

Experience of Introduction of Two Species of *Eryngium* in the North Caucasus

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ABSTRACT

The article gives recommendations on the cultivation of *Eryngium caucasicum* Trautv. and *Eryngium planum* L. in the Caucasus. **Introduction:** In Russia, grows about 20 species of *Eryngium*, in the Caucasus - 8 species. **Materials and Methods:** The subjects of the study were two species: *Eryngium caucasicum* Trautv. and *Eryngium planum* L. The main methods of research: field, observation, mathematical. **Results:** The seedlings appear on the 14-16th day. In the first year of vegetation, a rosette of leaves is formed. In September, the rosettes of leaves have a diameter of 35-39 cm. Plants of the second year of vegetation pass through all phases of development: *Eryngium caucasicum* Trautv. - for 180 days, *Eryngium planum* L. - for 160 days. **Conclusion:** Seeds should be sown in late autumn (late October - early November) or early spring (late February - beginning of March). Seeds are sown to a depth of 1-2 cm, between rows - 50-60 cm. Care of plants requires weeding from weeds and watering. Collection of seeds and fruits is recommended in August - September.

Key words: *Eryngium*, *Eryngium caucasicum*, *Eryngium planum*, Recommendations, Introduction.

INTRODUCTION

The genus *Eryngium* L. belongs to the family Apiaceae, which consists of about 300 species, species growing in the tropical, subtropical and temperate latitudes of the worldwide.¹ Species of *Eryngium* L. are widespread in Central Asia, America, Central and South-Eastern Europe. In Russia, grows about 20 species, in the Caucasus - 8 species.² *Eryngium caucasicum* Trautv. and *Eryngium planum* L. - perennial herbaceous plants. The aboveground and underground parts of these species contain terpenoids, saponins, flavonoids, phenolic acids, coumarins, polyacetylenes and other biologically active compounds.³⁻⁶ These substances determine diuretics, antispasmodic, antifungal, cytotoxic, antitubercular and stimulating properties.⁷⁻⁸ Among the known species of the genus *Eryngium*, we studied two species: *E. caucasicum* Trautv. and *E. planum* L., which are characterized by a wide variety of active substances and use in folk medicine.⁹ Plants have a large vegetative mass, which is important when harvesting raw materials. Studies on the introduction of these species were carried out from 2014 to 2017. Some observational data for 2014-2016 are published in the press.¹⁰⁻¹¹ In this paper, we propose the results of observations for 2017, taking into account climatic data and general recommendations for the cultivation of two species of the genus *Eryngium* in the Stavropol Territory (the North Caucasus).

MATERIALS AND METHODS

Plains of the Stavropol Territory receive 120-125 kcal / cm² of solar radiation per year. The maximum temperature reaches 37-45°C. The amount of rainfall is small, 170-180 mm per year. Seeds of *Eryngium caucasicum* Trautv. and *Eryngium planum* L. were harvested in various regions of Dagestan, Kabardino-Balkaria and the Stavropol Territory. Mature seeds were collected for research in August-September 2014. Seeds were placed in the soil in early spring (March) and late autumn (November). Seeds are small, 2-3 mm in length, sown to a depth of 1-2 cm, between rows - 50-60 cm, since leaves can reach a diameter of 60 cm. **The main methods of research** are: Observation, Field, Mathematical.

RESULTS AND DISCUSSION

Observations were carried out on plants of the first and second years of development. The species are propagated by seeds. In the first year, seeds were sown and the formation of a rosettes of leaves was observed. In 2017, spring seed sowing was carried out on March 30, when the air temperature was 12 degrees Celsius. Seedlings appeared on April 14-16. Rosettes of leaves began to form on May 4-6. The dynamics of rosettes growth, the number of formed leaves and temperature data in the first year of development are presented in Table 1.

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Figure 1: Rosettes of leaves: A - *Eryngium caucasicum*; B - *Eryngium planum*.

According to the Table, that the formation of rosettes of leaves in the first year of development continues 60-70 days. During August, slightly increased the size of leaf rosettes. At the same time, air temperature has no special effect on the formation of rosettes. The diameter of the rosettes and the number of leaves in the *Eryngium planum* are somewhat smaller than in the *Eryngium caucasicum* (Figure 1).

In this state, the plants were before winter. In winter, some of the leaves die off, but in spring the new leaves grow back.

In 2017, the growth of plants of the second year began on March 8-9, when the air temperature was 4-9°C. Rosettes of leaves formed in *Eryngium caucasicum* until April 30, in *Eryngium planum* - until May 12. Their dimensions were 58-60 cm and 47-54 cm, respectively.

The results of observations on the phases of plant development in the second year of vegetation are presented in Table 2.

Plants in the second year of vegetation first form rosettes of leaves, then begin to develop shoots. The phase of budding is shown in Figure 2.

The duration of vegetation phases is presented in Table 3.

Such differences in the duration of developmental phases are explained by the different degree of branching of shoots. In *Eryngium planum* inflo-



Figure 2: Plants in the budding phase: A - *Eryngium caucasicum*; B - *Eryngium planum*.

rescences less branched, more compact, *Eryngium caucasicum* forms a large number of lateral branches - the axes of inflorescences.

As a result of the study, it was found that when sowing seeds at the end of March it took 150-160 days to completely form a rosette of leaves in the first year of vegetation. Rosettes of leaves had a diameter of 35-39 cm. In the second year of vegetation, the formation of new leaves and their growth began on March 8-9 at a temperature of 4-9°C. The fruits of *Eryngium planum* ripened in August, and *Eryngium caucasicum* - in September. For the full development of plants, it took 120-140 and 160-180 days, respectively. Care of plants consisted of weeding from weeds and watering. In the absence of precipitation it is necessary to water 1-2 times a week. The spring-summer period of 2017 was characterized by a large amount of rainfall in April-June. Therefore, the plants of this year have grown to 120-140 cm.

