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FLOWERING AND PRODUCTIVITY OF *BERBERIS* L. SPECIES INTRODUCED TO THE ABSHERON PENINSULA

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*To expand international cooperation in the field of biodiversity conservation, the Republic of Azerbaijan acceded to the UN Convention on Biological Diversity in 2000. The National Strategy and Action Plan for the implementation of the “National Strategy for the Protection and Sustainable Use of Biological Diversity in the Republic of Azerbaijan for 2017-2020” are aimed at implementing effective measures in this area and achieving concrete results. For this purpose, the bioecology of *Berberis* L. species was studied to regulate the ecological balance. The main purpose of the research is to learn the biological characteristics of flowering and fruiting of barberry species. In the dry subtropical climate of Absheron, the age of the species barberry first flowering, the biological characteristics and duration of flowering, the shape and length of the inflorescence, the number of flowers in an inflorescence, the shape, color, size of the fruit, etc. morphological features were investigated.*

The study of fruit and seed productivity in barberry species with food, medicinal and decorative properties is of theoretical and practical importance [1, p. 196-222].

Keywords: *inflorescence, cluster, fertilization, productivity.*

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INTRODUCTION

Global warming, declining biodiversity, and food shortages are major concerns for the whole world. Plants play an important role in solving these problems. The species belonging to the genus *Berberis* L. have been selected as the object of study due to their great industrial and practical importance.

Many researchers have studied the biological characteristics of flowering and fruiting. According to these authors, the beginning of the flowering and fruiting phase of plants is a transition moment in their lives [2, p. 3-170], [5, p. 39-44], [6, p. 64]. Studies on the biological characteristics of flowering and fruiting in the species of barberry grown in Absheron conditions and used as a research object will be important in mastering the biological characteristics of plants. Because there is very little literature information about the flowering and fruiting characteristics of these plants in Absheron conditions. Taking into account the importance of the mentioned biological characteristics, the age of the first flowering, the biological characteristics and duration of flowering, the shape and length of the inflorescence, the number of flowers in one inflorescence, the shape, color, size of the fruit, etc. morphological signs were investigated.

MATERIAL AND METHODS

Nine species of the *Berberis* L. genus belong to the *Berberidaceae* Juss. the family was used as the study objects: *Berberis vulgaris* L. L. (Common barberry), *Berberis iberica* Stev & Fisch. Ex DC. (Georgian barberry), *B. densifolia* Rusby. (Densifolia barberry), *B. amurensis* Rupr. (Amur Barberry), *B. levis* L. (Levis barberry), *B. thunbergii* DC. (Japanese barberry), *B. juliana* C.K.Schneid



(Chinese barberry), *B.koreana* Palib. (Korean barberry), *B.heteropoda* Schrenk.(Hetrepoda barberry).

Grain yield during the study was calculated according to the method of I.V. Vaynaqy [3, c.826-830]. Morphological traits of fruits and seeds were studied by the method of I.A. Ivanov and N.M. Dudik [4, c. 43-54]. Mathematical calculations on the size of barberry fruits and seeds were performed on a personal computer using Microsoft Excel [5, p. 12-14].

RESULTS AND DISCUSSION

The first flowering age of barberry species in Absheron conditions is given in Table 1. As is well known, species of barberry begin to bloom in the 5th year. The flower group is formed at the end of the branches of the current year. Young twigs grow strongly, grow to a length of 15-30 cm, and a cluster of flowers is formed on them.

During the research, the morphological features of flowers and flower clusters in species of barberry were studied. The results of the study are given in Table 1.

