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New distribution areas of some species (*O. altissima, O. michauxii* and *O. buhseana*) of sainfoin (*Onobrychis* Mill.) in the flora of Azerbaijan and their bioecological characteristics

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The paper describes 8 new distribution areas of 3 species (*O. altissima, O. michauxii,* and *O. buhseana*) of sainfoin, their bioecological and phytocenological characteristics. The new distribution areas cover the northern part of the Lesser Caucasus, Talysh, and Nakhchivan regions. The goal is to clarify the distribution areas of the sainfoin species in the flora of Azerbaijan and to distinguish for selection species more resistant to drought and frost. The article provides a new distribution map of the collected species of sainfoin, a table with environmental information and photos.

Keywords: *Sainfoin, population, bioecology, family, genus, species, areal*

INTRODUCTION

The study of the forage reserves in the hayfields and pastures of our republic, identification of their species composition, and the natural populations in terms of conservation of the ancestor crops is very important.

The species belonging to the leguminous (*Fabaceae*) family are of high significance. One of the most important forage genera mentioned in the family is sainfoin (*Onobrychis* Mill.). *Onobrychis* Mill. (Miller, 1754), tribe *Hedysareae* (Lock, 2005, Polhil, 1981) has 173 species in the world and 25 species (Asgarov, 2016) of them are widespread in Azerbaijan. Some of them are endemic to the Caucasus. A number of investigations of this genus were carried out (Sirjaev, 1925, Yildiz, 1999).

The species of *Onobrychis* Mill. can be used both forage crops and initial material for drought and cold-resistant, productive cultivated varieties growing (Khinthibidze, 1960). In Azerbaijan 3 species (*O. viciifolia, O.arenaria, O. transcausasica*) of *Onobrychis* are cultivated.

MATERIALS AND METHODS

During the expeditions, descriptor data, herbarium specimens and seed samples of plants were collected and a GPS device was used to record the coordinates. "Flora of Caucasus" (Grossheim, 1952), "Flora of Azerbaijan" (Tamamshyan, 1954), "The plant world of Azerbaijan" (Asgarov, 2016) were used as literary sources. The collected herbarium specimens were sent to the Herbarium Funds of the Genetic Resources Institute and the Institute of Botany of ANAS and seed samples were sent to the Genebank.

RESULTS AND DISCUSSION

During the expeditions conducted in 2013, 2018, 2019, and 2021, the employees of the Department of Ecobotany and Taxonomy of the Genetic Resources Institute of ANAS revealed the new distribution range of three species of sainfoin (*O.altissima*, *O.michauxii*, and *O.buhseana*) in Lerik, north part of Lesser Caucasus and Nakhchivan regions (Table 1, Fig.1).

***O. altissima* Grossh.** - High sainfoin. It belongs to the *Eubrychis* section. Typus: Prov. Tiflis, distr. Gori. Окр. Баржоми спуск к р. Кура et с. Гамма. Leg: W. Kozlowsky, 1923, (TBI).

O. altissima is very close to the cultivated *O. viciifolia* Scop. species and may have its wild ancestor. In 1954, Tamamshyan studied the genus *Onobrychis* Mill. of the Flora of Azerbaijan and

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recorded that the species of *O. altissima* is close to *O. inermis* and distinguished only by the distribution area (Tamamshyan, 1954). Also in our opinion, *O. altissima* is very close to *O. inermis*. But they differ from each other in the length of the standard (in *O.inermis*standard shorter than keel).

O. altissima reaches the height of 90 cm, the stems are straight, almost rounded at apex, lower leaves long-petioled, with 6-8 pairs of oblong-oval or elliptic leaflets 12-30 mm long and 5-7 mm wide, the corolla is 10-11 mm long, the size of standard equals the keel. Pods are 5-7 mm long, 1.5-2 mm wide, crest, no prickles. Inflorescence occurs in June-July and fruit ripening in July-August. It is found in meadows, in shrubs, on rocky and sloping areas of the middle and subalpine zone.

According to literature data, *O. altissima* was found in Armenia (Tamamshyan, 1954), Turkey (Hedge, 1970), Iran (Ranjbar, 2010), and the Diabars (Talysh) region of Azerbaijan. Herbarium (BAK) material was collected in 2015 by Gasymova Sh. from the village of Avakhil in the Shamakhi district. As a result of our research, this species was collected in 2013 from 3 biologically rich regions of the Lesser Caucasus - the village of Yeni Zod of the Goy-Gol district, the village of Zakhmatkand of the Gadabay district, and Yasamal pass of the Shamkir district.

