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Assessment of water-holding capacity of leaves of *Armeniaca vulgaris* Lam. in the conditions of the Zhezkazgan region (the Central Kazakstan)

The expansion of the existing range of tree crops for the greening of settlements is of practical and environmental importance. In the Zhezkazgan industrial region it is necessary to select plants that are resistant to heat, drought, low temperatures and atmospheric pollution, which limits the species composition. In present article studies are conducted to assess the water content in the leaves of *Armeniaca vulgaris* Lam. during the vegetation season under growing using traditional furrow watering and drip irrigation. The assessment of leaf water content showed maximum parameters in May, a decrease in June and July, and repeated increase in August of 2020–2021. Minimum indicators of water-holding capacity are noted in May, maximum — in June. Leaves of plants grown on drip irrigation had parameters of water-holding capacity 1.3–3.9 % higher than under the traditional irrigation method, which indicates a better moisture supply. In general, the water content of apricot leaves was above 50 %, which shows sufficient water supply. The results showed the resistance of *Armeniaca vulgaris* plants to heat and drought, so, this species is recommended for use in green construction of the Zhezkazgan industrial region.

Keywords: Armeniaca vulgaris Lam., Zhezkazgan city, industrial region, water-holding ability, resistant, traditional and drip irrigation.

Introduction

The formation of a modern green building assortment plays an important role in the urban environment, especially for settlements located in industrial contaminated centers and in arid conditions [1–3]. Zhezkazgan industrial region is characterized by extra-arid conditions, a lack of precipitation, high summer temperatures and low temperatures in winter. Therefore, trees and shrubs for introduction into landscaping in the urban environment should be characterized by heat resistance, winter resistance and resistance to industrial pollution [4, 5].

The assortment of green spaces of the Zhezkazgan and Balkhash industrial regions is represented by a small number of species: *Ulmus pumila, Ulmus pinato-ramosa, Acer negundo, Caragana arborescens, Ribes aureum, Malus baccata, Populus nigra, Populus pyramidalis, Elaeagnus oxycarpa, Syringa josikaea, Crataegus sanguine, Pinus sylvestris* and other [6, 7].

Among perspective species for future cultivation in Zhezkazgan and Balkhash cities is *Armeniaca vulgaris*, which features high decorative qualities, rapid growth, frost resistance, tolerance of high summer temperatures and air pollution [8–10].

An important condition for the heat resistance of plants under arid conditions is the water-retaining ability, that is, the ability of plants to retain moisture in the summer [11, 12]. One way to solve the problems of increasing resistance to arid conditions is to organize satisfactory irrigation [13, 14]. Therefore, studies are needed to assess the physiological indicators of trees against the background of different irrigation methods.

International experience shows the prospect of drip irrigation in the urban environment, which saves water and maintains the stability of the different crops [15–17].

The purpose of present study is to consider the water-holding capacity of leaves of *Armeniaca vulgaris* grown on traditional watering and drip irrigation in the conditions of the Zhezkazgan region.

Materials and methodology

Object of study is young plants of apricot (*Armeniaca vulgaris* Lam., or *Prunus armeniaca* L., *Rosaceae* family). Apricot is usually a small tree from 5 to 12 meters high, a large shrub is rare [18]. Vegetation duration is 50–100 years that depends on the climate and cultivation conditions. Shoots of apricot are red-brown or greenish-brown, glabrous, shiny, sometimes covered with gray film. The root system is deep. The buds are located on 2–3 pieces. The sheet is simple, oval, with an elongated pointed tip, 4–12 cm long,

with a serrated edge. The flower is large, white-pink, fragrant, blooms before the opening of leaves. The fruit is a drupe, yellow or orange, fleshy, semi-fleshy or dry, usually pubescent and velvety to the touch. Fruiting occurs from 3–5 years.

Leaves of *Armeniaca vulgaris* are taken from 2-year trees (a middle part of crown) growing at the nursery in Zhezkazgan in May-August 2020–2021 (Fig. 1); separately from plots with traditional (superficial by borowa) and drip irrigation (diameters of fleets 20 mm) [19]. The watering rate in both versions of the experience was 1.5 m^3 per season with a number of waterings at least 10 [20].

A B

Figure 1. Samples of *Armeniaca vulgaris* on traditional (A) and drip (B) irrigation (Zhezkazgan city)

Leaf sizes were evaluated during full deployment (June), leaf area is evaluated by weighted area methods. From May to August, the water retention capacity of the leaves was assessed by measuring weight after 1, 3, and 6 hours [9, 21, 22].