Flower clusters of different shapes were observed on the species we studied: sparse, simple cluster (*Berberis vulgaris*, *B.amurensis*), sparse, swinging cluster (*B.iberica*, *B.koreana*), dense, swinging cluster (*B.densifolia*), cluster adjacent to the leaf axils (*B.levis*, *B.julianae*), rare or sparse clusters (*B.thunbergii*), pile cluster with different stalks (*B.heteropoda*) (Figure 1). The length of the flower cluster varies from 3 to 10 cm depending on the species. Thus, the longest cluster of flowers is *Berberis heteropoda* Schrenk. (4-10 cm), the shortest cluster is *B.iberica* Stev & Fisch. Ex DC. (3-6 cm). *Berberis levis* Franch. and *B.julianae* C.K.Schneid flowers bloom in a ball from 1 point on the leaf axil. This type of flower group has not been recorded in other barberry species we have studied. In other species, the length of the inflorescence varies from 4 to 9 cm. In a cluster of flowers, the flowers are arranged in a ball and individually. The number of flowers in a cluster is the highest in *Berberis densifolia* Rusby (13-20) and the lowest in *B. koreana* Palib (8-10). The length of the flower stalk is different in the cluster.

The longest flower stalk is *Berberis heteropoda* Schrenk. (0.5-1.5 cm), the shortest flower stalk is *B. koreana* Palib. (0.5-0.7 cm). The diameter of the flower crown varies from 0.5 to 1.5 cm, the length of the petals from 0.4 to 0.9 cm, and the width from 0.2 to 0.6 cm. The stamens are 6, 0.2-0.5 cm long. The ovary consists of 1-4 ovaries.

The color and shape, size, and weight of the fruit of species of *Berberis* L. are of particular importance. Observations and calculations were made in this direction and the results obtained are given in Table 2.

As can be seen from the table, the color of the fruit varies from crimson to purple or bright black (Figure 2). *Berberis densifolia* Rusby. species are red, *B. vulgaris* L. and *B. iberica* Stev & Fisch. ex DC. in species are scarlet. *B. julianae* C.K. Schneid and *B. heteropoda* Schrenk fruits change color from purple to black. *B. amurensis* Rupr. and *B. levis* L. the shape of the fruit is similar and elliptical.

As can be seen from the table, the morphological characteristics of the fruit differ from the biometric indicators of the species we studied. The length of the fruit varies from 0.5 to 1.2 cm depending on the species. The fruits are divided into 3 groups according to size and weight:

Group I: large fruits - *Berberis vulgaris* L., *B. thunbergii* DC., *B. amurensis* Rupr. and *B. densifolia* Rusby. types;

Group II: medium-sized fruits - *Berberis julianae* C.K.Schneid, *B. iberica* Stev & Fisch. Ex DC., *B.heteropoda* Schrenk. and *B. koreana* Palib species;

Group III: small fruits *Berberis levis* Franch. kind of.

The weight of 100 fruits of barberry species varies from 6.5 grams (*Berberis iberica* Stev & Fisch. Ex DC.) to 10.0 grams (*B. thunbergii* DC.).



The study found that a certain percentage of the flowers in the flower clusters of each species are pollinated and bear fruit as a result of the fertilization process. Thus, this indicator is *B. vulgaris* L., *B. densifolia* Rusby. 77-80% in *B. julianae* C.K. Schneid species, *B. iberica* Stev &

Table 1.

Morphological features of flowers and flower clusters of *Berberis* L. Species

Species	A cluster of flowers			Flower				
	Types	Lenght, cm	Number of flowers, pcs	The length of the flower stalk, cm	Diameter, cm	The length of the petal, cm	The width of the petal, mm	The length of the stamen, mm
<i>Berberis vulgaris</i> L.	sparse, simple cluster	6-9	12-18	0,8-1,2	0,8-1,0	0,5-0,7	0,4-0,5	0,3-0,4
<i>B. iberica</i> Stev & Fisch. Ex DC	sparse, swinging cluster	3-6	8-12	0,6-0,8	0,8-1,0	0,5-0,6	0,4-0,5	0,2-0,3
<i>B.densifolia</i> Rusby	dense, swinging cluster	6-8	13-20	0,5-1,0	0,8-1,2	0,5-0,7	0,4-0,5	0,3-0,4
<i>B.amurensis</i> Rupr.	sparse, simple cluster	6-8	10-15	0,8-1,2	1,0-1,1	0,5-0,8	0,4-0,5	0,3-0,5
<i>B. levis</i> Franch.	cluster adjacent to the leaf axils	-	13-17	0,8-1,0	0,9-1,0	0,6-0,9	0,4-0,6	0,3-0,5
<i>B.thunbergii</i> DC.	rare or sparse clusters	5-8	8-12	1,0-1,2	1,0-1,2	0,4-0,7	0,4-0,6	0,2-0,3
<i>B.julianae</i> C.K. Schneid	cluster adjacent to the leaf axils	-	14-18	0,7-0,8	0,8-1,0	0,5-0,8	0,4-0,6	0,3-0,5
<i>B. koreana</i> Palib.	sparse, swinging cluster	4-6	8-10	0,5-0,7	0,9-1,0	0,4-0,5	0,3-0,4	0,3-0,5
<i>B.heteropoda</i> Schrenk.	pile cluster with different stalks	4-10	15-18	0,5-1,5	0,8-1,0	0,4-0,6	0,2-0,4	0,2-0,4



