

P.U. Abdikarimova^{1*}, S.N. Atikeeva²

¹ Karaganda University of the name of academician E.A. Buketov, Kazakhstan;

² University Turan-Astana, Kazakhstan

*Corresponding author: pikon_04_93@mail.ru

Anatomic features of *Juniperus sabina* growing in the Central Kazakhstan

Anatomical parameters of the needles of the Cossack juniper growing in different geographical regions (the city of Karaganda, Karkaraly, Zhanaarka and Ulytau districts) were studied. During the research work of *Juniperus sabina* in the populations of Ulytau and Karkaraly districts, the development of hypoderma is not so great, and in the populations of *Juniperus sabina* of Zhanaarka district, good development of hypoderma, cuticle and epidermis can be observed. This in turn reflects the adaptation of plants to the harsh growing conditions in such regions. Descriptive statistics were arithmetic averages, standard deviations, coefficients of variation, according to the data of each geographic region, each population.

Keywords: coefficient of variation, cossack juniper, anatomy, transverse incision, size of the conducting beam, epidermis, cuticle, hypoderm.

Introduction

Cossack juniper (*Juniperus sabina* L., family *Cupressaceae*) is a shrub, rare species that forms small scattered populations. Plants quickly grow in width, forming dense thickets (Fig. 1).



Figure 1. *Juniperus sabina* in Karlaraly Mountains

Shrubs die when shaded by taller tree species, such as spruce. The dryness of the climate during the bora period could have contributed to the wide distribution of the species. In nature, small trees with curved trunks are rarely found. The bark is red-brown, flaky. The shoots contain an essential oil and are poisonous. The needles are of two types: in young plants and on shady branches, needle-shaped, straight, pointed, 4-6 mm long, bluish-green above, soft, with a pronounced middle root; in adult plants, the needles are scaly, lamellar. A characteristic feature of the species is a pungent odor [1, 2].

It is drought-resistant, photophilous, unpretentious to soils, resistant to smoke and gas, has protective properties in relation to soils. Shoots are rich in glycosides, saponins and flavonoids [3-5]. Juniper has a healing effect on the forest environment, releasing more phytoncides than other conifers. It also contributes to the natural regeneration of coniferous trees on clearing sites.

According to Perezhugin Yu.V., *J. sabina* is a type of rocky habitats associated within its main range with subarid and arid regions of the Palearctic and refers them to Pliocene relics [6].

J. sabina, despite its wide distribution in the forests of Kazakhstan, remains one of the least studied conifers. Detailed studies on the study of form diversity, biometric and morphometric variability of the *J. sabina*, the features of their renewal in the Karaganda region were not carried out.

Therefore, it is necessary to consider the issue of factors leading to changes in the environmental conditions of its growth over the past decades. *J. sabina* has a healing effect in the forest environment, produces more phytoncides than other conifers, forms the microclimate of the surface layer of the atmosphere and promotes the natural renewal of coniferous woody plants [7, 8].

The purpose of this study is to study the anatomical features of the vegetative organs of the Cossack juniper (*J. sabina*) growing in the territories of Karaganda (Karaganda city, Karkaraly and Zhanaarka districts) and Ulytau regions (Ulytau district).

Experimental

The object of this study is aboveground parts of *J. sabina*. Samples were collected from the following geographic regions: Karaganda city, Zhanaarka, Karkaraly and Ulytau districts (Fig. 2). The sample from each population consisted of 5-7 individuals, depending on the size of the population.

