



## Creation of Plantation *Crocus sativus* L. in the Conditions of Uzbekistan

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### Abstract

Bioecological features were studied: the beginning of vegetation, budding, flowering biology, vegetative propagation. The optimum air humidity, air temperature, and soil surface temperature were determined. At the same time, an optimal variant was developed for the cultivation of saffron sowing in the conditions of our republic.

**Keywords:** *Crocus sativus*; Introduction; Bloom biology; Phenology; Reproduction; Phenodynamics

### Introduction

*C. sativus* -saffron seed-an unusually beautiful perennial plant that gives the classic "Golden spice". Known to man since ancient times. In the wild, it does not grow anywhere; it is difficult to establish a home. Most likely, this is Iran, Asia Minor or India. In the wild does not occur and without the participation of man cannot reproduce. According to the widespread theory, the saffron seed was planted in Crete by carriers of the Minoan civilization [1]. Saffron is cultivated for red stigmas, which are used as raw materials with a strong aromatic odor.

Saffron has a strong peculiar flavor and bitterish spicy taste. Saffron stigmas are used for coloring and flavoring confectionery, in cooking, as well as in the production of cheese, sausages and liqueurs. As a spice saffron is used in a very small amount. In the Middle East, in Central Asia and Southern Europe, it occupies an important place in the preparation of dishes from rice (pilaf) and peas. Saffron is added as spice in transparent soups when cooking lamb, mutton, fish soup and cauliflower, broth. In Sweden, saffron is used for dyeing dough products. Along with the spicy properties, saffron also has a preservative effect. Food prepared with saffron is well preserved for several days. In medicine, saffron stigma (lat. Stigmata), collected during flowering and dried, is used. In many countries the stigmas of saffron sowing are used as an antispasmodic and stimulant. Saffron in the past used as a spice to increase appetite. Occasionally, the stigma is used as an analgesic, diuretic, with diseases of the liver, heart and for eye lotions. In folk medicine of Azerbaijan, saffron was recommended in whooping cough, hysterical spasms, as a means of stimulating sexual activity. Abdullaev pointed out that saffron can be useful in cancer chemoprophylaxis soon [2].

Saffron was and remains a very expensive spice (the cheapest Iranian saffron costs 460-470 US dollars per 1 kg, Greek saffron - 770-790 US dollars per 1 kg (Reuters) The most expensive Spanish saffron costs 900-950 dollars USA for 1 kg.). Since growing and obtaining it requires high costs (to get 1 kg of dry saffron, you need to sort out about 2000 flowers.) From 1-hectare plantation in the first year, you can collect only 6 kg of saffron, in the second year - up to 20 kg.). In the Middle Ages, merchants made whole fortunes on this spice, investing in the cost of the goods the cost of its transportation. The use

of saffron in food could only allow wealthy people. It is no accident that the flowers of saffron became a symbol and were used in the heraldry of boursbons. Lily is nothing but a symbolized saffron flower. The genus *crocus* is characterized by underground corms, single apical flowers with a long tubular perianth of white, yellow, purple or purple. Some species bloom in spring, others in autumn. Flowers appear directly from the ground, before the leaves or simultaneously with them, the ovary of the flower remains below the ground level. Plants are stems less [3]. In Index Kewensis there are about 80 species of *crocus* inhabiting Middle-earth, Middle Europe, Front and Central Asia. Classification of the genus *crocus* is rather artificial, since the variability of various species makes it difficult to select the leading characters used in grouping species [4].

### Materials and Methods

In 2011, *C. sativus* was introduced in two different conditions: the city of Tashkent (Botanical Garden) and the Fergana Valley (district Quva, experimental site). The phytochemical composition of the aerial parts of plants under the conditions of introduction was studied.

Saffron - *Crocus sativus* L.-Corms plant with a height of 20-25 cm, has a globular flattened corm, about 2.5-3 cm in width, covered with mesh and fibrous scales and dark brown fibers from the destroyed old scales. The leaves are linear, with a longitudinal white strip, 15-20 cm long and 2-3 mm wide. The flower grows on the end of the stem. A large light purple flower has a strong aroma. Plants in the conditions of introduction blossom in September-October. To study phenology, the method of was used by Beidemann [5]. Studies of the biology of flowering by Ponomarev [6-10].

### Results and Discussion

To determine the optimal variant for the cultivation of saffron, tubers were planted with different options: the diameter of the bulbs, the depth of sowing and watering. Under the conditions of Tashkent, the tubers were planted 10 cm apart and 15 cm deep, with inter-row spacing 40 cm. The vegetation of the underground part of the plant began in the first and second decades of August. The diameter of the bulbs is 2-3 cm, the number of roots is 46-50 pieces, the length of the roots is 4.5-5 cm. The height of the general underground part of the plant is 5.5-6 cm. The length of the sprout is 4-5 cm, width 0.3-5 mm. In the third decade of August, the vegetation of the aerial part will

begin. The height of the general part of the plants is 8-10 cm, the aerial part is 2.5-3.5 cm. The diameter of the bulbs is 2.5-3 cm, the number of roots is 50-54 pieces, the length of the roots is 5 cm (Figure 1).