Table 1. New distribution areas of *O. altissima, O. Michauxii,* and *O. buhseana*

Pop-on №	Collection area	Coordinate	Collection date and route
***O. altissima* Grossh.**			
1	Goy-Gol district, Yeni Zod village	N40°28'898" E046°20'808"	V_{1-1} 29.06.2013
2	Nakhchivan MR, Shahbuz district, Bichanak village, Batabat pasture, Goshagoz Bridge	N39°53'524" E45°79'866"	NVSh-4 01.07.2021
3	Shamkir district, on the side of the Yasamal road	N40°48'225" E045°57'760"	Y_{1-3} 27.06.2013
4	Gadabay district, Zakhmatkand village	N40°41'821" E045°49'940"	G_{1-2} 27.06.2013
***O. michauxii* DC.**			
5	Lerik district, Hoveri village	N38°41'334" E48°23'588"	ST_1 18.06.2019
6	Lerik district, Galasar village, Syxabin sanctuary	N38°41'485" E48°23'905"	ST_4 19.06. 2019
7	Lerik district, Galasar village, Syxabin sanctuary	N38°41'485" E48°23'905"	Z_6 05.07.2018
***O. buhseana* Bunge ex Boiss.**			
8	Lerik district, Nimakesh village	N38°39'549" E48°22'095"	ST2 18.06.2019

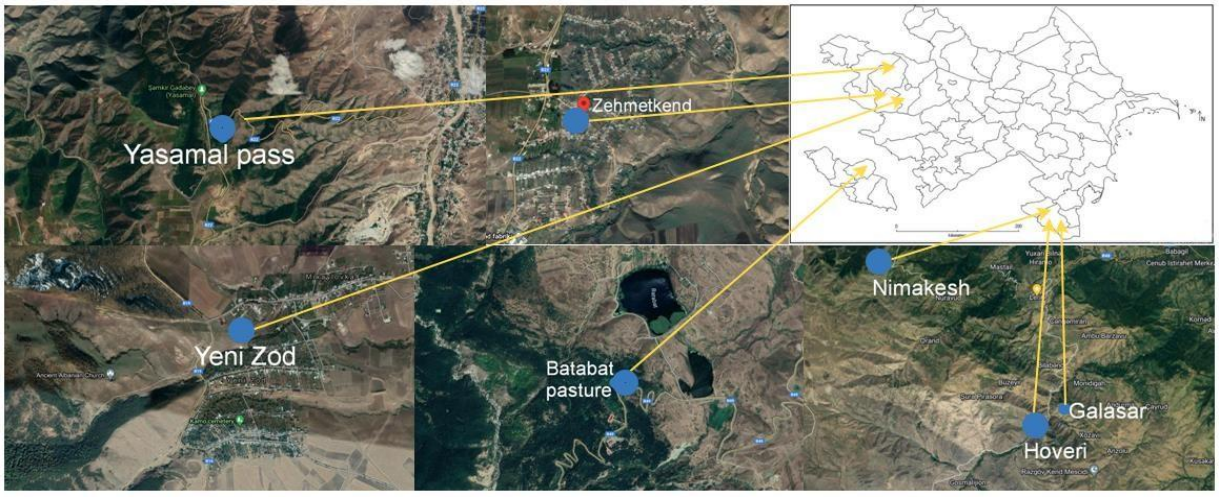

Fig. 1. Distribution map of *O. altissima, O. michauxii* and *O.buhseana.*

a **b**

Fig. 2. General view (a) and populationview (b) of *O. altissima*.

Although, 16 of 25 species of the genus *Onobrichis* Mill. are spread in the territory of Nakhchivan, which differs from other physical and geographical regions of Azerbaijan in its heavy continental climate, species *O. altissima* was not found in these territories till now. It was revealed around the Batabat pasture of the village of Bichanakin Nakhchivan in 2021 (Fig.2a, 2b).

***O. michauxii* DC.** – Misho sainfoin. Belongs to the *Hymenobrychis* section, it was described from Iran. Its type is located in Paris.

The roots of *O. michauxii* are polysepalous and quite thick. The long stem consists of 7-10 pairs of leaflets. Pods are small, 10-12 mm wide, densely long-villous-tomentose with short prickles concealed by pubescence. Inflorescence occurs in May-June and fruit ripens in June-July. It is found in dry slopes, rocks, rocky, sloping areas, and shrubs in the low and moderate-high belts.

According to the literary data, the species of *O. michauxii*are found in Iran (Ranjbar, 2012), Armenia (Tamamshyan, 1962), the Lesser Caucasus and the Nakhchivan (Tamamshyan, 1954) region of Azerbaijan. Herbarium data (BAK) was collected in 1936 in the Goychay district, in 1937 in the village of Maraza of the Shamakhi district and in 2018 and 2019 in the territory of the village of Hoveri and Galasar of Lerik district as well (Fig.3).

***O. buhseana*Bunge ex Boiss.** – Buze sainfoin. Refers to the section *Heliobrychis*, described from Tabriz. Type is in Paris.

Leaves (2) have 3-4 pairs of leaflets. The standard is rounded at the apex, keel, and wings are glabrous. Pods 6-8 mm wide, semiglobular, surface and margin covered with hair-like bristles. Inflorescence and fruit ripening occur in May-June. It is found in dry rocky, sloping slopes and deposits of lime in the low and moderate-high belts (Fig. 4).

Fig. 3. General view of *O. michauxii*

Fig. 4. General view of *O. buhseana*.