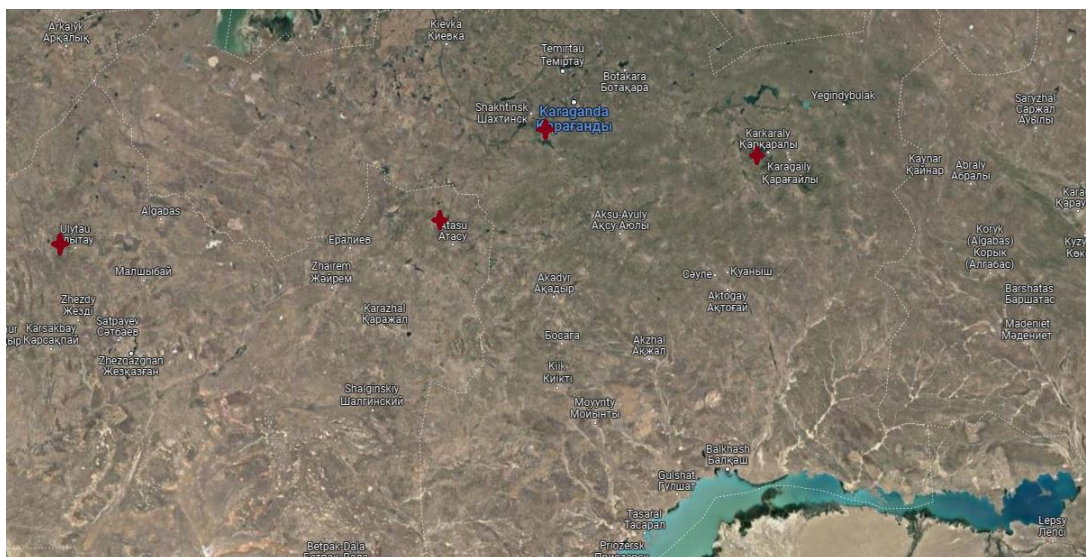


Figure 2. Place of samples collection of *Juniperus sabina*

In field research, specimens of *J. sabina* were collected from four research zones (Karaganda, Zhanaarka district, Karkaraly district, Ulytau district). At least five objects were obtained from each study area. In the course of the research work, an anatomical study of *J. sabina* was carried out for the following indicators: the average diameter of the receptacle, the width of the epidermis; the size of the conducting beam [9, 10]. *J. sabina* was stored in ethyl alcohol for at least a day (50 %), after which a cross section was made.

Surface preparations and sections were made manually using a razor blade. The resulting sections were placed in a drop of glycerin and photographed. Microscopic photographs of cross sections of aboveground organs were obtained using an Altami A2098 microscope with a digital camera Altami UCMOS03100KPA, recorded by the Altami Studio program. The photos were processed in the Paint application 11.2208.6.0.

All research work was carried out on the base of research park of biotechnology and ecomonitoring, the Karaganda University named after E.A. Buketov.

All data were processed statistically using the computer program Microsoft Office Excel, and the reliability criterion was calculated according to Mann-Whitney [11].

Results and Discussion

In the course of the research work, an analysis of the vegetative organ of *J. sabina* was carried out. Such indicators of a coniferous plant as the thickness of the epidermis, hypodermis and the diameter of the receptacles were studied, as well as a cross section was made and a study was conducted. The width of the epidermis does not depend on the age of the coniferous juniper. But the area of the cross section and the area of the conducting beam tend to increase (Fig. 3). These features were observed in populations in all regions of the study. The cuticle of a young juniper thickens, resulting in a larger cross section.