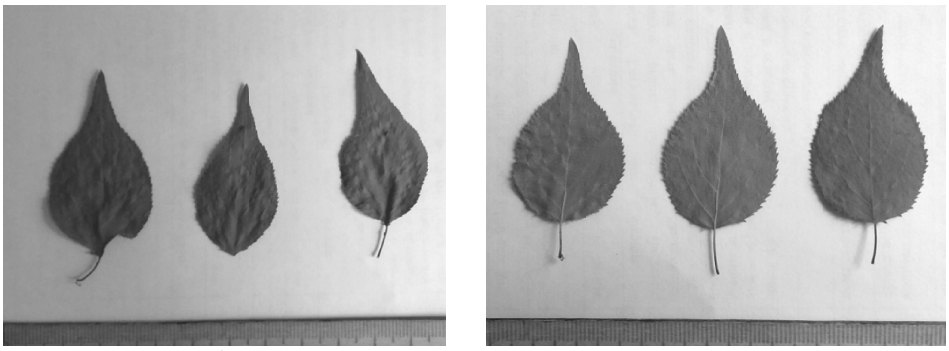
The results of 2-year observations are combined and processed statistically using online system www.medstatistic.ru.

Results and discussion

The growing season in Zhezkazgan is tense due to arid conditions, frequent dry winds and low relative humidity [23]. Tree-shrub plants experience the greatest moisture deficiency from the end of June to mid-August [24].

Visual observations of apricot leaves showed that the strongest negative effects are observed in July, 2021. Partial yellowing of the leaves of the upper part of crow, burns, single fall are observed. Leaves of the middle and lower part of the crown practically did not change in appearance.

Under different irrigation conditions, reliable differences in size and area of apricot sheet plates are observed (Fig. 2, Tab. 1).



A B

Figure 2. Internal view of leaves of *Armeniaca vulgaris* (middle part of crown):
A — traditional irrigation, B — drip irrigation

Table 1

The morphological parameters and square of leaf sheets of *Armeniaca vulgaris* depending on method of irrigation in the conditions of the Zhezkazgan region

Method of irrigation	Sheet length, cm	Sheet width, cm	Length of sheet petiole, cm	Square of sheet plate, cm^3
Traditional irrigation	5.3 ± 0.6 4.5 — 6.0	2.97 ± 0.29 2.5 — 3.4	1.18 ± 0.16 1.0 — 1.5	11.48 ± 1.61 9.2 — 14.8
Drip irrigation	6.6 ± 0.5 6.0 — 7.4	4.07 ± 0.31 3.5 — 4.7	1.54 ± 0.10 1.4 — 1.7	20.40 ± 1.97 18.0 — 25.1
*in a numerator — M±m; in a denominator the maximum and minimum value of an indicator				

So, in length, plant leaves on drip irrigation turned out to be by 1.3 cm bigger than with traditional irrigation; by the width of the sheet — by 1.1 cm, by the length of the petiole of the sheet — by 0.36 cm, by the area — by 8.92 cm^3.

During the growing season the water content of apricot leaves ranged from 54.3 to 64.6 % by fresh weight (Tab. 2).

Table 2

The water-holding capacity of *Armeniaca vulgaris* leaves depending on method of irrigation in the conditions of the Zhezkazgan region

Method of irrigation	Month	Water content, %	Loss of moisture during jamming through, %		
			1 hour	3 hours	6 hours
Traditional irrigation	May	61.1±2.0	15.8±0.5	18.2±0.3	36.9±1.2
	June	59.6±2.2	7.5±0.4	20.5±0.7	28.3±0.8
	July	54.3±0.9	18.6±1.0	35.4±1.6	45.6±1.5
	August	58.9±1.6	9.4±0.4	20.8±0.8	32.4±1.4
Drip irrigation	May	64.5±0.6	12.6±0.6	16.2±0.4	33.5±1.6
	June	62.4±0.5	9.5±0.8	14.5±0.5	30.4±1.6
	July	58.8±1.1	14.8±1.2	24.6±0.6	36.5±1.3
	August	60.1±2.1	8.1±0.5	19.5±0.8	28.5±0.6

The reduced moisture content is noted in the traditional irrigation method, which indicates that moisture loss occurs. On drip watering, the plants received more water.

The water content and water-holding capacity of the leaves of *Armeniaca vulgaris* varied on different month. So, in May, the leaves had maximum humidity, which is due to the lower temperatures and higher relative humidity of the spring period [25]. However, water losses in apricot plants were higher in May than in June. This aspect is explained by the fact that the leaves are young, not adapted to drought. In June, the water content of the leaves was lower, but the mass when dried is less (Fig. 3). Apparently, adult apricot leaves more easily adapted to drought, better kept it in the flesh.

