vol. 135.

Gusev, II 2002, Modelling of ecosystems. Arkhangelsk, Russia.

Ishmuratova, MYu, Tleukenova, SU, Dodonova, ASh & Gavrilkova HA 2013, Study of water-holding indicators of various environmental groups of trees and shrubs under Zhezkazgan region conditions. *European Researcher,* 49: 1298-1303.

Nassif, WG, Lagenean, FHS & Al-Taai, OT 2023, Impact of vegetation cover on climate change in different regions of Iraq. *Caspian Journal of Environmental Sciences*, 21: 333-342.

Nysanbayev, EN 2009, Principles and ways of improving green construction based on a comprehensive assessment of natural and man-made factors on the territory of Astana, Almaty, Kazakhstan.

Orlov, FB, Tarabrin, VP & Malakhovets PM 1969, Some issues of acclimatization and introduction of trees and shrubs in the North. *Trudy ALTI*, 21: 24-29.

Ouedraogo, SKL, Kebre, MB & Zougmore, F 2021, Water dynamics under drip irrigation to proper manage water use in arid zone. *Journal of Agricultural Chemistry and Environment*, 10: 57-68.

Sturiale, L & Scuderi, A 2019, The role of green infrastructures in urban planning for climate change adaptation *Climate*, 7: 119-123.

Wolch, JR, Byrne, J & Newell, JP 2014, Urban green space, public health, and environmental justice: The challenge of making cities 'just green enough. *Landscape and Urban Planning*, 125: 234-244.

Zhumagulov, Zh 2010, Assessment of the stability of coniferous introducents in the landscaping plantings of Astana, Almaty, Kazakhstan.

Bibliographic information of this paper for citing:

Shaldybayeva, A, Sarsekova, D, Mukhtubayeva, S 2023 Identification of promising types of shrubs suitable for introduction in Astana, Kazakhstan. Caspian Journal of Environmental Sciences, 21: 955-963.