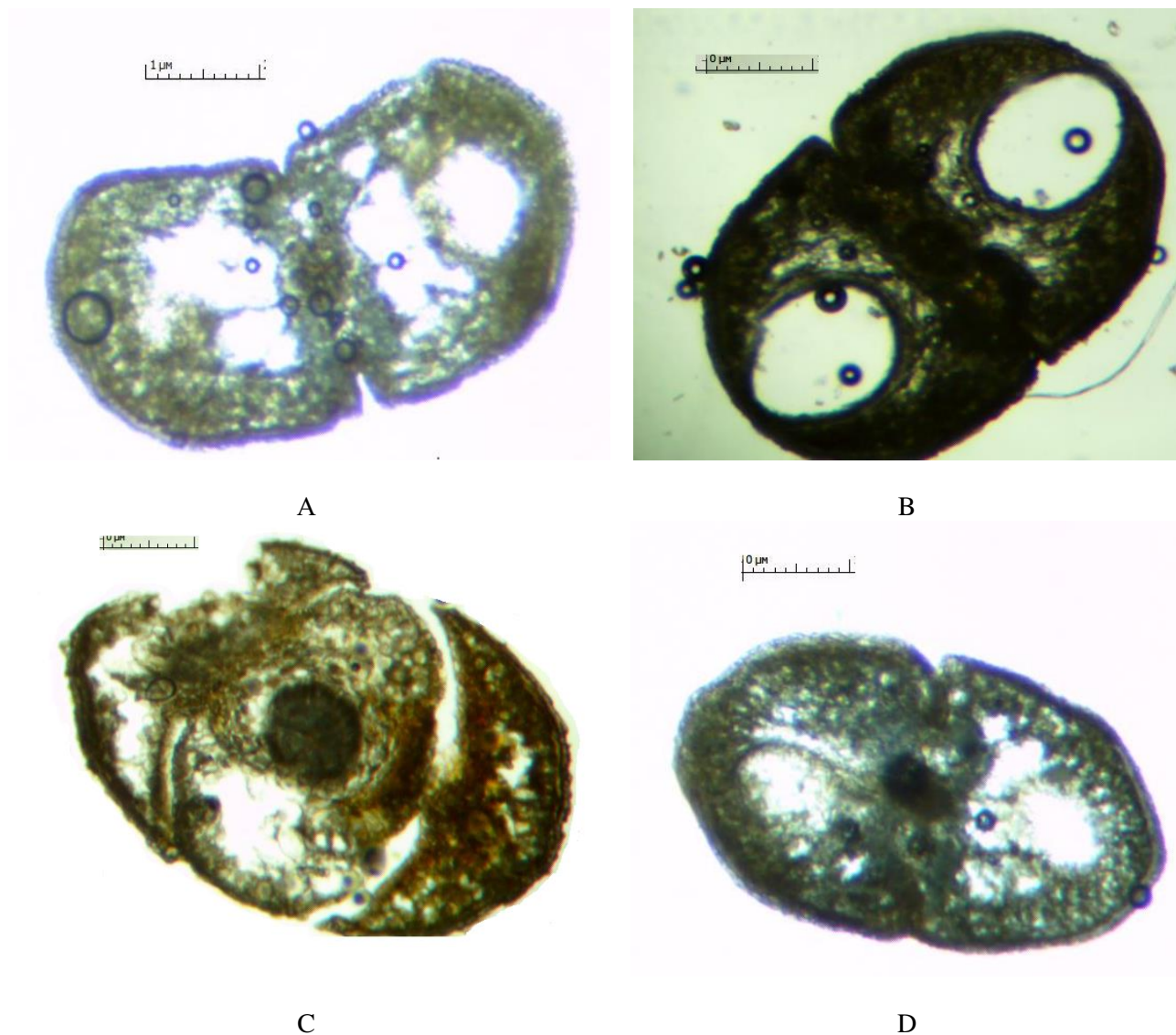


Figure 3. Cross section of *Juniperus sabina*: A — sample from Karaganda city; B — sample from Zhanaarka district; C — sample from Karkaraly Mountains; D — sample from Ulytau Mountains

The anatomical features have less variability and therefore belong to low or very low variability. The medium and high levels of variation are characterized by the dimensions of the conducting beam [12]. If we dwell on the anatomical indicators of *J. sabina*, which grows in arid conditions in the studied regions (Table 1), then in all regions the epidermis of *J. sabina* has a width of one size, and the size of the conductive bundles in the Karkaraly, Zhanaarka and Ulytau regions is 1.5- 1.7 μm , then the size of the conductive beams of the assembled object was 2.5 μm .

