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BIOLOGY FLOWERING *Salvia officinalis* L. (LAMIACEAE) IN THE CONDITIONS OF INTRODUCTION

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БИОЛОГИЯ ЦВЕТЕНИЯ *Salvia officinalis* L. (LAMIACEAE) В УСЛОВИЯХ ИНТРОДУКЦИИ

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ABSTRACT

The article presents the results of studying the phenology and diurnal dynamics of flowering of *S. officinalis* in the conditions of the Karshi oasis. It was established that the plant entered the generative phase in the second year of vegetation in the conditions of the Karshi oasis, and that flowering lasted 52-59 days. The diurnal dynamics of flowering were studied, and it was observed that flowers open from 8:00 to 11:00 hours, and the peak of flowering occurs at 11:00 hours.

АННОТАЦИЯ

В статье представлены результаты изучения фенологии и суточной динамики цветения *S. officinalis* в условиях Каршинского оазиса. Установлено, что в генеративную фазу растение вступил на второй год вегетации в условиях Каршинского оазиса, что цветение длилось 52-59 дней. Изучена динамика суточного цветения, и наблюдали, что цветы раскрываются с 8^{00} до 11^{00} часов, а пик цветения наступает в 11^{00} часов.

Keywords: medicinal sage, generative phase, flowering, petal, sepal, pistil, stamen, inflorescence, flowering dynamics.

Ключевые слова: шалфей лекарственный, генеративная фаза, цветение, венчик, чашечка, пестик, тычинка, соцветие, динамика цветение.

Introduction. *Salvia officinalis* L. – medicinal sage is a valuable medicinal plant, containing a large amount of essential oil and has long been used in medicine. Essential oils are collected in plant leaves from 1-2,5%, in the above-ground green parts and flowering branches from 0,32% to 0,40% [1, pp. 37-42; 2, pp. 63-68]. In medicine, the leaves of the plant are included in herbal teas used for inflammation of the throat, chest, upper respiratory tract, stomach diseases, and diarrhea. In medicine, it is used as a disinfectant and anti-inflammatory agent [1, pp. 37-42; 3, pp. 215-221].

Considering its valuable medicinal properties and as an essential oil plant, it was introduced into the Botanical Garden of Uzbekistan, and was identified as a promising plant under these conditions [4, pp. 110-125].

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In the conditions of the Karshi oasis, *S. officinalis* was first introduced in 2012 from seedlings grown in the conditions of the Tashkent Botanical Garden. Under these conditions, the seeds were planted in 2014 and its ontogeny was studied. The studies carried out showed that the plant went through all stages of ontogenesis in new conditions [5, pp. 6-8; 6, pp. 93-96]. The biology of flowering *S. officinalis* that went through a generative period in the conditions of the Karshi oasis was studied.

Flowering biology is a part of plant reproductive biology where it is important to study. The main phase of plant ontogenesis is the flowering phase. The flowering phase is an important system that shows the interdependence of all phenophases and the adaptation of the plant to a new environment [7, pp. 10-55].

Studying the biology of plant flowering under conditions of introduction allows us to characterize them ecologically and biologically [8, pp. 9-19]. Flowering and seed formation of a species introduced into new conditions are an important indicator of adaptation [9, pp. 20-40]. This plant blooms, produces seeds and leaves offspring in new conditions only if the requirements of the introduced species for environmental factors are adapted to the new conditions. Proof of this is scientific research conducted to study the biology of flowering of the species under conditions of introduction [3, pp. 215-221; 5, pp. 6-8; 10, pp. 7596-7602; 11, pp. 396-402].

