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## INTRODUCTION OF *Bixa orellana* L. IN APSHERON CONDITIONS

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## ИНТРОДУКЦИЯ *Bixa orellana* L. В УСЛОВИЯХ АПШЕРОНА

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*Abstract.* The article, for the first time at the Institute of Dendrology of Azerbaijan NAS, presents information on the introduction, reproduction and bioecological characteristics of the species *Bixa orellana* L. in the conditions of Absheron. Seeds of *Bixa orellana* L. were obtained by exchange from the Central Botanical Garden of Padua, Italy. For the first time, the biological characteristics of *Bixa orellana* L. were studied in Absheron conditions, the morphological characteristics of its shoots, the growth dynamics of 1-2-year-old seedlings, the root system, and nutritional value. The plant is propagated by seeds and cuttings. Soil sowing (06.10.2021) was carried out in the first ten days of June. The first shoots were observed on 06.23.2021, mass shoots were observed on 06.30.2021. Germination was 80%, sprout survival rate was 60%. When propagating by cuttings, young shoots 8-10 cm high are selected and planted in fertile soil or wet sand. After 7-9 weeks they produce a lot of roots. After this, they can be moved to the field. In 1-2-year-old plant seedlings, the above-ground part (39-80 cm) develops better than the underground part (14-26.5 cm). The growth of *Bixa orellana* L. is divided into 2 periods; intensive height growth in the first period lasts from the second ten days of May to the end of June, the second - from the end of August to the third ten days of October. The annual growth was 20-25 cm. The growing season ranges from 280±5 days. This species is tolerant to the climatic conditions of Absheron.

*Аннотация.* Впервые в Институте дендрологии НАН Азербайджана представлены сведения об интродукции, размножении и биоэкологических особенностях вида *Bixa orellana* L. в условиях Апшерона. Семена *Bixa orellana* L. были получены в результате обмена из Центрального ботанического сада Падуи, Италия. Впервые изучены биологические особенности *Bixa orellana* L. в условиях Апшерона, морфологические особенности ее побегов, динамика роста 1-2-летних сеянцев, корневая система и пищевая ценность. Растение размножают семенами и черенками. Посев почвы (10.06.2021) проводился в первой декаде июня. Первые всходы наблюдались 23.06.2021, массовые всходы наблюдались 30.06.2021. Всхожесть составила 80%, приживаемость ростков 60%. При размножении черенками отбирают молодые побеги высотой 8-10 см и высаживают в плодородную почву или влажный песок. Через 7-9 недель они дают много корней. После этого их можно будет перемещать на поле. У 1-2-летних сеянцев растений надземная часть (39-80 см) развивается лучше, чем подземная (14-26,5 см). В росте *Bixa orellana* L. выделяют 2 периода; интенсивный рост высоты в первый период продолжается со второй декады мая до конца июня, второй — с конца августа до третьей декады октября. Годовой прирост составлял 20-

25 см. Вегетационный период колеблется в пределах  $280 \pm 5$  дней. Этот вид толерантен к климатическим условиям Апшерона.

*Keywords:* introduction, bioecological characteristics, reproduction, morphology, growth and development, significance.

*Ключевые слова:* интродукция, биоэкологические характеристики, размножение, морфология, рост и развитие, значение.

Bixaceae family, genus *Bixa* L., species *Bixa orellana* L. is a shrub or small tree native to tropical regions of America. It was introduced by the Spaniards in the 17th century and is also cultivated in Southeast Asia. The plant is an evergreen, ornamental plant known for the red pigment contained in the seeds and is widely used as a food coloring as an alternative to similar synthetic products. The dye is extracted from the seeds and used in powder or paste form. All parts of the plant contain a coloring pigment, the fleshy seed coat is especially rich in it, which is the source of the red-orange color. Its main component is red dye.

