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INTRODUCTION AND BIOLOGICAL FEATURES OF ATROPA BELLADONNA L. IN THE CONDITIONS OF KARAKALPAKSTAN

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ABSTRACT

The article presents the results of studies of the biological characteristics of Atropa Belladonna L. when introduced in the conditions of Karakalpakstan. It has been established that the life strategy of Atropa belladonna L. is characterized by a wide plasticity along the illumination gradient, which is due to constantly changing conditions in the studied areas of Karakalpakstan.

KEYWORDS

Life strategies, Atropa belladonna L., introduction, environmental conditions, phenology.

INTRODUCTION

One of the main tasks defined in the World Strategy for Nature Conservation, developed under the auspices of the UN and the International Union for Conservation of Nature (IUCN), is to preserve the representativeness of the organic world. Among the most vulnerable ecosystems are the populations of raw plants [3, 10]. In recent decades, medicinal plants have gained great interest. This is due to the fact that herbal preparations are safer compared to chemical ones. About 40% of medicines are obtained from plants or they contain an active ingredient of plant origin. Over the past 20 years, the demand for medicinal plants has increased by more than 25%. Wild herbs are a very valuable raw material for obtaining many effective drugs [11, 14].

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The introduction of new medicinal plants into the culture is a long and laborious process carried out over several stages: collecting seed or planting material, studying the biological, edaphic, climatic characteristics of medicinal plants, conducting experimental crops and identifying the optimal zone for new crops, selecting economically valuable populations, development of effective methods of cultivation [2, 16].

In this regard, the knowledge of the biological characteristics of introduced medicinal plants, the identification on this basis of the ways of adaptation of species to various environmental conditions, as well as the establishment of phylogenetic transformations of structures in taxa of various ranks is of particular relevance [4, 6]. In addition, with the growing threat of a reduction in plant biodiversity, it is necessary to maximize the accumulation of materials characterizing the specific biological characteristics of wild and introduced species of medicinal plants, expanding the possibilities of plant conservation by adjusting and choosing the optimal conditions for their introduction and reintroduction.

Fig.1. Belladonna (Atropa belladonna L.,)

Atropa belladonna L.– perennial herbaceous plant from the Solanaceae family, with many-headed rhizome and large branching roots. The stem is straight, branched, up to 2 m high. The leaves are plentiful dark green, the lower leaves are alternate, short-leaved. The flowers are located in the axils of the leaves, solitary, drooping, on short lowered legs [9]. Corolla cylindrically bell-shaped, falling, 2-3 cm long and up to 1.5 cm in diameter and brown-violet or dirty purple, the fruit is a two-celled, multi-seeded, purple-black, juicy berry the size of a cherry. Seeds are roundish-reniform, brown, with a cellular surface. Blooms from June until the end of the growing season [2, 9, 11]. Soil and air humidity is of great importance for the growth and development of belladonna. Atropa belladonna L. Sufficiently moist loose humus soils, under natural conditions, belladonna is found in the mountainous regions of the Crimea, the Caucasus and Western Ukraine, as well as in Western Europe. Medicinal raw materials are leaves (whole and cut) and

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grass (whole and cut) of belladonna. Its commodity raw materials are dried leaves, grass and roots, which contain alkaloids - atropine, hyoscyamine, scopolamine [11, 12].

In 2013 - 2019 we have studied the seasonal flowering rhythm of Atropa belladonna L. when introduced on experimental plots in the Kegeyli and Ellikkala regions of Karakalpakstan. The flowering rhythm was studied by quantitative accounting of flower opening [11, 14]. A study of the seasonal dynamics of flowering showed that in Atropa belladonna L. this process is very slow: after the appearance, the bud develops within 13–16 days, sometimes more; the flowers open acropetally and remain open on the plant for up to 6–8 days. At the beginning of flowering in 3–5 days, 1–2 flowers opened in one individual of the plant. In the period from the end of June to the middle of July, 3–4 flowers opened on the marked individuals in 3–5 days. Mass flowering was noted in the first decade of July and this rhythm of flowering continued until early September.

In the experimental sites of the Kegeyli region in August, there was a noticeable increase in air temperature compared to the previous summer months, the average monthly temperature was +44.00C, relative air humidity - an average of 36%. Starting from this period, a gradual decline in the rhythm of flowering was observed, one flowering as a whole continued until mid-October. Under the shadow exposure, the plants of Atropa belladonna L. entered the phase of the beginning of flowering in early June.

The air temperature in June averaged about +42.60C, and the relative air humidity varied from 15 to 30%. During this period, each noted individual bloomed 1–2 flowers. Since the end of July, mass flowering has been noted in plants; for 3–5 days, 4–5 flowers opened in each individual noted. In Ellikkala district in July, the average daily air temperature ranged from +47.4 to +49.60C, and the average monthly relative humidity was 20–37%. The peak of flowering was noted in the period from July 20 to August 26 (mass flowering). Blooming belladonna usually begins in the second year.