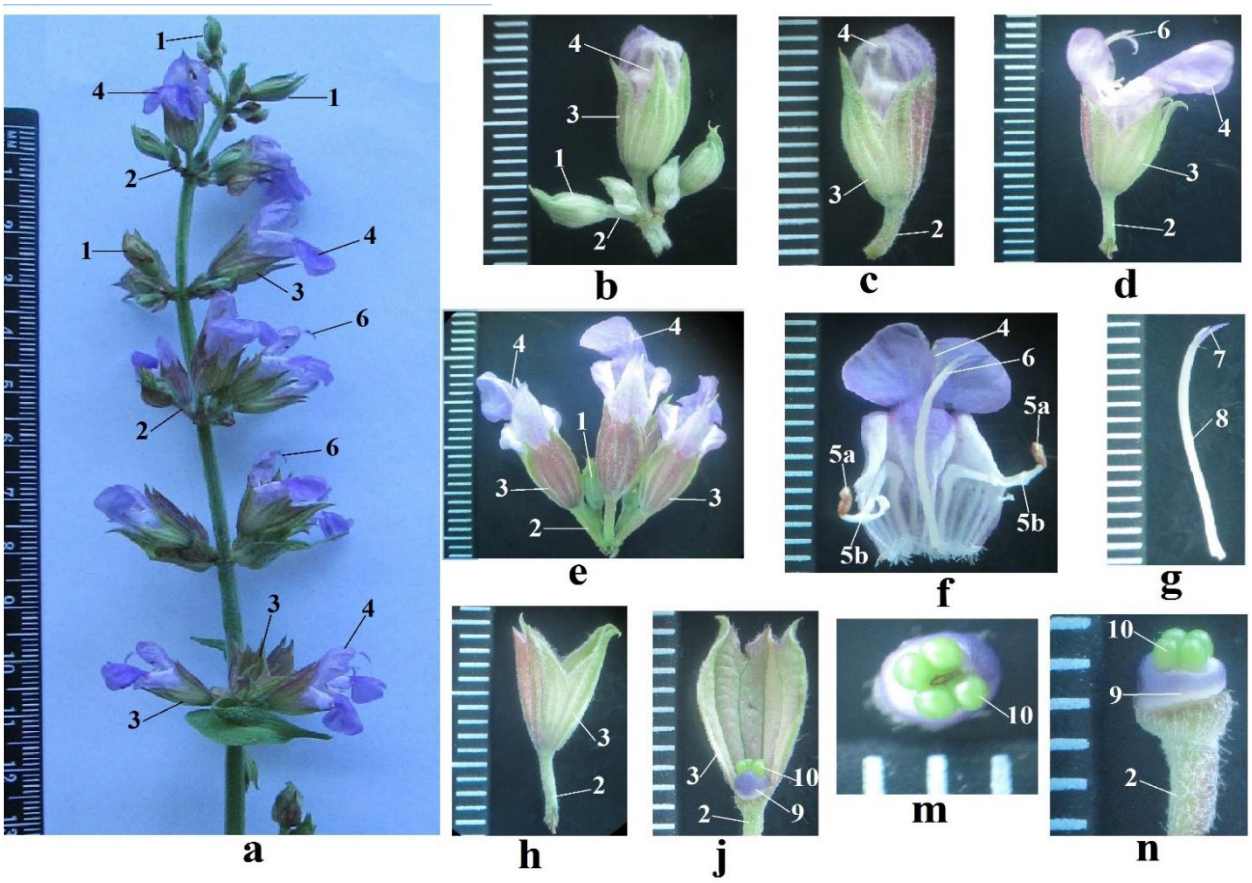
Research methods. To study the diurnal flowering dynamics of *S. officinalis* in the conditions of the Karshi oasis, the number of flowers opening every 2 hours from 5:00 in the morning to 19:00 in plants of the generative phase was counted, the number of open flowers during the day and the time of oblique flowering on one plant, during beginning, mass and end of flowering [10, pp. 9-19]. The morphological features of the flower are given according to generally accepted criteria [12, 352 p]. The results were analyzed statistically [13, 424 p].

Research results. *S. officinalis* flowers are bisexual, blue-violet, zygomorphic. The flowers are collected in a panicle formed at the tips of the main and lateral branches. The flowers are located on the axis of the inflorescence with pedicels covered with glandular hairs and 7,03±0,32 mm long. The sepals are deep, five-toothed, green, covered with glandular hairs. The sepals do not fall off and remain until the fruit ripens. The petals are bluish-violet, two-lipped, the upper lip consists of two petals, the lower one - of three petals bent downwards. Pistil 1, apex of stigma bilobed, ovary superior, four-locular, green. The flower has 2 stamens attached to the tapered base of the corolla. The stamen filaments return from the base, the upper part is arched, white, smooth. Anther slightly bent.