Table 1

Anatomical indicators of *Juniperus sabina* growing in dry conditions

Field of study	Average diameter of the receptacles, mm	Width of the epidermis, μm	Conductive bundle size, μm
Karkaraly Mountains	1.5 \pm 0.2	0.5 \pm 0.1	1.7 \pm 0.5
Zhanaarka district	1.8 \pm 0.6	0.6 \pm 0.5	1.5 \pm 0.6
Ulytau Mountains	1.5 \pm 0.4	0.5 \pm 0.3	1.7 \pm 0.5
City of Karaganda	1.9 \pm 0.8	0.5 \pm 0.2	2.5 \pm 0.9

J. sabina experiences large anthropogenic loads in urban conditions (Table 2). The results obtained above on the coefficients of variation of traits show that the Cossack juniper has a low level of variability of the anatomical features of the vegetative organs. According to the results, the calculated values of the Student's t-test are much higher than the tabular ones. The arithmetic mean values are quite reliable (Fig. 4).

Table 2

The values of the signs of the needles of *Juniperus sabina*

Parameters	Sign of leaves			
	Length, μm	Width, μm	Receptacle diameter, μm	Epidermis width, μm
Karkaraly Mountains				
Size of the attribute	5.32 \pm 0.75	3.8 \pm 0.41	1.5 \pm 0.05	0.52 \pm 0.02
The coefficient of variation, %	10.9	8.1	8.2	8.6
Average sampling error	0.26	0.14	0.05	0.02
Zhanaarka district				
Size of the attribute	5.54 \pm 0.61	4.08 \pm 0.18	1.82 \pm 0.02	0.54 \pm 0.01
The coefficient of variation, %	2.1	2.7	4.6	10.1
Average sampling error	0.05	0.05	0.04	0.02
Ulytau Mountains				
Size of the attribute	4.68 \pm 0.37	3.46 \pm 0.39	1.5 \pm 0.05	0.49 \pm 0.06
The coefficient of variation, %	10.8	27.7	12.5	4.6
Average sampling error	0.23	0.43	0.08	0.01
City of Karaganda				
Size of the attribute	5.1 \pm 0.11	3.82 \pm 0.63	1.76 \pm 0.04	0.52 \pm 0.03
The coefficient of variation, %	10.19	17.79	30.49	8.6
Average sampling error	0.23	0.3	0.24	0.02

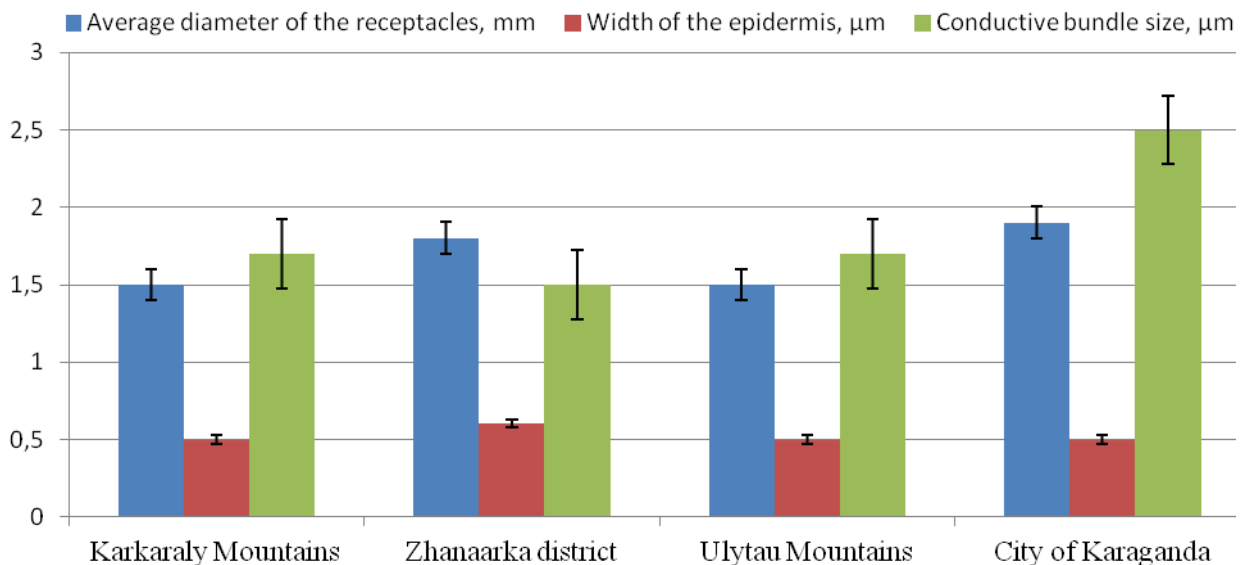


Figure 4. The thickness of the surface tissues of *Juniperus sabina* in natural populations