1.



2.



3.



4.

Fig. 1. Appearance of flowers of 1-*Berberis thunbergii* DC., 2-*B.amurensis* Rupr., 3-*B. julianae* C.K.Schneid, 4-*B.vulgaris* L.



1.



2.



3.

4.

Fig. 2. The fruits of the species of 1- *Berberis julianae* C.K. Schneid, 2- *B. heteropoda* Schrenk, 3- *B. densifolia* Rusby., 4- *B. vulgaris* L.

Fisch. Ex DC., *B.thunbergii* DC. and *B. heteropoda* Schrenk. 64-70% of species, *B. koreana* Palib., *B. amurensis* Rupr. and *B. levis* Franch. species was 55-63%. 1-2 seeds were found in 60-72% of fruits of the studied species, and 3 seeds were found in 28-40% (per 100 fruits).

The number of seeds in a fruit depends directly on the size of the fruit, as the number of seeds in large fruits is greater than in small fruits [Figure 3]. The ripening period of fruits is not the same as in the flowering stage of barberry species. However, this biological process does not prevent the fruits from being harvested at the same time, and the ripe fruits remain in the bush for a long time. Fruits remain on the plant until the end of December.

When studying the seed productivity of the species we studied, was evaluated with 2-3 points, referring to the 3-point scale adopted by V.G. Kapper for shrubs [7, p. 12-14].

Thus, no species corresponding to the low-yielding (1-point) group were observed [Table 3]. The species of barberry we studied were divided into the following groups according to the methodology for seed yield:

1. 2 points - average productive species - *Berberis levis* and *B. heteropoda*. The productivity of these species is estimated to be 30-40%. Fruit clusters on the plant are sparse.

2. 3 points - good productive species- *Berberis vulgaris* L., *B. thunbergii* DC., *B.amurensis* Rupr., *B.densifolia* Rusby, *B. julianae* C.K. Schneid, *B. iberica* Stev & Fisch. Ex DC., *B. koreana* Palib. In these species, fruit clusters cover 60-80% of the plant. The fruit covers more than half of the shrub.

The productivity of the studied species was determined by the "average model tree" method per plant per unit mass. For this purpose, the selected mass of 5 medium-sized bunches of fruits of each species was calculated (from 6-year-old plants). Based on the productivity of the model tree, the mass of fruit collected from a single branch and a corresponding plant in the studied species was calculated. The number of branches for each species, the weight of the fruit, and the number of branches in the bush were calculated for the area of 1m² cultivated under favorable conditions and the productivity of 1 bush was determined (Table 4).

Table 2.Comparative study of fruits in *Berberis L.* species

Species	Fruit			100 fruit mass (average), g	100 seed mass (average), g
	color	shape	Length, cm		
<i>Berberis vulgaris</i> L.	scarlet	Oblong	0,8-1,1	8,5	2,55
<i>B. iberica</i> Stev & Fisch. Ex DC	scarlet	oblong cylindrical	0,7-1,0	6,5	2,0
<i>B. densifolia</i> Rusby	red	ovoid or oblong	0,8-0,9	7,5	2,25
<i>B. amurensis</i> Rupr.	bright red	Elliptical	0,9-1,1	8,5	2,55
<i>B. levis</i> Franch.	violet	Elliptical	0,5-0,7	7,5	2,25
<i>B. thunbergii</i> DC.	Dark red	Longish	0,9-1,2	10,0	3,0
<i>B. julianae</i> C.K. Schneid	bluish black	Ovarid	0,7-0,9	8,5	2,55
<i>B. koreana</i> Palib.	bright red	oblong-ovoid	0,8-1,0	7,5	2,25
<i>B. heteropoda</i> Schrenk.	bluish or bright black	Spherical	0,8-1,0	7,5	2,25

