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S.U. Tleukenova*, E.A. Gavrilkova, M.B. Zhanayeva, A.N. Madiyeva

Karaganda Buketov University, Karaganda, Kazakhstan
**Corresponding author: damir—6@mail.ru*

Water-holding capacity of *Ribes aureum* leaves in the conditions of Karaganda region

Study of fruit plants and selection of species resistant to local climatic conditions is an important task for nursery development. In conditions of Central Kazakhstan there is a limited assortment of fruit plants, so it is necessary to select crops resistant, first of all, to arid climate. A promising species is *Ribes aureum*, characterized by rapid growth, undemanding soil conditions and resistance to diseases and pests. Under the conditions of Karaganda city, studies were conducted to assess the water content and water-holding capacity of this crop during the growing season — from May to September. The results showed that the maximum values of water-holding capacity of *Ribes aureum* leaves are observed in May and June months, which is associated with the youth of leaves, their physiological activity, as well as cool and wet weather. In July, water-holding capacity starts to decrease, which can be attributed to hot conditions. However, in August and September, an increase in water-holding capacity can be observed due to abundant precipitation and cooler weather. Indicators of water regime show that the crop is highly resistant to water deficit.

Keywords: Ribes aureum, Karaganda, water content, water-holding capacity, water regime.

Introduction

The problem of preserving the genetic potential of fruit and berry plants, its practical introduction into culture, and its use in modern breeding is one of the basic foundations in the creation of new varieties, forms, and hybrids [1]. The necessity of work on the study of genetic potential of wild fruit and berry plants and creation of gene pool of new assortment is dictated by the fact that due to climate change, anthropogenic impact on biocenoses their habitats are sharply decreasing, up to the threat of complete extinction. The research is conditioned by the need of Kazakhstan to assess the current state of fruit and berry plants to solve the problem of food security, to carry out monitoring for scientifically based conservation measures [2].

In different regions of Kazakhstan there is a need to develop and create scientific and practical basis of regional collection funds and nurseries, which will allow meeting the growing demand for resistant crops to certain soil and climatic conditions of fruit and berry plants [3, 4]. *Ribes aureum*, characterized by high yield and undemanding to irrigation, soil fertility and resistant to diseases and pests, can be defined as a promising fruit crop in arid conditions of Central Kazakhstan [5].

To understand the levels of adaptation of different crops to local climatic conditions, it is necessary to study the water regime [6]. Based on the above mentioned, the aim of the present study was to investigate water content and water-holding capacity of promising fruit crop *Ribes aureum* Pursh (Grossulariaceae) in Karaganda city conditions.

Experimental

The studies were conducted at the fruit plant nursery of the Faculty of Biology and Geography of KarU in 2024. 3–5-year-old plants of *Ribes aureum* were selected to study water metabolism (Fig. 1).

Determination of total moisture content and water-holding capacity were performed according to the method of G.V. Eremin and T.A. Gasanova [7].

Total water content of leaves was calculated by the formula: $W=100\times(M-M2)/M$;

water-holding capacity of leaves: $R=100\times(M1-M2)/M$;

content of "mobile" moisture in leaves: $L=W-R$,

where: M — mass of fresh sample;

M1 — mass of the sample after 3 hours;

M2 — mass of sample after drying.

A B

Figure 1. Internal view of flowering (A) and fruitening (B) shoot of *Ribes aureum*

Leaves were weighed after 60, 120, 180 and 360 minutes. All measurements were carried out from May to September in 10-fold repetition.

The obtained numerical indices were analyzed using Statistica 6.1 and Microsoft Office Excel 2007 software packages.

Results and Discussion

Analysis of water content showed changes in *Ribes aureum* during the growing season (Fig. 2). The maximum water content was observed in May and amounted to 64.0 %, in the following months a steady decrease in water content can be observed. Thus, in June, this indicator amounted to 60.3 %, in June — 55.4 %, in August — 50.2 %, in September — 48.5 %.