When formed, plant buds are initially very small (2,0-3,0 mm). After 10-12 days, the buds open, the buds grow to 7,09±0,33 mm, the upper part of the sepals opens, and the petals begin to appear between the teeth of the sepals. At first, the petals are light purple, and when the bud fully opens, they become blue-violet. The buds ready to open during flowering are larger than others. Flower opening was observed when the plant buds were fully formed, when the sepal length was 9.02±0.27 mm, the petal length was 13,9±0,33 mm. A fully opened flower has petals twice as long as the sepals, length 18,2±0,59 mm. Flower opening occurs acropetally. Plant flowers are pollinated by entomophiles, mainly with the help of representatives of the bee family. The fruit is a coenobium, consisting of a nut formed by the growth of 4 sepals (Fig. 1).

According to the research conducted, the formation of generative organs was observed in *S. officinalis* in the second year of the growing season in the conditions of the Karshi oasis. In the second year of the growing season, the plant produces 8-10 flowers, in the third year – 150-200, in the fourth year – 120-180 [5, pp. 6-8]. The flowers are arranged in 6-7 rings on the axis of the inflorescence, with up to 10-16 flowers in one ring. Research has shown that one *S. officinalis* flower blooms for 2-3 days, one inflorescence blooms for 10-15 days, and one plant blooms for 52-59 days. *S. officinalis* is a light-loving plant, and the plant can be classified as a group of plants whose flowers open during the day [8, pp. 9-19; 14, pp. 548-557].

In our studies, the beginning of flowering occurred mainly in the first ten days of April, and mass flowering occurred in the period from the second ten days of April to the second ten days of May. The flowering period lasts 52-59 days, mass flowering is observed 8-10 days after the flowers begin to open (Table 1).



Fugire 1. Inflorescence and flower S. officinalis: a – fragment of paniculate inflorescences; b – small inflorescences in bud state; c – the bud is ready to open; d – fragments of flowers; e – small inflorescence in open state; f – longitudinal section of a flower; g – fragment of pistil; h – fragment of sepal; j – longitudinal section of a sepal; m, n – ovary; 1 – bud; 2 – peduncle; 3 – sepal; 4 – petal; 5 – stamen (5a – anther, 5b – filament); 6 – pistil; 7 – stigma; 8 – style; 9 – ovary; 10 – ovule.

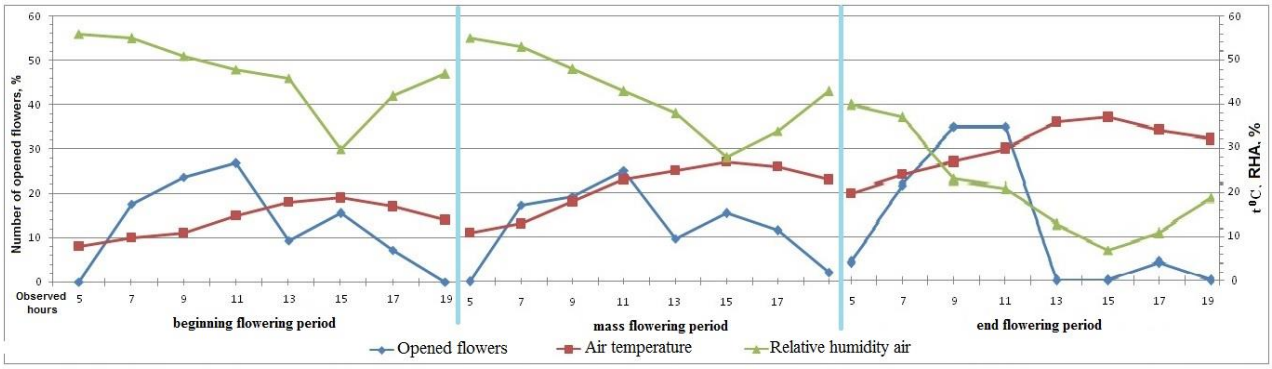
Table 1.

