

## THE FEATURES OF GROWTH, DEVELOPMENT AND CULTIVATION OF *NANDINA DOMESTICA* THUNB. UNDER THE CLIMATIC CONDITIONS OF THE REPUBLIC OF MOLDOVA

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**Abstract:** The article describes the bioecological features, the technology of propagation and cultivation of *Nandina domestica* Thunb. under the climatic conditions of the Republic of Moldova. The results of the research have shown that the optimal way of obtaining high-quality planting material is generative propagation, by sowing freshly cleaned seeds, in autumn, in a substrate consisting of forest humus and compost made from plants. The coefficient of uniformity and the germination capacity of seeds sown in autumn at a depth of 2-3 cm was 2-2.7 times higher than that obtained from sowing in spring. The planting material obtained after sowing in autumn is more vigorous than that obtained after sowing in spring, with a fasciculate and well-developed root system.

**Keywords:** Cultivation, development, *Nandina domestica* Thunb., propagation.

### Introduction

The main objective of botanists has been the intensification of the activity of identification and mobilization of new plants from the spontaneous flora, as well as from the exotic one. The world flora provides us with a huge range of woody plants, which can be used to obtain benefits in various sectors of the national economy. In this context, we consider *Nandina domestica* Thunb., commonly known as nandina, heavenly bamboo or sacred bamboo, as a precious shrub with high potential for cultivation in the Republic of Moldova. Heavenly bamboo is a species in the family *Berberidaceae* Juss., which includes 14 genera and about 650 species, occurring in the temperate zone of North America and Eurasia, as well as in tropical and subtropical zones of Asia, it is successfully cultivated in the Crimea, the Caucasus and in the subtropical areas of the former Soviet Republics [DEREVIA I CUSTARNICHI SSSR, 1954]. In the Republic of Moldova, 37 species and cultivars of 3 genera of this family, namely *Berberis* L., *Mahonia* Nutt., *Nandina* Thunb., are cultivated currently [PALANCEAN, 2017, PALANCEAN & COMANICI, 2009]. In the “Alexandru Ciubotaru” National Botanical Garden (Institute) (NBGI), Chisinau, *Nandina domestica* Thunb. was introduced in 2011 from Nikitsky Botanical Garden, Yalta, Ukraine. The seeds were received by international seed exchange. In the Republic of Moldova, this species is very rarely found in green spaces, only in NBGI and maybe in the private gardens of some amateur horticulturists.

The purpose of our research has been to identify the bioecological features, the technology of propagation and cultivation of newly introduced plants, under the conditions of the Republic of Moldova.

### **Materials and methods**

The research was carried out in 2017-2020 in the plant nursery of the Dendrology Laboratory of the “Alexandru Ciubotaru” National Botanical Garden (Institute). The plants of *Nandina domestica* Thunb., from which the annual shoots were taken in 2 periods – March-April and June-July, and the fruits were harvested at the end of October, served as research subjects. The lignified cuttings were prepared in March and planted in cold frames in April. The semi-lignified cuttings were taken and prepared in June-July, when the intense growth of the shoots takes place, they are little lignified, but, when choosing the time to take cuttings, the climatic conditions under which they developed should be taken into account. The cuttings were cut and prepared with well-sharpened tools, in the morning, as fast as possible and at the optimal time for collecting them. The cuttings were treated with 0.01% solutions of  $\text{KMnO}_4$  and IBA for 16 and 24 hours according to the methodology [HROMOVA, 1980]. The cuttings treated with distilled water served as control. The harvested fruits were soaked in water for 24 hours and the seeds were subsequently extracted. The freshly cleaned seeds were divided into 2 parts. Some of these seeds were sown in autumn in well-loosened soil at a depth of 2-3 cm. Another part of these seeds was stratified for 3-4 months. To determine the germination percentage, three repetitions (V1, V2, V3) of 100 seeds were performed in spring and autumn. Phenological observations on the growth of 6-7 year old mother plants and seedlings of nandina in the first growing seasons were made according to the method developed at the Moscow Botanical Garden [METODICA FENOLOGHICESCHIIH NABLIODENII V BOTANICESCHIIH SADAH SSSR, 1979] and perfected by Dr. hab. A. Palancean [PALANCEAN & COMANICI 2009].