Table 3.Productivity of *Berberis L.* species

№	Species	Productivity (points)		
		1	2	3
1.	<i>Berberis vulgaris</i> L.			+
2.	<i>B. iberica</i> Stev & Fisch. Ex DC.			+
3.	<i>B. densifolia</i> Rusby.			+
4.	<i>B. amurensis</i> Rupr.			+
5.	<i>B. levis</i> Franch.		+	
6.	<i>B. thunbergii</i> DC.			+
7.	<i>B. julianae</i> C.K. Schneid			+
8.	<i>B. koreana</i> Palib.			+
9.	<i>B. heteropoda</i> Schrenk.		+	



Table 4.

Productivity of 1 bush of barberry species (in 6-year period)

№	Species	Number of branches	Weight of fruit (in grams)	Quantity of fruit on 1 branch, (in numbers)	Productivity of 1 shrub (in grams)
1.	<i>Berberis vulgaris</i> L.	40	0,085	60	204
2.	<i>B. iberica</i> Stev & Fisch. Ex DC.	39	0,065	58	147
3.	<i>B. densifolia</i> Rusby.	39	0,075	62	181
4.	<i>B. amurensis</i> Rupr.	37	0,085	54	170
5.	<i>B. levis</i> Franch.	35	0,075	50	131
6.	<i>B. thunbergii</i> DC.	40	0,1	60	240
7.	<i>B. julianae</i> C.K.Schneid	32	0,085	60	163
8.	<i>B. koreana</i> Palib.	36	0,075	56	151
9.	<i>B. heteropoda</i> Schrenk.	32	0,075	50	120

In 6-year-old barberry species, the average fruit yield per shrub was 120-240 grams of middle-aged *B. vulgaris* L., *B. thunbergii* DC., and *B. densifolia* Rusby. It is possible to collect up to 1 kg of fruit from the bushes. In barberry species, the fruits are formed on last year's branches. Young branches give a growth of 15-30 cm in height, depending on the species, and the next year fruits are formed on it.