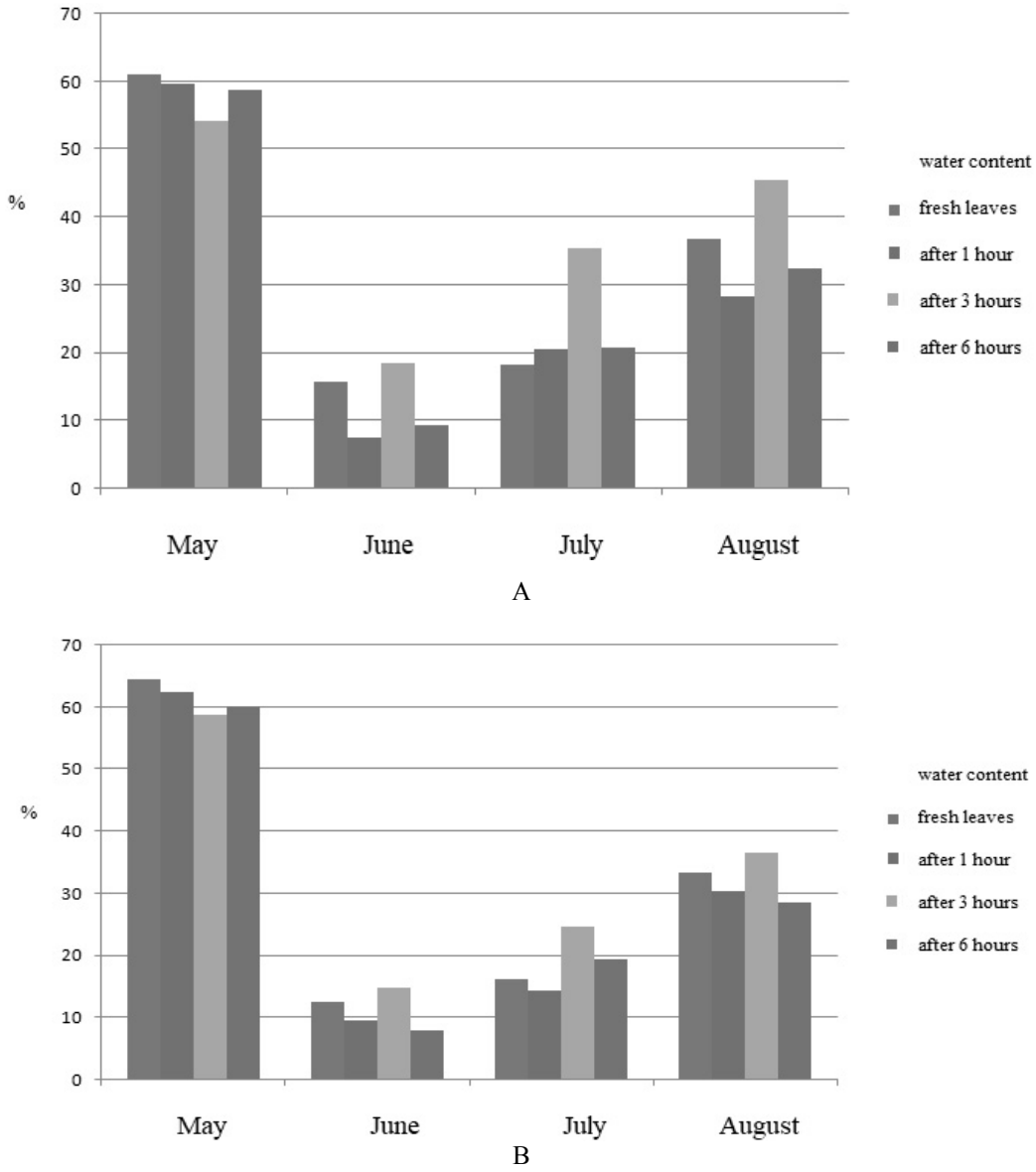


Figure 3. The water-holding capacity of *Armeniaca vulgaria* leaves by months under the Zhezkazgan city conditions: A — traditional irrigation, B — drip irrigation

The minimum moisture content of apricot leaves is noted in July, characterized by maximum temperatures and minimum relative humidity. This affects the water retention capacity, which was minimal for all types of irrigation and all test indicators by month.

In August the water content in the leaves was higher than in July due to a decrease in air temperature and precipitation. It was also recorded that the moisture loss during drying was minimal. A comparison of the results of the studies showed the adaptive reaction of apricot leaves in all variant of observation to prolonged dehydration.

In general, the moisture content of apricot leaves above 50 % indicates sufficient watering, although more moisture is obtained by drip irrigation of plants. The water content and weight loss during drying in plants on drip irrigation turned out to be higher than in plants on traditional watering. The monthly difference ranged from 1.3 to 3.9 % in favor of drip irrigation efficiency.