Phenology of flowering *S. officinalis* in the conditions of the Karshi oasis

Observed years	Budding	Flowering period			
		beginning of flowering	mass flowering	end of flowering	duration (days)
2015	03.04	13.04	21.04–19.05	04.06	52
2016	27.03	05.04	18.04–20.05	02.06	58
2017	29.03	08.04	17.04–22.05	06.06	59

The diurnal dynamics of *S. officinalis* flowering were studied in the third year of plant growing season (2016) (Table 2). To do this, the number of open flowers in each bush was counted.

At the beginning of flowering, when the dynamics of daily flowering is observed, at 5:00 o'clock in the morning the air temperature is $+8^0$C, the relative humidity air is 56%, not a single flower has blossomed on the plant. At 7:00 o'clock the temperature is $+10^0$C, the relative air humidity is 55%, the plant has 17 flowers, at 9:00 o'clock the air temperature is $+11^0$C, the relative air humidity is 51%, 23 flowers, at 11:00 the air temperature is $+15^0$C, the relative air humidity is 48%, 26 flowers, at 13:00 the air temperature is $+18^0$C, the relative air humidity is 46%, 9 flowers, at 15:00 the air temperature is $+19^0$C, the relative air humidity is 30%, 15 flowers, at 17:00 the air temperature is $+17^0$C, the relative air humidity is 42%, 7 flowers, have blossomed. During the day 97 flowers bloomed on one plant (Fig. 2).



Fugire 2. Diurnal dynamics of flowering of S. officinalis in the conditions of the Karshi oasis

During the period of massive flowering, 81 flowers bloomed at 6:00-7:00 o'clock in the morning at an air temperature of $+13^0$C, a relative humidity of 53%. At 9:00 o'clock the air temperature was $+18^0$C, relative humidity air 48%, 90 flowers, at 11:00 the air temperature was $+23^0$C, relative humidity air 41%, 117 flowers, at 13:00 the air temperature was $+25^0$C, the relative air humidity 37%, blooming of 45 flowers, 15:00 the air temperature was $+27^0$C, the relative air humidity 28%, blooming of 72 flowers, 17:00 the air temperature was $+26^0$C, the relative air humidity 34%, blooming of 54 flowers, 19:00 the air temperature was $+23^0$C, the relative air humidity 43%, blooming of 9 flowers, was observed. During the period of massive flowering, 468 flowers bloomed on one plant during the day (Fig. 2).

At the end of the *S. officinalis* flowering during the day from 5:00 to 13:00 hours, only 22 flowers opened. During the hottest time of the day, from 12:00 to 16:00, the flowers did not open; only one flower opened at 17:00. At the end of the entire day's flowering, 23 flowers opened, with the most opened flower occurring at 9-11 o'clock. At this time, the air temperature was $+30^0$C, the relative air humidity was 21% (Fig. 2).

In our studies, it was noted that the daily operating time lasts from 7:00 to 19:00 hours. During the day, the beginning of flowering, mass flowering and at the end of flowering, the most opened flower was observed from 8:00 to 11:00 o'clock, and the flowering process reached its peak at 11:00 o'clock (Table 2).

Table 2.

Diurnal flowering dynamics *S. officinalis*

Flowering period	Opened flowers	Observed hours								In a day
		5^{00}	7^{00}	9^{00}	11^{00}	13^{00}	15^{00}	17^{00}	19^{00}	
Beginning 10.04.2016	number	–	17	23	26	9	15	7	–	97
	%		17,5	23,7	26,8	9,3	15,5	7,2		100
Mass 25.04.2016	number	–	81	90	117	45	72	54	9	468
	%		17,3	19,2	25	9,6	15,4	11,5	2	100
End 27.05.2016	number	1	5	8	8	–	–	1	–	23
	%	4,3	21,8	34,8	34,8			4,3		100

Conclusion. According to the results of our observations, *S. officinalis* entered the generative phase in the second year of vegetation in the conditions of the Karshi oasis, the flowering duration was 52-59 days. In one plant, at the beginning of flowering, up to 97 flowers bloom during the day, up to 468 in mass flowering and up to 23 at the end of flowering. Flowers bloom in large numbers between 8^{00} and 11^{00} hours (air temperature $+15+20^0$C, relative humidity air 45-50%), and at 9^{00} hours flowering reaches its peak. It has been established that the flowers of *S. officinalis* belong to the group of plants that bloom during the day.

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