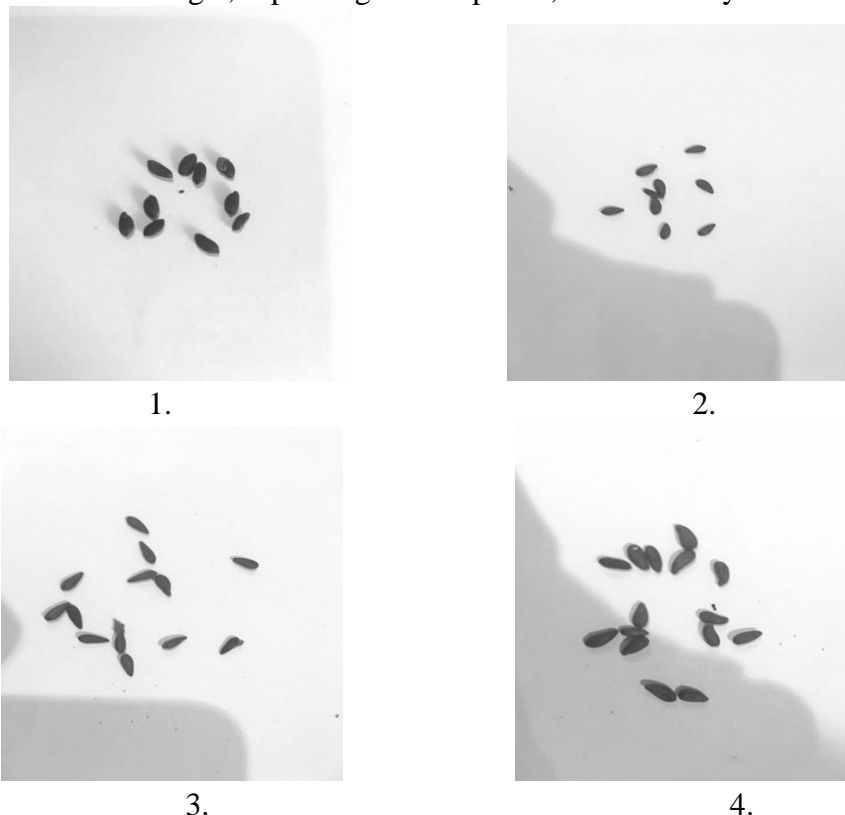


Fig. 3. The seeds of the species of 1- *Berberis julianae* C.K. Schneid, 2- *B. koreana* Palib., 3- *B. amurensis* Rupr., 4- *B. densifolia* Rusby



CONCLUSION

Flower clusters of different shapes were observed on the species we studied: sparse, simple cluster (*Berberis vulgaris* L., *B.amurensis* Rupr.), sparse, swinging cluster (*Berberis iberica* Stev & Fisch. Ex DC., *B.koreana* Palib.), dense, swinging cluster (*B.densifolia* Rusby.), cluster adjacent to the leaf axils (*B.levis* L., *B.julianae* C.K.Schneid), rare or sparse clusters (*B.thunbergii* DC.), pile cluster with different stalks (*B.heteropoda* Schrenk.). Seed productivity of the studied species received 2-3 points on a 3-point scale of V.G. Kapper for shrubs. Thus, no species corresponding to the low-yielding (1-point) group were observed. 2 points - average productive species - *Berberis levis* and *B. heteropoda*. The productivity of these species is estimated to be 30-40%. Fruit clusters on the plant are sparse. 3 points - good productive species- *Berberis vulgaris* L., *B. thunbergii* DC., *B.amurensis* Rupr., *B.densifolia* Rusby, *B. julianae* C.K. Schneid, *B. iberica* Stev & Fisch. Ex DC., *B. koreana* Palib. In these species, fruit clusters cover 60-80% of the plant. The productivity of 1 bush was studied on the studied species. In 6-year-old barberry species, the average seed yield per tree was 120-240 grams. From the middle age bushes of *B. vulgaris* L., *B. thunbergii* DC., *B. densifolia* Rusby. up to 1 kg of fruits can be harvested. The seed mass was 30% of the total fruit mass (average). Seed mass varied from 6.5 g to 10.0 g for the species studied. The mass of 100 seeds was higher in *Berberis thunbergii* DC. and less in *Berberis iberica* Stev & Fisch. Ex DC. The number of fruits containing 1-2 seeds was higher than those containing 2-3 seeds. Thus, the number of seeds in large fruits exceeds the number of seeds in small fruits.

REFERENCES

1. Мәммədov, Т.С. Azərbaycan dendroflorası: [3 cilddə] / Т.С.Мәммədov. – Bakı: Səda nəşr, - с. 2. – 2015. – 26 s.
2. Арифханов, К.Т. Виды рода *Berberis* L., интродуцированных Ботаническим садом АН УзССР / К.Т. Арифханов, Т.И. Славкина – Ташкент: – 1981. – 167 с.
3. Вайнагий, И.В. О методике изучения семенной продуктивности // – Санкт-Петербург: Ботанический журнал, – 1974, 59 (6), – с. 826-830.
4. Иванова, И.А. К методике описания морфологических признаков семян. Составление определений растений по плодам и семенам / И.А. Иванова, Н.М. Дудик – Киев: Наукова думка, – 1974. – 11 с.
5. Куклина, А.Г. Барбарисы / А.Г.Куклина. – Москва.: Изд. Дом МСП, – 2009. – 5 с.
6. Куклина А.Г. Красивоплодные кустарники (барбарис, магония, снежногородник, бересклет) / А.Г.Куклина. – Москва: Изд. Дом МСП, – 2010. – 64 с.
7. Каппер, В.Г. Шкала глазомерной оценки цветения и плодоношения взрослого дерева и кустарника. Лесные культуры / В.Г.Каппер, Г.И.Редько, А.Р.Родин [и.др.] // Агропромиздат, – Москва: – 1985. – с. 12-14.