Table 2. Some environmental variables of *O. altissima, O. michauxii, O. buhseana*

Ecogeographical factors	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Altitude (m)	1206	2209	941	1433	1281	1360	1360	1590
Slope inclination	3%	8%	30%	30%	16%	30%	30%	30%
Slope orientation	W	SE	W	E	SE	S	S	W
Max. temp., °C	17.4	19.1	11.4	15.9	15.4	15.4	15.4	15.4
Min. temp., °C	9.83	7.2	3.56	4.3	4.6	4.6	4.6	4.6
Annualprecipitation(mm)	93.82	267	134.07	293	429	429	429	429
Biotope	reserve, roadside	roadside, meadow	roadside, forest stripe or forest side	roadside, meadow	rocky place	roadside,shrubbyplace	roadside,shrubbyplace	stony-gravelly slope
Collectionsite	100-1000 m^2	10-100 m^2	10-100 m^2	>1000 m^2	10-100 m^2	100-1000 m^2	100-1000 m^2	>1000 m^2
Relief	plain	hill	verticalslope	verti-calslope	foothill	verti-calslope	verti-calslope	verti-calslope
The mechanical composition of the soil	clay soil	mixed	stony-gravelly	mixed	stony-gravelly	sandy	sandy	stony-gravelly
Degreeofpasture	no	no	no	slightly	slightly	no	no	strong
Soilerosion	no	no	no	no	no	no	no	yes
Quantityratio	abundant enough (40-100)	scattered (100-150 sm)	scattered (100-150 sm)	scattered (100-150 sm)	scattered (100-150 sm)	abundant (20-40 sm)	abundant (20-40 sm)	scattered (100-150 sm)

In Azerbaijan, its distribution range is not large. According to the literary data, *O. buhseana* is found in Nakhchivan (Tamamshyan, 1954), Armenia (Tamamshyan, 1962), and Iran (Ranjbar, 2012). Herbarium specimens *O. buhseana* were not found. Herbarium specimens were collected from the village of Nimakesh in the Lerik district in 2019 (Figure 3).

Some environmental features of *O.altissima, O. Michauxii,* and *O. buhseana*: bioecological assessment of the ecological condition of wild sainfoins was conducted. For this purpose, environmental observations reflecting general information were carried out. The table of the data like altitude, sides, annual maximum and minimum temperature, annual precipitation, biotope, collection site, relief, the mechanical composition of the soil, degree of pasture, soil erosion, quantity ratio (Drude's scale) were prepared to analyze the environmental features (Table 2).

As can be seen from the table, *O. altissima*is found in Shamkir district (lowest alt. 941 m, min. tem. 3.56°C) and Nakhchivan AR (max.altitude 2209 m, max. tem. 19.1°C) where the least altitude and temperature difference was observed. Thus, the distribution range of this species is not only in the moderate-high belts but also in all high belts.

Although the low mountain belt forests are more exposed to anthropogenic influences, the spread of this species across all mountain belts allows it to expand its range. In addition, *O. altissima* is an arid and cold-tolerant crop and is found in areas with different environmental conditions. It is more resistant to climatic factors of the environment. Thus, species of *O. altissima* have a special agricultural significance and their involvement in breeding is advisable. *O. michauxii* and *O. buhseana* are found on stone-gravelly, sandy, not grazed, and non-eroded soils, mainly in steep slope areas.

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Azərbaycan florasında bəzi xaşa növlərinin (*O. altıssıma, O. mıchauxıı* and *O. buhseana*) yeni yayılma sahələri və onların bioekoloji xüsusiyyətləri

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Məqalədə 3 xaşa növünün 8 yeni yayılma sahələri aşkar edilmiş, onların bioekoloji və fitosenoloji xüsusiyyətləri öyrənilmişdir. Yeni yayılma sahələri Kiçik Qafqazın şimal hissəsini, Talış və Naxçıvan bölgələrini əhatə edir. Məqsəd Azərbaycan florasında xaşa cinsi növlərinin yayılma areallarının dəqiqləşdirilməsi və seleksiya üçün quraqlığa, şaxtaya daha davamlı növlərin aşkar edilməsidir. Məqalədə toplanılan xaşa növlərinin yeni yayılma sahələrinə aid xəritə, ekoloji məlumatları əks etdirən cədvəl və foto şəkillər verilmişdir.

***Açar sözlər**: Xaşa, populyasiya, bioekologiya, fəsilə, cins, növ, areal*

Новые ареалы распространения некоторых видов эспарцета *(O. altıssıma, O. mıchauxıı И O. buhseana)* во флоре Азербайджанаи их биологические особенности

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Выявлено 8 новых ареалов 3-х видов эспарцета, изучены их биоэкологические и фитоценологические особенности. Новые ареалы распространения охватывают северную часть Малого Кавказа, Талышскую и Нахичеванскую области. Цель исследования заключалась в уточнении ареалов распространения эспарцета во флоре Азербайджана и выявлении видов, более устойчивых к засухе и морозам, для вовлечения их в селекционные работы. В статье представлены карта ареалов новых видов эспарцета, таблица, отражающая экологическую информацию, и фотографии.

***Ключевые слова**: Эспарцет, популяция, биоэкология, семейство, род, вид, ареал*