The seeds of *Bixa orellana* L. have been used as a natural colorant in many traditional Asian dishes. The seeds of the plant take the second place in the world in economic importance among natural dyes, and its extract has antimicrobial and antioxidant properties. The plant is popularly known as "Lipstick tree"[11]. The seeds of the plant are widely used in cosmetology. The pigment color of the outer layer of seeds of *Bixa orellana* L. varies from yellow to red and depends on the concentration of coloring compounds. The main coloring pigments of seeds are bixin and nor-bixin extracted from the outer shell of seeds. All parts of the plant contain a coloring pigment, especially the fleshy seed coat, which is the source of the red-orange dye known as annatto, Orléans. Its main component is red dye bixin. This harmless dye is widely used for coloring oils, margarines, cheeses, chocolates and some other food products, as well as oils, waxes, cosmetics. At the same time, it is used to dye silk and wool. *Bixa orellana* L. is used in traditional medicine. Other parts of the plant with astringent properties are used in the treatment of dysentery, jaundice (leaves) and other kidney diseases [1].

*Bixa orellana* L. extract is registered as a food additive E160b used to improve the commercial appearance of cheeses, yogurts, oils and other dairy products [13].

#### *Material and research methods*

*Bixa orellana* L. species of Tropical American origin, introduced in Absheron conditions, was obtained as a result of exchange from the Central Botanical Garden of Padua, Italy (<https://kurl.ru/Mdfla>). Observations were made on the studied species every ten days. The study of promising plants in the research work was carried out by T. S. Mammadov [1], introduction U. M. Agamirov, M. R. Gurbanov [2], Quinones-Bravo X.; Yunda-Romero M. C. [12], Jansen P. C. M., [11], propagation by seeds A. I. Huseynova [3], morphology of seedlings И. Т. Vasilchenko [4], phenological observations on the plant A. I. Huseynova [5], growth dynamics Molchanov A. A. [6], resistance to heat and drought Akhmatov K. A. [7], root system morphology Kolesnikov V. A. [8] literature materials were used [9, 10, 13].

#### *Results and discussion*

*Bixa orellana* L. is a perennial, tall shrub to small evergreen tree that can reach 6–10 m (20–33 ft) high. It bears clusters of 5 cm (2 in) bright white or pink flowers, resembling single wild

roses, that appear at the tips of the branches. The fruits of the *Bixa orellana* are globular, ovoid capsules arranged in clusters resembling spiky looking red-brown seed pods covered in soft spines. Each capsule, or pod, contains 30–45 cone-shaped seeds covered in a thin waxy blood-red aril. When fully mature, the pod dries, hardens, and splits open, thereby exposing the seeds.

The plant is most well known as the source of the red-orange annatto pigment. The pigment is derived from the pericarp (the waxy aril layer that covers the seeds) of the *Bixa orellana* L. fruit. The red-orange annatto dye is rich in the carotenoid pigments, 80% which consists of bixin (the red pigment) and norbixin or orelline (the yellow pigment) Annatto oil contains tocotrienols, beta-carotene, essential oils, saturated and unsaturated fatty acids, flavonoids, and vitamin C [10].

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It requires warm and light care all year round. Lighting - bright filtered light with a small amount of direct sunlight per day. Watering is regular, without waterlogging. It can tolerate short-term drought (Figure 1).



Figure 1. General view of *Bixa orellana* L. species

*Bixa orellana* L. is propagated by seeds and cuttings. Seeds are sown directly (2-3 seeds per hole) in a well-prepared seed bed or in planting pots that will be transplanted within 3-4 months. The seeds remain viable for 1 year and germinate easily. In propagation by cuttings, 8-10 cm young shoots are taken and they are planted in fertile soil or moist sand. After 7-9 weeks, they produce many roots. After that, they can be transferred to the field [12].

*Bixa orellana* L. begins to bear fruit after 2-4 years. The tree can live up to 50 years in natural conditions and up to 30 years in commercial plantations [9].

The first seeds of *Bixa orellana* L. species were sown 1.5-2.0 cm deep on 10.06.2021, after keeping them in hot water for 12-24 hours, in a substrate prepared as a mixture of soil, sand and peat (1:1:1). It is covered with glass and stored in a warm (23-25°C) lighted place [3]. The first sprouts appear 13-15 days after sowing the seeds (23.06.2021), mass sprouting 30.06.2021. The seeds produce aerial sprouts. The hypocotyl is pink in color, the length is 1.9-2.0 cm, and the epocotyl is 1.5 cm. The development of the root system begins at the same time as the development of the above-ground part. The leaves are shiny, oval, obtuse, heart-shaped at the base, light green in color and later darken. The height of seedlings of *Bixa orellana* L. species reaches 6-7 cm at the end of the second decade of July, and 9-11 cm at the end of the third decade. There are 3-5 leaves on the



cultivated young shoots [5].