### **Results and discussions**

*Nandina domestica* Thunb. (nandina, heavenly bamboo or sacred bamboo) of the *Berberidaceae* family, is a species native to China and Japan. Nandina or heavenly bamboo, in its native country, is a small tree, 5-6 m tall, evergreen, with moderate growth rate. It also grows well on slopes. The heavenly bamboo plants introduced under the climatic and soil conditions of our country are evergreen shrubs with slow growth rate and reach up to 3 m in height. The root system is superficial. In the first 1-2 years, the annual shoots of seedlings obtained generatively were affected in winter, but in spring, the plants regenerated by growing new shoots from the root collar. The bark of young branches is initially light brown and then it becomes gray-brown and longitudinally ridged. The buds have an elongated shape, are pointed at the tip and are, on average, 1 cm long. *Nandina* is appreciated as an ornamental plant particularly due to the loose and airy crown, the colour of the foliage in early spring and late autumn, its aspect during flowering, fruit ripening and the bright colour of the fruits in late autumn. The leaves are imparipinnate compound. The petiole of the compound leaf was 10-15 cm long, and that of the leaflets – only 1-3 cm long. The flowers are white, 6 mm in diameter and are grouped in panicle inflorescences (Figure 1). The length of the inflorescences varied between 20 and 40 cm, the average being 28 cm. The flowers produce nectar, which attracts pollinating insects, especially bees. It bears flowers in June-July, but the fruits ripen in the September-October. As a result of the phenological research, it has been found that the number of fruits in an inflorescence varied from 91 to 171 units depending on the weather conditions during the flowering and fruiting stages. The average

weight of 1000 fresh fruits was 250 g and depended directly on the weather conditions during fruit onto-morphogenesis. The diameter of the seeds was 6 mm. The fruits were bright red, 8 mm in diameter and remained on the branches until the first frosts (Figure 2).



**Figure 1.** *Nandina domestica* in the flowering stage.



**Figure 2.** *Nandina domestica* in the fruit ripening stage.

In the first 1-2 growing seasons, it is characterized by slow growth of annual shoots, but produces a lot of shoots from the root collar. The colour of the wood is yellow-brown. It grows better in partial shade, but if it is cultivated in sunny areas, it needs artificial shading during the periods with hot weather.

Based on the analysis of the germination capacity of seeds and the percentage of successful rooting of cuttings, we have come to the conclusion that the optimal method of propagation is the generative one. Thus, some of the freshly cleaned seeds were sown in autumn in well-loosened soil, to a depth of 2-3 cm. Others were stratified for 90-120 days. The germination capacity of the seeds sown in autumn in trenches constituted 40-45%,

**THE FEATURES OF GROWTH, DEVELOPMENT AND CULTIVATION OF NANDINA...**

depending on the weather conditions during the flowering and fruit development and if the cultivation technology had been followed throughout the growing season (Table 1).

**Table 1.** The germination capacity of heavenly bamboo seeds in different periods of the year.

Year	Variant	Sowing date	Number		Germination percentage, %	
			seeds, units	obtained plants, units	per variant	average
2018	V1	20.IV	100	30	30	21.7
	V2	20.IV	100	20	20	
	V3	20.IV	100	15	15	
2018	V1	26.X	100	50	50	45
	V2	26.X	100	40	40	
	V3	26.X	100	45	45	
2019	V1	17.IV	100	10	10	15
	V2	17.IV	100	20	20	
	V3	17.IV	100	15	15	
2019	V1	24.X	100	40	40	40
	V2	24.X	100	45	45	
	V3	24.X	100	35	35	

The germination capacity of seeds sown in autumn was 2-2.7 times higher in comparison with those sown in spring. The seeds sown in autumn germinated uniformly at the beginning of May, but those sown in spring germinated unevenly in the first half of June and had low germination percentage (15-21.7%) (Figure 3).

The seedlings obtained from seeds sown in autumn were more vigorous and with a more developed root system as compared with those obtained from seeds sown in spring.

The length of the first-order roots of the seedlings obtained from seeds sown in autumn, in the second growing season, varied between 16 and 18 cm. The height of these plants in the second growing season was 28-35 cm. In the seedlings obtained from seeds sown in spring, the length of the roots varied between 10 and 14 cm, and the height of the plants was only 14-18 cm (Figure 4). Some researchers recommend the vegetative propagation of heavenly bamboo by cuttings, layering and grafting on mahonia. In the framework of our research, the results of the attempts to propagate nandina by lignified and semi-lignified cuttings, untreated and treated with root stimulators, were zero. The seedlings obtained generatively, after the first growing season, were transplanted into containers in a substrate slightly enriched with plant residues and complex mineral fertilizers, keeping its acidity within the limits of 4.5-5 for further growth, following the cultivation technology (Figure 5 a, b, c).

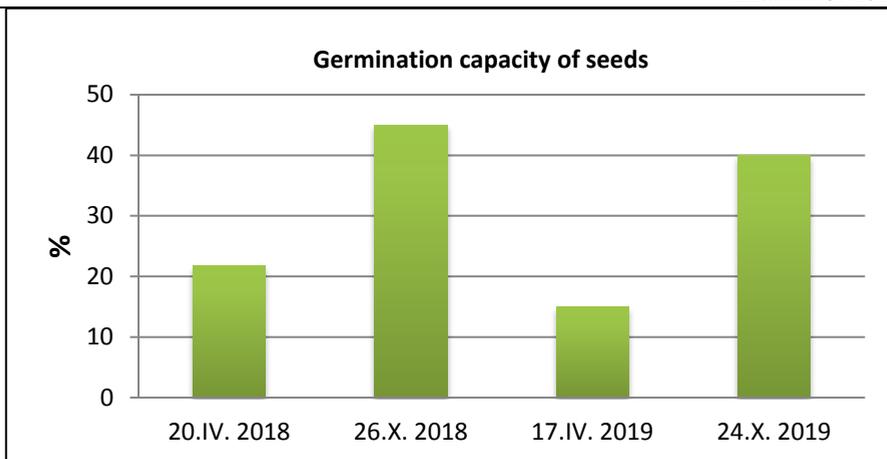


Figure 3. Germination capacity of seeds depending on the sowing period.