**Figure 1:** Underground and above-ground part of *C. sativus* (Tashkent).

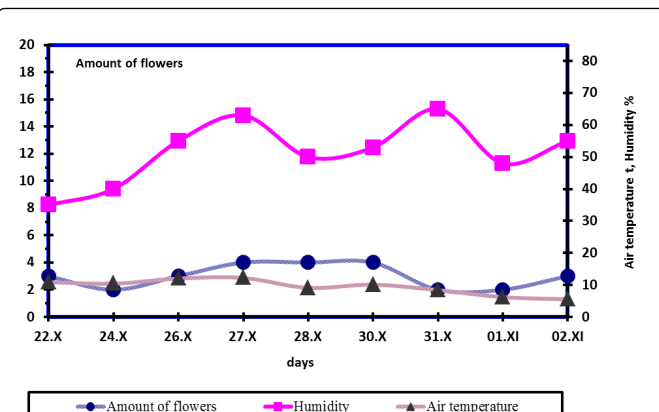
The leaves of *C. sativus* in an amount of 6-10, narrow, linear, dark green, from below with two white strips and a light middle section, appear during or after flowering. Flowers in number 1-4, fragrant, large with a simple corolla-shaped perianth, bisexual, leaving as if from a tuber surrounded by a double-leaved cover covering the perianth tube almost along its entire length. Pedicels are short, unclearly trihedral, 1.5-2 cm long. Perianth is streaky, regular, funnel-shaped, 10-15 cm long, its tube 8-10 cm long, narrow, cylindrical, in the lower part unpainted, Purple, in the throat is hairy. Stamens 3, ovary lower, oblong, almost cylindrical, three-cavity, column 10-12 cm long, coming out from the tip of the ovary, filiform, in the lower part colorless, yellow at the top, ending in three stigmas, 3-3.5 cm long, tubular, slightly enlarged upward, internally longitudinal-split with truncated crenate fanciful tops. Stigmas dark orange, at base yellowish, initially erect, then bent and finally hanging (Figure 2).



**Figure 2:** Flowers of *C. sativus* (Tashkent).

The growth of leaves and the appearance of buds in *C. sativus* L. in Tashkent conditions is observed in the II-III decades of October, sometimes in November, depending on the weather conditions of the year. The earliest bloom was recorded on October 13, 10, most recently at 5.11. Flowering ends in the second decade of November. Saffron is bred by tubers, resembling bulbs in appearance (seeds it does not give), which are obtained from three and four flying plants. The end of vegetation is observed in the first half of May.

In studying the biology of flowering saffron seed, the optimum air humidity, air temperature and temperature of the soil surface are determined (Figure 3).



**Figure 3:** Biology flowering *C. sativus* under introductions (Tashkent).

In the conditions of the Fergana valley, the vegetation of the underground part of the plant began in the first and second decades of August. The diameter of the bulbs is 2.5-3.5 cm, the number of roots is 50-56 pieces, and the length of the roots is 4.5-6 cm. The height of the general underground part of the plant is 6.5-7.5 cm. The length of the sprout is 4-5 cm, width 0.3-5 mm. In the third decade of August, the vegetation of the aerial part will begin. The height of the general part of the plants is 8-12 cm; the aerial part is 2.5-3.5 cm. The diameter of the bulbs is 2.5-3.5 cm, the number of roots is 55-60 pieces, and the length of the roots is 8 cm (Figure 4).



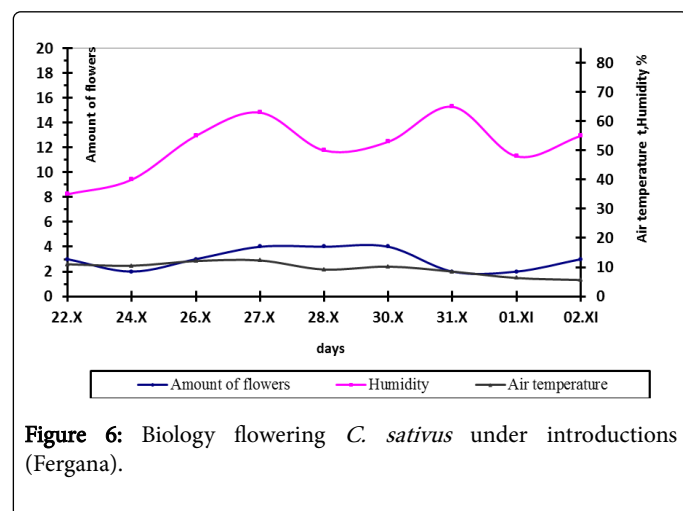
**Figure 4:** Underground and above-ground part of *C. sativus* (Fergana).

The growth of leaves and the appearance of buds in *C. sativus* in Fergana are observed in the first decade of October, sometimes in November, depending on the weather conditions of the year (Figure 5).

