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STUDY OF THE INFLUENCE OF DIFFERENT SOWING PERIODS ON THE PHENOLOGICAL AND DECORATIVE CHARACTERISTICS OF *VERBASCUM THAPSUS* L.

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Abstract

Verbascum thapsus L. is a wild plant in Bulgaria and has very good decorative qualities. The purpose of this study was to explore the possibility of using Verbascum thapsus as an ornamental plant. The investigation was conducted during the period 2017-2019. Seeds of wild plants were collected in the area of Plovdiv. The seeds were sown on 4 dates - the beginning of June, July, August and September. Vitality, germination and germination energy of the seeds were studied. The phenological and ornamental characteristics were recorded. The plants with the sowing of seeds in the beginning of July have the best decorative behaviour - the largest flowers, the largest number of flowers and the longest flowering period.

Key words*: Verbascum, seed propagation, cultivation, germination, ornamental plant.*

INTRODUCTION

Verbascum thapsus L., the family *Scrophulariaceae*, is a biennial, perennial or, rarely, an annual plant with a deep tap root. It is native to Eurasia and Africa (Muzik, 1970; Fuller and Barbe, 1985). In its first year it produces a low vegetative rosette up to 60 cm in diameter. Basal leaves are oblong-obovate to obovate lanceolate, 10.2-30.5 cm long, 2.5-12.7 cm wide and covered with woolly hairs. Stem leaves are elliptic lanceolate, decurrently alternate and decrease in size towards the apex. The rosette overwinters and a 50-180 cm flowering stem develops in the succeeding growing season. The flower stem is longitudinally ridged by the bases of decurrent leaves and is densely woolly with branched hairs (Watson, 1977; Baskin and Baskin, 1981; Gross and Werner, 1982). The inflorescence is a spikelike raceme 20-50 cm long and approximately 3 cm in diameter. It is usually very dense; rare axillary racemes may arise from the upper leaves. The sessile flowers are usually one per axil with pedicels less than 2 mm and slightly irregular with rotate corollas. The calyx consists of 5 lanceolate or ovate sepals, 7-9 mm long with caudate tips. The corolla is 20-25 mm broad consisting of five yellow or white petals and the seeds ripen from August to September (Gross, 1984; Salisbury, 1942). The plant is suitable for sandy, loamy and clay soils and prefers well-drained soil (Spencer, 1957). It can grow in very alkaline soils with pH - acid, neutral and basic (Brewer, Watson, and Gray, 1976; Gross, 1981). It cannot grow in the shade, prefers a sunny position. The plant can tolerate strong winds but not maritime exposure. It is an easily grown plant (Kivilaan and Bandurski, 1981; Semenza, Young, and Evans, 1978). Hybridizes with other members of this genus, though the progeny are usually sterile (Daar, 1983; Gross, 1984). A very ornamental plant with attractive foliage, flowers or blooms, it often self-sows, especially on dry calcareous soils (Gross, 1980). The plant attracts birds and butterflies. Edible, invasive, naturalizing, suitable for dried flowers (Jones and Stokes 1984; Semenza, Young, and Evans, 1978; Gross and Werner, 1978).

There are many decorative types and varieties of *Verbascum* (Lade et al. 1974). The wild species of the *Verbascum* genus, are characterized by valuable decorative and ecological qualities. They are distinguished by their toleration to soil and climatic conditions, drought tolerant, relative pests and disease free

(Westcott, 1960; USDA, 1953; 1960; 1984) and are very well adapted to the conditions in Bulgaria. Therefore, the purpose of this study was to explore the effect of different sawing dates on seed quality, as well as on phenological and ornamental characteristics of *Verbascum thapsus* L.

MATERIALS AND METHODS

The seeds were collected in October from previously identified wild plants of *Verbascum thapsus* L. near the city of Plovdiv. The sowing was carried out from June to September of the respective year in 4 dates in containers, the soil mixture was suitable for sowing flower and vegetable seeds. With the emergence of 3-4 true leaves, the plants were picked outdoors at 25 cm between the spacing and 20 cm between the rows. The absolute mass of 1000 seeds was according ISTA (2013), vitality, germination, germination energy and length of embryonic root were determined. Phenological characterristics traced the beginning and mass emergence of seedlings, the appearance of cotyledons, the appearance of the first true leaf and the appearance of 4 true leaves. The decorative characteristics studied were the height and diameter of the inflorescence, the diameter of the flower and the number of flowers in the inflorescence. The results were processed by analysis of variance.

RESULTS AND DISCUSSIONS

Table 1 presents the results of studies of the seed quality of *Verbascum thapsus*. The absolute mass of 1000 air-dried seeds was 0.072 g. This indicator is influenced by the size and fulfillment of the seeds, as well as by the climatic conditions in the growing area. These data are a criterion for the ecological plasticity of a species and its suitability for acclimatization to the conditions of an area. The vitality of the seeds determines their potential ability to germinate. In the seeds used in this experiment, the vitality was 78.91%. Germination is the most important indicator of the suitability of seeds to form normal sprouts under optimal conditions over a period of time. In *Verbascum thapsus*, seed germination was determined at 7 days - 82.48% (Table 1).