Thus, the indicators of water content and water retention ability indicate sufficient drought resistance of ordinary apricot in the conditions of Zhezkazgan, which allows us to recommend it for green construction.

Conclusion

A study of the water content and water retention of the leaves of *Armeniaca vulgaris* showed that in spring and late summer the moisture content was higher than in early and mid-summer. The water content of

the leaves during the studied vegetation season was higher than 50 %, which indicated a sufficient rate of watering.

In the process of vegetation, a change in the water retention ability is observed. Maximum indicators are noted in June, minimum — in May. The water content of apricot leaves was higher for plants grown on drip watering, and the leaves lost less moisture when dried. The obtained indicators signity positive effect of drip irrigation.

The obtained data on apricot show its good resistance to summer conditions in Zhezkazgan city, so this species should be recommended for introduction into green building.

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М.Ю. Ишмуратова, А.Н. Матвеев, С.У. Тлеукенова, А.Г. Жумина, Р.Т. Мусина

Жезқазған аймағы жағдайында *Armeniaca vulgaris* Lam. жапырақтарының суұстау қабілетін бағалау (Орталық Қазақстан)

Елді мекендерді көгалдандыру үшін ағаш дақылдарының қолданыстағы ассортиментін кеңейту практикалық және экологиялық маңызды. Жезқазған өнеркәсіптік аймағында ыстыққа, құрғақшылыққа, төмен температура мен атмосфералық ластануға төзімді өсімдіктерді таңдау қажет, бұл түрлердің құрамын шектейді. Мақалада вегетациялық кезеңде борозда дәстүрлі суару және тамшылатып суару арқылы өсіру кезіндегі *Armeniaca vulgaris* Lam. жапырақтарындағы судың мөлшерін бағалау бойынша зерттеулер нәтижесі берілген. Жапырақтардың құнарлылығын бағалау мамыр айында максималды мәндерді, маусым мен шілде айларында төмендеу, 2020–2021 тамыз айында қайта өсуді көрсетті. Тамшылатып суару кезінде өсірілетін өсімдіктердің жапырақтары дәстүрлі суару әдісіне қарағанда суды ұстап тұру қабілеті 1,3–3,9 %-ға жоғары болды, бұл ылғалдың жақсы қамтамасыз етілгендігін көрсетеді. Жалпы абрикос жапырақтары 50 %-дан жоғары болды, яғни сумен жеткілікті қамтамасыз етілді. Алынған нәтижелер *Armeniaca vulgaris* өсімдіктерінің жылу мен құрғақшылыққа төзімділігін көрсетті, сондықтан бұл түр Жезқазған өнеркәсіптік аймағының жасыл құрылысында қолдану үшін ұсынылады.

Кілт сөздер: Armeniaca vulgaris Lam., Жезқазған қаласы, өнеркәсіптік аймақ, суды ұстап тұру қабілеті, тұрақтылығы, дәстүрлі және тамшылатып суару.

М.Ю. Ишмуратова, А.Н. Матвеев, С.У. Тлеукенова, А.Г. Жумина, Р.Т. Мусина

Оценка водоудерживающей способности листьев *Armeniaca vulgaris* Lam. в условиях Жезказганского региона (Центральный Казахстан)

Расширение существующего ассортимента древесных культур для озеленения населенных пунктов имеет важное практическое и экологическое значение. В Жезказганском промышленном регионе необходимо подбирать растения, отличающиеся устойчивостью к жаре, засухе, низким температурам и атмосферному загрязнению, что ограничивает видовой состав. В статье приведены результаты исследования по оценке содержания воды в листьях *Armeniaca vulgaris* Lam. в течение вегетационного периода при выращивании с применением традиционного полива по бороздам и капельного орошения. Оценка оводненности листьев показала максимальные значения в мае, снижение в июне и июле, повторное повышение в августе 2020–2021 гг. Минимальные показатели водоудерживающей способности отмечены в мае месяце, максимальные — в июне. Листья растений, выращиваемых на капельном орошении, имели показатели водоудерживающей способности на 1,3–3,9 % выше, чем при традиционном методе полива, что свидетельствует о более лучшей обеспеченности влагой. В целом, оводненность листьев абрикоса была выше 50 %, то есть с достаточной обеспеченностью водой. Полученные результаты показали устойчивость растений *Armeniaca vulgaris* к жаре и засухе, поэтому данный вид рекомендуется для применения в зеленом строительстве Жезказганского промышленного региона.

Ключевые слова: Armeniaca vulgaris Lam., город Жезказган, промышленный регион, водоудерживающая способность, устойчивость, традиционное и капельное орошение.

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