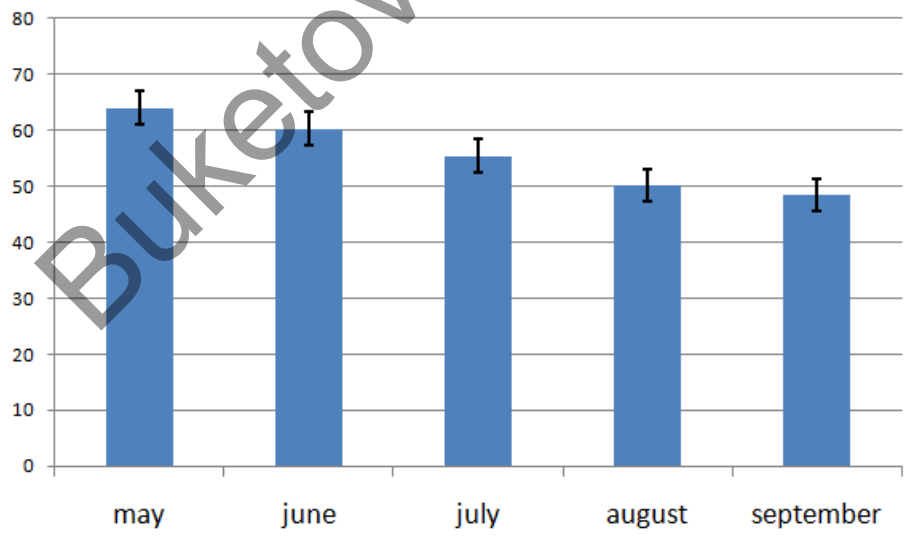

Figure 2. Water content of *Ribes aureum* leaves during 2024 vegetative period

High water content of currant leaves in spring is associated with their youth and relatively low temperatures and high humidity. With the onset of summer temperatures, the amount of free water in leaves decreases due to high transpiration. In the fall period, leaves physiologically senesce, which leads to a decrease in water content.

However, the water content of leaves cannot be a reliable sign of plant resistance to arid conditions, because under favorable watering this indicator can remain at a high level even in low drought-resistant plants.

Therefore, at the second stage, we analyzed the water-holding capacity of *Ribes aureum* leaves during the growing season.

Thus, in May leaves had maximum moisture content, which is due to lower temperatures and higher relative air humidity. However, plant water losses were higher in May than in June. This aspect is due to the fact that the leaves are young, not adapted to drought. In June, the water content of leaves was lower, but the loss in mass by desiccation was lower. Apparently, mature leaves adapted to drought more easily and retained it better in the pulp.

The results showed that in May currant leaves, leaves effectively retained free water for 60 and 120 minutes after cutting from the plant (Fig. 3). No significant difference was found between the water-holding capacity at these periods, 88.2 and 82.4 %. After 180 minutes, leaves begin to significantly reduce their water-holding capacity — 70.6 %. After 6 hours, this indicator decreases more than 2 times — till 41.1 %.