Table 1. *Verbascum* seed quality averages 2017-2019

Absolute mass per 1000 seeds (g)	Vitality, %	Germination, %	Germination energy, %	Embryonic root length (cm)
0.072	78.91	82.48	73.18	1.07

Germination energy indicates the percentage of normally germinated seeds under optimum germination conditions within a period shorter than that for germination. In *Verbascum thapsus* L., the germination energy was determinated for 5 days and was 73.18%, indicating that the seeds germinate jointly and give strong and viable seedlings and, respectively, more viable plants. The average embryonic root length of *Verbascum thapsus* L. is 1.07 cm, which is also evidence of seed viability and usability.

The phenological characteristics of the plants are presented in Table 2. The seeds sown on 08.08 appeared first - variant 3, seeds sown at the beginning of July, September and June, 1.7, 2.4 and 4.8 days, respectively. However, the mass emergence occurs first at sowing in early July - 13.7 days after sowing, followed by sowing in August, July and September. The appearance of cotyledons, the appearance of the first and fourth true leaves (Figure 1) follows the trend observed in the mass emergence indicator - these phenophases first occur in the seeds sown in early July, followed by sowing in August, June and September.

Table 2. *Verbascum* phenological behaviour averaged over the period 2017-2019

Variants	Beginning of emergence (days)	Mass emergence (days)	Occurrence of cotyledons (days)	Occurrence of the first true leaf (days)	Occurrence of the fourth true leaf (days)	Duration of flowering of a single flower (days)	Duration of flowering of the whole plant (days)
1. Sowing 4.06.	11.5	19.2	15.8	27.9	37.9	7.4	72.1
2. Sowing 6.07.	8.4	13.7	9.7	18.4	27.3	7.2	91.4
3. Sowing 8.08.	6.7	16.9	11.7	21.8	30.5	7.4	77.2
4. Sowing 1.09.	9.1	21.8	19.3	31.4	-	-	-
LSD (p=0.05%)	0.7	1.3	2.4	7.5	6.8	0.1	12.5

The plants obtained from the seeds sown in September do not at all enter the “emergence of a fourth true leaf” phase. All plants from this date of sowing die in winter. The sowing time does not affect the duration of flowering of the

individual flower - 7.4; 7.2; 7.4 days respectively for the three sowing periods. The duration of flowering period of the whole plant is greatest for the plants obtained from sowing in July - 91.4 days. The flowering period of plants obtained from sowing in August and June was with 15.5% and 21.1% shorter, respectively. The sowing time of the seeds had a significant effect on the decorative appearance of *Verbascum thapsus* L. (Table 3). The height of the inflorescence is greatest for plants obtained from seeds sown in July - 61.8 cm. The height of the inflorescence of plants obtained from seeds sown in August is 11.1 cm lower and 21.1 cm lower than the height of the inflorescence of those obtained from sown in June.

Table 3. *Verbascum* ornamental characteristics averages 2017-2019

Variants	Height of inflorescence (cm)	Inflorescence diameter (cm)	Flower diameter (cm)	Number of flowers in inflorescence
1. Sowing 4.06.	40.7	2.47	0.31	134.5
2. Sowing 6.07.	61.8	2.50	1.75	384.5
3. Sowing 8.08.	50.7	2.51	0.65	211.7
4. Sowing 1.09.	-	-	-	-
LSD (p=0.05%)	9.6	0.07	0.35	143.5

The diameter of the flower is a determinant of the decorative qualities of the plants. The largest are the flowers of the plants obtained from sown in July seeds - 1.75 cm, followed by those obtained from sowing in August and June - respectively by 1.10 cm and 1.44 cm smaller. The strongest influence is the sowing time on the number of flowers in the inflorescence. The plants obtained from sowing in July form 384.5 flowers with 172.8 pcs. and 250.0 pcs. more than those obtained from sowing in August and June, respectively by 65.1% and 44.9% respectively. The sowing time does not affect the diameter of the inflorescence, it varies within very small limits - from 2.47 cm for plants obtained from sowing in June to 2.51 cm for plants obtained during sowing in August.

Figure 1. Phenophases: emergence (left), first true leaf (middle) and fourth true leaf (right)

CONCLUSIONS

1. It was found that the seeds collected in October from wild plants *Verbascum thapsus* L. have very good qualities - 78.91% vitality; germination - 82,48% and germination energy - 73,18% and can be used for production of propagating material.
2. The best phenological characteristics have the plants obtained from sowing seeds in July. The same plants have the longest flowering period of the whole plant. The sowing time does not affect the duration of flowering period of the individual flower.
3. The values of the height of the inflorescence, the diameter of the individual flower and the number of flowers in the inflorescence are highest for the plants obtained from sowing in July. For obtaining of plants with high ornamental characteristics and long flowering period, it is recommended to be used this sowing term.
4. *Verbascum thapsus* L. plants can be successfully used as ornamental plants in outdoor gardening.

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