The collection of leaves and roots can take place in the first year, but it should be borne in mind that the content of alkaloids in these materials will be significantly lower than in biennial or three-year plants.

In the first year of life, the morphological characteristics of belladonna plants in variants with different sowing dates were characterized by different values. The number of shoots and leaves on the plant, as well as fruits on the shoot, was maximum in the variants of winter and early spring sowings and amounted to 4.1-5, 85-101 and 5.3-4.1 pieces, respectively, while at late spring sowing it was minimal - 2.5, 73 and 3.8 pcs respectively.

It should be noted that the listed features are the main elements of the crop structure. With almost the same content of active substances in the leaves, the best in terms of grass yield were winter and early spring crops. They also had a higher seed yield. In the variant of winter sowing in the structure of the grass yield, 70% accounted for leaves and flowers - the most valuable components in terms of the amount of alkaloids, enriching the quality of raw materials. This is due to the more powerful development of plants, their high foliage and the presence of a large number of reproductive organs [14, 16].

According to T.A. Rabotnov [13] and A.A. Uranov [15], we identified the following age periods in the life cycle of Atropa belladonna L.: latent, virginal, and generative. In the virginal period, the immature stage was not distinguished, because This species belongs to homoblastic life forms. The age spectrum was dominated by pregenerative plants. The share of

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seedlings averaged 45.0% (Fig. 2), juvenile plants - 18.0%, virginal - 14.0%. Young generative plants accounted for 16.0%, while single mature generative plants were noted, the share of which was 2.0%. Old generative plants were absent in the age composition in the first year of observations. The projective cover of belladonna ranged from 60 to 78%.

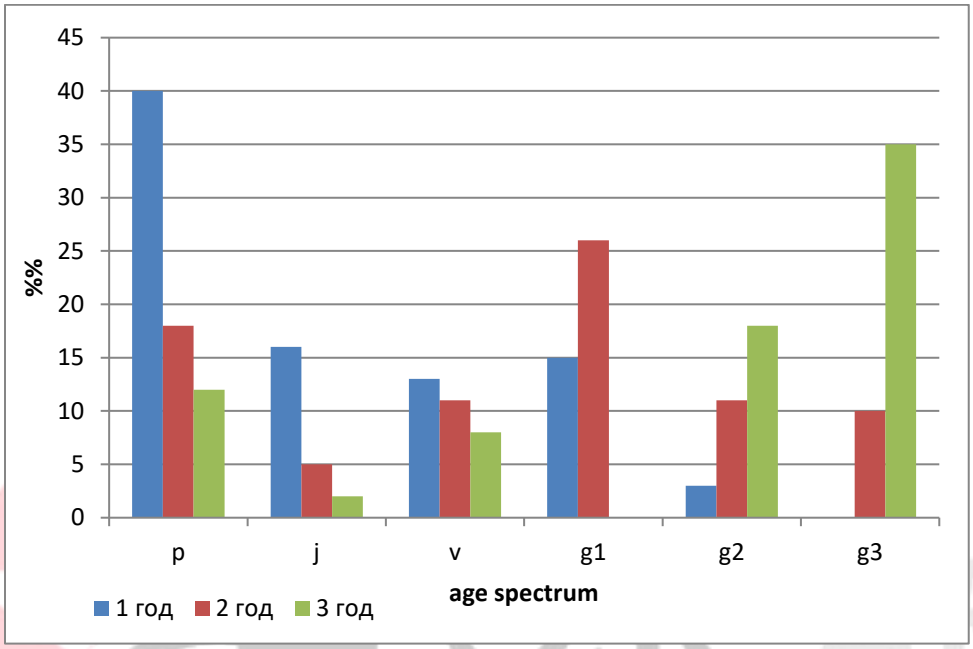

Fig.2. Age spectra of Atropa belladonna L. under conditions full lighting

In the second year of observations, the belladonna projective cover decreased to 40-55%, and the number of specimens both in the community and per unit area also decreased. In the age spectrum, generative plants began to prevail: their share was 47% with a predominance of young generative plants (30.0%). Compared to the previous year, there was a sharp decrease in the share of juvenile plants (from 16.0 to 4%), as well as seedlings (from 40.0 to 11.6%).

In the third year of observation of this community, there was a significant reduction in the number of belladonna plants. Its projective cover fell to 2-3%. Most of the plants of Atropa belladonna L., judging by the morphological features, passed into the old generative state and had a depressed appearance. The height of generative specimens did not exceed 1 m, and the placement density was no more than 2-3 plants per 1 sq.m. The share of generative plants was 71.1% with a predominance of old generative plants in this age group - 38.2%, while the proportion of juvenile and virginal plants decreased to 14.9%, and the number of seedlings decreased in comparison with the first year of observation three times (up to 15%) . At the same time, most of the seedlings were noticeably depressed due to the intensive development of the ground grass cover [8, 9].