In the course of the research work, one can observe a good development of the hypodermis in the populations of *J. sabina* from Zhanaarka district, and in the populations from Ulytau and Karkaraly Mountains, the development of the hypodermis is not so great.

The epidermis of *J. sabina* of Ulytau Mountains is better developed than other regional objects. It gives coniferous plants a protective ability in the event of adverse conditions.

Conclusion

According to the results obtained, *J. sabina* experiences large anthropogenic loads in urban conditions. The anatomical parameters of the needles of *J. sabina*, which grows in different geographical regions (the city of Karaganda, Karkaraly, Zhanaarka and Ulytau regions), were also studied. The results obtained above on the coefficients of variation of traits show that *J. sabina* has a low level of variability of the anatomical features of the vegetative organs. According to the results, the calculated values of the Student's t-test are much higher than the tabular ones. According to the data obtained, the arithmetic mean values are quite reliable.

In the course of the research work of *J. sabina* in the populations of the Ulytau and Karkaraly regions, the development of the hypodermis is not so great, and in the populations of *J. sabina* of the Zhanaarka region, one can observe a good development of the hypodermis, cuticle and epidermis. This, in turn, reflects the adaptation of plants to the harsh growing conditions in such regions. All significant changes in the structure are associated with the natural and climatic conditions in which certain individuals grow.

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П.У. Абдикаримова, С.Н. Атикеева

Орталық Қазақстанда өсетін *Juniperus sabina* анатомиялық ерекшеліктері

Мақалада әр түрлі географиялық аймақтарда (Қарағанды қаласы, Қарқаралы, Жаңаарқа және Ұлытау ауданы) өсетін *Juniperus sabina* иелерінің анатомиялық параметрлері зерттелген. *Juniperus sabina*-ны зерттеу жұмысы барысында Ұлытау және Қарқаралы аудандарындағы популяцияларында гиподерманың дамуы соншалықты үлкен емес, ал Жаңаарқа ауданының *Juniperus sabina* популяцияларында гиподерманың, кутикуланың және эпидерманың жақсы дамығанын байқауға болады. Бұл өз кезегінде өсімдіктердің осындай аймақтардағы катал өсу жағдайларына бейімделуін көрсетеді. Сипаттамалық статистика орташа арифметикалық мәліметтермен, стандартты ауытқулармен, әр географиялық аймақтың, әр популяцияның мәліметтері бойынша вариация коэффициентімен ұсынылған.

Кілт сөздер: вариация коэффициенті, казак аршасы, анатомия, көлденең кима, өткізгіш сәуленің мөлшері, эпидермис, кутикула, гиподерма.

П.У. Абдикаримова, С.Н. Атикеева

Анатомические особенности *Juniperus sabina*, произрастающей в Центральном Казахстане

В статье изучены анатомические параметры хвои *Juniperus sabina*, произрастающей в разных географических регионах (город Караганда, Карқаралинский, Жаңаарқинский и Улытауский районы) на такие показатели, как средний диаметр места вместилища, ширина эпидермиса, размер проводящего пучка. Дана краткая характеристика исследуемого объекта. Были изучены следующие показатели хвойного растения: толщина эпидермиса, гиподерма и диаметр вместилищ; а также сделан поперечный срез и проведено исследование. Описательная статистика представлена средними арифметическими данными, стандартными отклонениями, коэффициентом вариации по данным каждого географического региона и популяции.

Ключевые слова: коэффициент вариации, можжевеловый казахский, анатомия, поперечный срез, размер проводящего пучка, эпидермис, кутикула, гиподерма.

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