ABŞERON YARIMADASINA İNTRODUKSIYA OLUNMUŞ *BERBERIS L.* NÖVLƏRİNDƏ ÇİÇƏKLƏMƏ VƏ MƏHSULDARLIQ

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Biomüxtəlifliyin qorunması sahəsində beynəlxalq əməkdaşlığı genişləndirmək üçün Azərbaycan Respublikası 2000-ci ildə BMT-nin Bioloji Müxtəliflik Konvensiyasına qoşulmuşdur. "Azərbaycan Respublikasında bioloji müxtəlifliyin mühafizəsi və davamlı istifadəsinə dair 2017-2020-ci illər üçün Milli Strategiya"nın icrasına dair Milli Strategiya və Fəaliyyət Planı bu sahədə səmərəli tədbirlərin həyata keçirilməsinə və konkret nəticələrin əldə olunmasına yönəlib. Bu məqsədlə ekoloji tarazlığı tənzimləmək üçün *Berberis L.* növlərinin bioekologiyası tədqiq edilmişdir. Abşeron şəraitində becərilən və tədqiqat obyektinə kimi istifadə olunan zirinc növlərində çiçəkləmə və meyvəvermənin bioloji xüsusiyyətlərinə dair tədqiqatların bitkilərin bioloji xüsusiyyətlərinin mənimsənilməsində əhəmiyyət kəsb edəcək. Çünki bu bitkilərin Abşeron şəraitində çiçəkləmə və meyvəvermə xüsusiyyətlərinə dair ədəbiyyat məlumatı çox azdır. Qeyd edilən bioloji xüsusiyyətlərin əhəmiyyətini nəzərə alaraq, quru subtropik iqlimə malik Abşeron şəraitində tədqiq etdiyimiz zirinc növlərində ilk çiçəkləmə yaşı, çiçəkləmənin bioloji xüsusiyyəti və davam etmə müddəti, çiçək salxımının forması, uzunluğu, bir çiçək salxımındakı çiçəklərin sayı, meyvənin forması, rəngi, ölçüləri və s. morfoloji əlamətlər araşdırılmışdır. Qida, dərman və dekorativ xüsusiyyətlərə malik olan zirinc növlərində meyvə və toxum məhsuldarlığının öyrənilməsi nəzəri və praktiki əhəmiyyətə malikdir.

Açar sözlər: *çiçəklənmə, salxım, mayalanma, məhsuldarlıq*

ЦВЕТЕНИЕ И ПРОДУКТИВНОСТЬ ВИДОВ *BERBERIS L.*, ИНТРОДИЗИРОВАННЫХ НА АБШЕРОНСКИЙ ПОЛУОСТРОВ

Э.Х. Салахова

Для расширения международного сотрудничества в области сохранения биоразнообразия Азербайджанская Республика присоединилась к Конвенции ООН о биологическом разнообразии в 2000 году. Национальная стратегия и план действий по реализации «Национальной стратегии охраны и устойчивого использования биологического разнообразия в Азербайджанской Республики на 2017-2020 годы» нацелены на реализацию действенных мер в этой сфере и достижение конкретных результатов. С этой целью была изучена биоэкология видов *Berberis L.* для регулирования экологического баланса. Основной целью исследований является изучение биологических особенностей цветения и плодоношения видов барбариса. В условиях сухого субтропического климата Абшерона возраст первого цветения вида барбариса, биологические особенности и продолжительность цветения, форма и длина соцветия, количество цветков в соцветии, форма, окраска, величина плодов, и др. были исследованы морфологические признаки. Изучение плодово-семенной продуктивности у видов барбариса с пищевыми, лечебными и декоративными свойствами имеет теоретическое и практическое значение.

Ключевые слова: *соцветие, гроздь, оплодотворение, продуктивность*