The height of sprouts reaches 14-18 cm in the first decade of August, 20-22 cm in the second and third decade of August, and 25-30 cm in the first decade of September. The intensive growth of sprouts accelerates due to rising air temperature, and this process continues until the end of September. Starting from the second decade of September, the growth of the plant weakens [7] (Table 1).

Table 1

GERMINATION OF SEEDS OF *Bixa orellana* L. SPECIES

Place of sowing	Number of seeds	Planting time	First shoots	Germination	Survival rate
Institute of Dedrology	25	10.06.	23.06.	80%	60%

True leaves emerge from between the sepals. The first real leaves appear on 02.07.2021, and the following ones begin to appear at the end of July. The true leaves arranged alternately on the stem are stalked, heart-shaped, light green, flat, full-margined, and the veins are net-shaped (Figure 2).



Figure 2. *Bixa orellana* L. mass seedling

*Bixa orellana* L. grows in broad soils, it is better in neutral and slightly alkaline soils. It grows best in deep, fertile and organically rich soils. As the plant grows rapidly, the leaves also grow rapidly. On 16.08.2021, the height of the plant is 36-39 cm, the length of the leaves is 19 cm, and the width is 9 cm. In 2021-2024, the seasonal growth and annual growth of the species were investigated. During the vegetation period, plant height and canopy diameter were measured [6]. Biometric indicators of annual growth and development of *Bixa orellana* L. species are given in Table 2.

Table 2

GROWTH DYNAMICS OF *Bixa orellana* L. species 2021-2024 YEARS

Years	Height, cm	Umbrella diameter, cm	Diameter of the stem, cm	Lateral branches	
				lateral branches	Length, cm
2021	36-39	44	3,5	8-11	14-19
2022	69-80	59	5,2	9-13	16-19
2023	90-148	96	7,5	19-28	24-28
2024	165-173	134	9,2	37-45	36-39

It was found out from the research that the growth of *Bixa orellana* L. species is divided into 2 periods, the intensive height growth in the first period lasts from the second decade of May to the end of June and the second growth lasts from the end of August to the third decade of October. Annual growth was 20-25 cm [4].

In general, the plant grows for nine months. The vegetation period varies between  $280 \pm 5$  days. *Bixa orellana* L. spends  $70 \pm 9$  days of relative peace from the second decade of January to the second decade of March.



Figure 3. *Bixa orellana* L. 2-year and 3-year

The morphology and development dynamics of the root system of 1-3-year-old plants were studied. Our research showed that the well-developed species *Bixa orellana* L. has a spindle-shaped root. Bixin substance is reflected in red color in the root system of the plant (Figure 4).



Figure 4. Root system of *Bixa orellana* L.

Morphology and development of the root system in 1-3-year-old plants according to Kolesnikova, "roots are completely dug out and washed" was studied using the methodology. The

main root branches are formed in the soil at a depth of 5-20 cm, a large number of taproots. The diameter of the main root for the studied specie is 2.5-3.0 mm 3-5 cm below the root throat. The length of first-order lateral roots reaches 2.5-5.3 cm. An increase in the number and length of the second-third degree side roots, thickening is observed. The number of lateral roots is 3-7 units, the length is 4.0-12.0 cm. Lateral roots mainly spread in the soil layer near the top surface [8]. It branches from the main root to lateral roots of the first degree at a depth of 5 cm in the soil. Better development of the root system is observed in 3-year-old plants. During this period, lateral roots of the II and III degrees are formed and spread horizontally in the soil on both sides. In a 3-year-old plant, the main root extends to a depth of 34-39 cm.

The species *Bixa orellana* L., first introduced into the conditions of Absheron, has normal development phases during the growing season. The plant is very important in almost all its parts. It is advisable to use it in the supply of raw materials for the food and medical industries, as well as in landscape design. The decorative effect of the plant is maintained throughout the year. The size and shape of the plant is controlled by periodic pruning. Cultivation of *Bixa orellana* L. is advisable taking into account its adaptive capabilities, biological and decorative properties, promising criteria, as well as medicinal and nutritional value.

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