Observations in 2017 confirm the possibility of successful cultivation of two species of Eryngium in the Stavropol Territory.

Table 1: Duration of vegetation of two species of Eryngium in the first year of development.

Date of observation	Air temperature, °C	Eryngium caucasicum		Eryngium planum	
		Diameter of rosettes of leaves, cm	Number of leaves	Diameter of rosettes of leaves, cm	Number of leaves
12.05.17 r.	17	3,5-9	3-7	7-9	3-4
19.05.17 r.	14	12-17	8-11	8-13	3-5
26.05.17 r.	20	13-20	20-23	8-14	3-5
01.06.17 r.	20	15-25	22-25	13-18	4-5
08.06.17 r.	28	19-27	24-26	14-19	5-6
15.06.17 r.	22	21-29	27-30	15-20	6-7
22.06.17 r.	20	22-30	31-35	17-20	6-8
02.07.17 r.	36	24-32	34-43	18-20	7-8
11.07.17 r.	26	32-36	37-48	20-28	7-8
20.07.17 r.	20	33-38	37-48	23-32	7-8
08.09.17 r.	24	36-39	37-48	26-35	7-8

Table 2: Dynamics of shoots growth of two species of Eryngium.

Date of observation	Air temperature, °C	<i>Eryngium caucasicum</i>		<i>Eryngium planum</i>	
		Height of shoots, cm	Development phase	Height of shoots, cm	Development phase
06.05.17 r.	8	5-15	growth of shoots	–	rosette of leaves
08.05.17 r.	20	25-40	growth of shoots	–	rosette of leaves
12.05.17 r.	17	35-49	growth of shoots	–	rosette of leaves
16.05.17 r.	10	48-67	growth of shoots	7-22	growth of shoots
21.05.17 r.	23	50-90	growth of shoots	18-35	growth of shoots
25.05.17 r.	14	51-96	growth of shoots	27-47	growth of shoots
28.05.17 r.	18	60-98	growth of shoots	40-62	beginning of budding
01.06.17 r.	20	80-105	beginning of budding	40-63	budding
08.06.17 r.	28	94-125	budding	74-87	budding
20.06.17 r.	20	112-134	budding	93-109	budding
02.07.17 r.	36	135-140	beginning of flowering	100-115	beginning of flowering
11.07.17 r.	26	135-140	flowering	100-115	flowering
16.07.17 r.	27	135-140	flowering	116-120	flowering
30.07.17	25	135-140	flowering	116-120	end of flowering
10.08.17 r.	29	135-140	end of flowering	116-120	beginning of fruits ripening
18.08.17 r.	27	135-140	beginning of fruits ripening	116-120	fruits ripening
08.09.17 r.	24	135-140	fruits ripening	–	–

Table 3: Duration of vegetation phases of two species of Eryngium in the second year of development (days).

Species	Rosettes of leaves	Growth of shoots	Budding	Flowering	Fruits ripening	Total
<i>Eryngium caucasicum</i>	50	25-30	25-30	40	20-30	160-180
<i>Eryngium planum</i>	65	10-15	15-20	20-25	10-15	120-140

CONCLUSION

Thus, as a result of observations of the vegetation of two species of Eryngium in the Stavropol Territory (the North Caucasus) during 2014-2017, we propose the following recommendations for their introduction:

1. Plants must be propagated by seeds.
2. Seed sowing should be done in late February - early March. In addition, you can sow in the autumn - in late October - early November.
3. Seeds are placed in the soil at a depth of 1-2 cm, between rows - 50-60 cm.
4. Make weeding and watering as necessary.
5. Chemical protection of plants from pests is not required.
6. Harvesting fruits and seeds in August-September.

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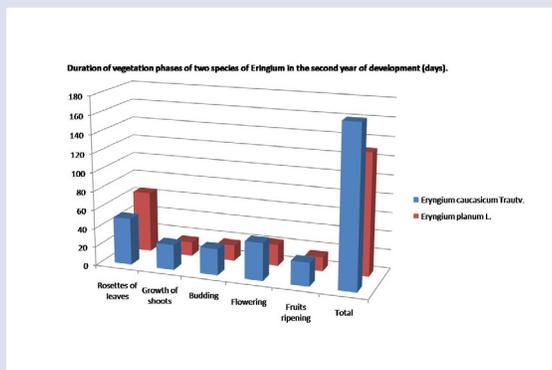
CONFLICT OF INTEREST

When performing this research conflicts of interest did not arise, since all of the authors have conducted research work comprehensively.

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GRAPHICAL ABSTRACT



SUMMARY

- The article gives recommendations on the cultivation of *Eryngium caucasicum* Trautv. and *Eryngium planum* L. in the Caucasus. Seeds should be placed in the ground in late autumn (late October-early November) or early spring (late February-early March). Seeds are sown to a depth of 1-2 cm, between rows of 50-60 cm. The seedlings appear on the 14-16th day. In the first year of vegetation, a rosette of leaves is formed. By the beginning of September, the rosettes of leaves have a diameter of 35-39 cm. The plants of the second year are *Eryngium caucasicum* Trautv. Develop within 180 days and *Eryngium planum* L. - for 160 days. Care of plants is the removal of weeds and watering. Collection of seeds and fruits is recommended in August-September.

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