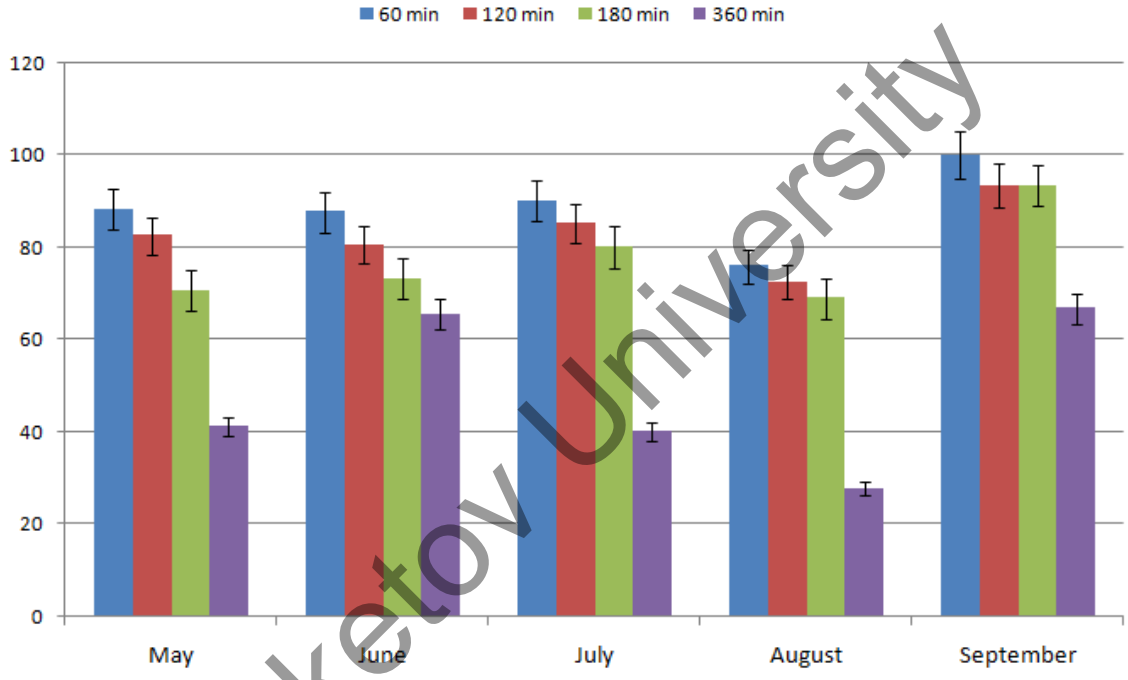

Figure 3. Indicators of water-holding capacity of *Ribes aureum* leaves during the 2024 vegetation period

In June, water loss by currant leaves decreases. Thus, after the 1st hour the water retention capacity was 87.6 %, after 2 hours — 80.4 %, after 3 hours — 73.2 %, after 6 hours — 65.4 %. Probably, currant leaves become mature and effectively use physiological mechanisms for water retention.

A similar situation is observed in the month of July. There is a slight loss of free water by currant leaves after 1, 2 and 3 hours, 90.0; 85.0 % and 80.0 %, respectively. However, after 6 hours, the water-holding capacity decreases sharply to 40.0 %. The same situation is with the indicators of water-holding capacity of *Ribes aureum* leaves in August. Thus, this indicator decreases insignificantly after 1, 2 and 3 hours — 75.8; 72.4 and 68.9 %, respectively, and after 6 hours — a sharp decrease to 27.6 %.

July and August were characterized by the highest temperatures during the growing season and minimum soil and air humidity, which makes plants retain water more actively, however, the lack of moisture reduces the efficiency of water-holding capacity after 6 hours.

The highest values of water-holding capacity were observed in September 2024. Thus, after 1 hour it was estimated at 100 %, after 2 and 3 hours — 93.3 %, after 6 hours — 66.7 %.

In general, the analysis of the obtained data shows maximum values of water-holding capacity in May and June months, which is associated with the youthfulness of leaves, their physiological activity, as well as cool and wet weather of the current year. In July, water-holding capacity starts to decrease, which can be ex-

plained by hot conditions. However, in August and September, an increase in water-holding capacity can be observed due to abundant precipitation and cool weather.

Conclusion

Thus, the study of water regime of *Ribes aureum* showed high adaptability to arid conditions of Karaganda region, which implies the ability to withstand periods of precipitation deficit and irrigation. Critical points for irrigation are July and August months, in which it is necessary to organize more active irrigation, in May, June and September this culture does not need intensive irrigation.

The results allow recommending *Ribes aureum* for more intensive application in fruit growing in Karaganda oblast.