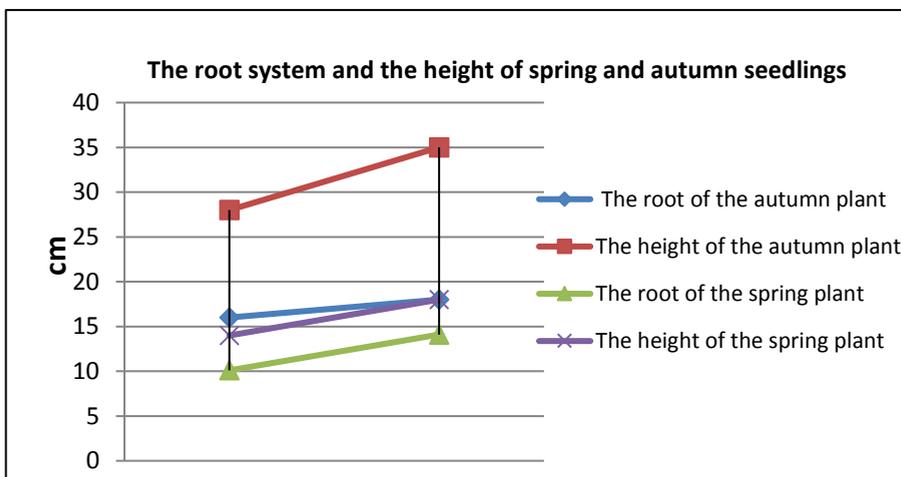


Figure 4. The growth rate of the root system and the height of *Nandina domestica* Thunb. plants in the second growing season.

Under the conditions of the Republic of Moldova, the only impediment to the cultivation of heavenly bamboo in the first 1-2 years was the gap between the lowest and the highest temperatures in winter and early spring. The cultivation of nandina in private gardens is profitable because it does not require special care. In early spring, it supports pruning the shoots by 1/3 of their length. The damaged branches are cut at the level of the root collar. During the whole growing season, additional complex mineral or fermented organic fertilizers are applied around the plant every month. If the plants are cultivated in containers, the substrate should be light, with pH=3.8-6.5, it should be changed every 2 years and fertilized with complex mineral substances (Figure 5). When transplanting plants into larger containers, the roots are slightly shortened. All parts of the plant are poisonous and it is

## THE FEATURES OF GROWTH, DEVELOPMENT AND CULTIVATION OF NANDINA...

recommended to wash your hands after each contact with the plant. This shrub is decorative throughout the year and also has some medicinal uses, for example, it can be used as a raw material in antirheumatic, febrifugal and tonic remedies. Two varieties of high decorative value are known: *Nandina domestica* 'Alba' – a shrub with upright habit and white-cream fruits, *Nandina domestica* 'Royal Princess' – a 2-3 m tall shrub with more abundant flowering.



**Figure 5.** Seedlings obtained generatively in the second growing season (a – the root system of the seedlings obtained by sowing seeds in spring; b – the root system of the shoots obtained by sowing seeds in autumn; c – seedling grown in a container, evergreen).

It can be planted separately or in groups. Under the conditions of the Republic of Moldova, heavenly bamboo withstands frost, sometimes only annual vines partially freeze, it is undemanding in terms of soil fertility, withstands pruning and temporary lack of moisture.

### **Conclusions**

As a result of bioecological and phenological research on *Nandina domestica* Thunb. plants (heavenly bamboo), it has been found that the growth and development rates match the annual cycle of our climate. Under the given conditions, it is an evergreen shrub with slow growth in the first growing seasons.

The optimal method of propagation of nandina (heavenly bamboo) was by sowing freshly cleaned seeds in autumn, in a light substrate enriched with plant residues and fermented organic fertilizers. The germination capacity of seeds sown in autumn at a depth of 2-3 cm was 2-2.7 times higher than that obtained from sowing in spring. The seeds sown in autumn germinate more evenly as compared with those sown into the soil in spring. The seedlings obtained from seeds sown in autumn are more vigorous and with a more developed root system as compared with those obtained from seeds sown in spring.

If heavenly bamboo is cultivated in containers, the substrate should be light, with pH varying between 3.8 and 6.5, and, every 2 years, it should be changed and fertilized with complex mineral substances.

Heavenly bamboo has been successfully studied can be recommended as an ornamental plant for landscaping in the central and southern districts of the Republic of Moldova, being decorative throughout the year, particularly due to the loose and airy crown, the colour of the foliage in early spring and late autumn, its aspect during flowering, fruit ripening, the bright colour of the fruits in late autumn.

It is cultivated in the foreground in small groups, along alleys, in all types of green spaces (except those near kindergartens, schools).

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