The duration of the period from germination to fruit ripening in the first year of life was 109-121 days, in the

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second - from plant regrowth to ripening - from 77 to 85 days, which is consistent with the zonal possibilities of vegetation of heat-loving crops.

The study of life forms, biological characteristics of introducers - rhythms of growth and development, the ability to bear fruit, to seed and vegetative renewal - make it possible to assess the adaptive capabilities of plants, their introduction resistance, and outline the prospects for further practical development

The passage of a full cycle of ontogenetic development by plants indicates their successful introduction. The fruiting of introduced plants is the most important indicator of their adaptation to new conditions, since it opens up the possibility of fixing the adaptive properties acquired in the process of ontogenesis [4, 5]. The generative sphere is most responsive to changes in environmental conditions. Flowering and fruiting are of particular importance in urban environments, providing an attractive decorative look and usefulness of plant use.

The adaptive fitness of species to new environmental conditions in our studies was determined using the Bakanova scale (1983) [1]. It takes into account such basic indicators as overwintering, the degree of damage by drought or frost, the presence of regular flowering and fruiting. Each score is a numerical expression of the degree of success of the introduction of a plant into new conditions for them. A higher serial number of the score means a higher degree of introduction of the species. An indicator of success is resistance to adverse climatic factors, the presence of regular flowering and fruiting, the ability to self-seeding and self-settlement. Gradations of success assessments are represented by the following ball [1]:

1 ball - introducers exist for a short time and only in a vegetative state, they are absolutely not resistant to local climatic conditions.

2 balla - introducers exist for a short time, but some salts can bloom without setting seeds. They are unstable to local climatic conditions. They reduce the number, and in especially unfavorable years they die completely.

3 balla - no more than half of adult individuals of introducers bloom and bear fruit. They are weakly resistant to local climatic conditions. Their total number is gradually decreasing. The culture of such species is possible, but with summer watering or winter shelter of plants.

4 balla - more than half of adult specimens of introducers regularly bloom and bear fruit in large numbers. They are weakly resistant to local climatic conditions. Their total number is gradually declining. When cultivating such species, watering is necessary in especially dry periods.

5 balla - all adult individuals of introducers regularly bloom and bear fruit en masse. Resistant to local climatic conditions, does not require watering or shelter.

6 ballov - introducents regularly bloom and bear fruit massively, give a single self-sowing or reproduce vegetatively. Highly resistant to local climatic conditions.

7 ballov - introducents regularly bloom and bear fruit massively, actively self-settle by mass self-sowing or vegetatively. Highly resistant to local climatic conditions [1].

In our studies, using this scale, we assessed the success of the introduction of Atropabelladonna L. (Table 1)

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Table1.

Evaluation of the success of the introduction of Atropabelladonna

according to the Bakanova scale (1983)

№	Indicators	plant species
		Atropa belladonna
1	Development of vegetative organs	+
2	The presence of regular flowering	+
3	The presence of regular fruiting	+
4	winter hardiness	+
5	drought tolerance	+
6	The ability of introducers to a single self-dispersal	+
7	The ability of introducers to mass self-dispersal	+
	Introduction success scores	7

The plants studied by us annually grow and give a vegetative mass, regularly bloom and bear fruit, they are resistant to adverse climatic conditions, drought-resistant and winter-hardy.

The assessment of winter hardiness and drought resistance is carried out by the field method by counting the preserved plants on fixed sites and visually describing the degree and nature of damage. It is carried out in spring during regrowth and in autumn before going into winter, as well as during the greatest reaction of plants to the action of one or another unfavorable environmental factor. Under winter hardiness, it is customary to understand the resistance of plants to damaging factors of the winter period [3, 5, 17]. Many perennial plants overwinter in the form of underground storage organs (bulbs or rhizomes) protected from freezing by a layer of soil and snow. Thus, the studies have shown that Atropa belladonna L. is well adapted to the climatic conditions of the Republic of Karakalpakstan. The absolute minimum air temperature during the study period did not affect the growth of plants after wintering, which makes it

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possible to judge the high resistance of plants in the winter period.

CONCLUSION

Thus, the conducted studies have shown that the life strategy of Atropa belladonna L. is characterized by wide plasticity in the illumination gradient, which is due to constantly changing conditions in the studied areas of Karakalpakstan. Plants of Atropa belladonna L. of the first and second years of vegetation in the Kegeyli and Ellikala regions of Karakalpakstan went through a full cycle of growth and development during the season.

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