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С.У. Тлеукенова, Е.А. Гаврилькова, М.Б. Жанаева, А.Н. Мадиева

Қарағанды облысының жағдайындағы *Ribes aureum* жапырақтарының су ұстау қабілеті

Жеміс өсімдіктерін зерттеу және жергілікті климаттық жағдайларға төзімді түрлерді таңдау питомниктерді дамытудың маңызды міндеті. Орталық Қазақстан жағдайында жеміс өсімдіктерінің шектеулі ассортименті бар, сондықтан, ең алдымен, құрғақ климатқа төзімді дақылдарды таңдау қажет. *Ribes aureum* перспективалы түрлер болып табылады, ол тез өсуімен, топырақ жағдайына сәйкес келмеуімен және аурулар мен зиянкестерге төзімділігімен ерекшеленеді. Қарағанды қаласының жағдайында вегетациялық кезең ішінде — мамырдан қыркүйекке дейін осы дақылдың су басуы мен су ұстау қабілетін бағалау бойынша зерттеулер жүргізілді. Нәтижелер *Ribes aureum* жапырақтарының суды ұстау қабілетінің максималды мәндері мамыр және маусым айларында байқалатынын көрсетті, бұл жапырақтардың жас болуына, олардың физиологиялық белсенділігіне және 2024 жылғы салқын және ылғалды ауа-райына байланысты. Шілде айында суды ұстау қабілеті төмендей бастайды, оны ыстық жағдайлармен түсіндіруге болады. Алайда, тамыз және қыркүйек айларында жауын-шашынның көптігі мен салқын ауа-райына байланысты суды ұстау қабілетінің жоғарылауы байқалады. Су режимінің көрсеткіштері дақылдың су тапшылығына деген жоғары тұрақтылығын көрсетеді.

Кілт сөздер: Ribes aureum, Қарағанды, су басу, суды ұстау қабілеті, су режимі.

С.У. Тлеукенова, Е.А. Гаврилькова, М.Б. Жанаева, А.Н. Мадиева

Водоудерживающая способность листьев *Ribes aureum* в условиях Карагандинской области

Изучение плодовых растений и выбор видов, устойчивых к местным климатическим условиям, являются важной задачей для развития питомников. В условиях Центрального Казахстана существует ограниченный ассортимент плодовых растений, поэтому необходимо подбирать культуры, устойчивые, прежде всего, к аридному климату. Перспективным видом является *Ribes aureum*, отличающийся быстрым ростом, нетребовательностью к почвенным условиям и устойчивостью к болезням и вредителям. В условиях г. Караганды были проведены исследования по оценке оводненности и водоудерживающей способности данной культуры в течение вегетационного периода — с мая по сентябрь. Результаты показали, что максимальные значения водоудерживающей способности листьев *Ribes aureum* наблюдаются в мае–июне, что связано с молодостью листьев, их физиологической активностью, а также прохладной и влажной погодой 2024 года. В июле водоудерживающая способность начинает снижаться, что можно объяснить жаркими условиями. Однако в августе–сентябре можно наблюдать увеличение водоудерживающей способности из-за обилия осадков и прохладной погоды. Показатели водного режима свидетельствуют о высокой устойчивости культуры к дефициту воды.

Ключевые слова: Ribes aureum, Караганда, оводненность, водоудерживающая способность, водный режим.

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Information about the authors

Tleukenova Saltanat Ushkempirovna — Candidate of biological science, Head of Botany Department, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *damir—6@mail.ru;*

Gavrilkova Elena Anatoljevna — Master of biology, Senior lecturer of Botany Department, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *elena_2809@mail.ru;*

Zhanayeva Merey Baibolovna — PhD-student, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *mereyka_1995@mail.ru;*

Madiyeva Aida Narimanovna — Master of biology, Senior lecturer of Zoology Department, Karaganda Buketov University, Karaganda, Kazakhstan; e-mail: *madievaaida@mail.ru.*