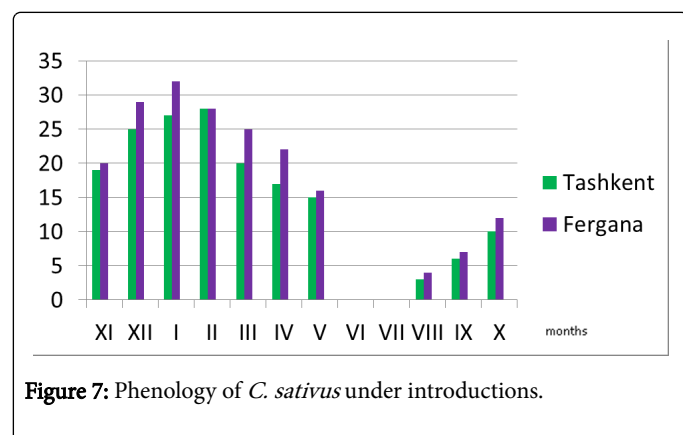


**Figure 5:** Flowers *C. sativus* (Fergana).

The earliest bloom was recorded on 05.10, most recently at 8.11. Flowering ends in II-III decades of November (Figure 6).



The end of vegetation is observed in the second half of May. Duration of vegetation is 210-218 days (Figure 7).



The study noted that in the Ferghana Valley, the beginning of vegetation, budding and flowering will begin earlier than in Tashkent (about 10 days). Phenological features are reflected in Table 1.

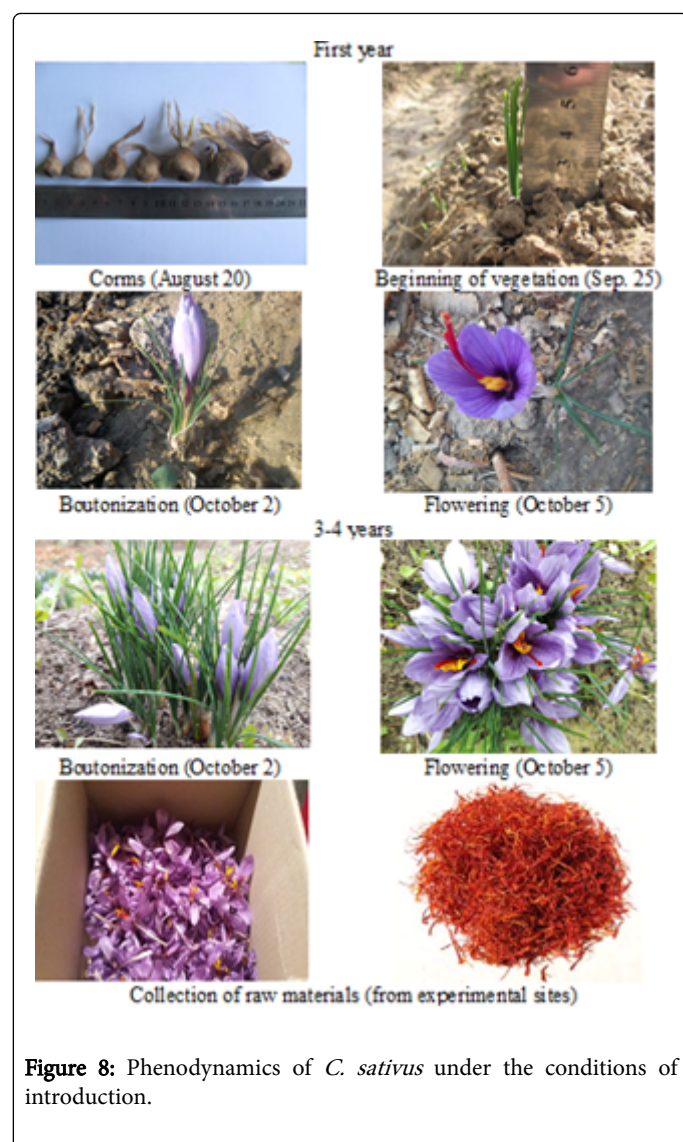
Place of introduction	Version	Beginning of vegetation (aboveground part)	Flowering			Duration of flowering (days)
			Starting	Mass flowering	The end of flowering	
Tashkent (Botanical Garden)	Onion diam. 4-6 cm	28.09	28.1	1.11	7.11	11
	Onion diam. 3-5 cm	28.09	30.1	2.11	8.11	10
	depth 15 cm	28.09	31.1	3.11	8.11	9
	depth 10 cm	28.09	25.1	27.1	3.11	9

Fergana Valley	With watering *	28.09	27.1	1.11	7.11	11
	No watering *	2.1	27.1	30.1	1.11	5
	Onion diam. 4-6 cm	26.09	22.1	25.1	1.1	12
	Onion diam. 3-5 cm	26.09	23.1	25.1	1.11	10
	depth 15 cm	26.09	23.1	26.1	2.11	11
	depth 10 cm	26.09	23.1	26.1	30.1	8
	With watering *	26.09	24.1	27.1	6.11	13
	No watering #	3.1	28.1	29.1	2.11	6

**Table 1:** Phenological characteristic of *C. sativus* under conditions of introduction. \* - At this point the plant was watered once at the beginning of the growing season; # - At this point, plants were not watered at all during the vegetation. Plant watering was carried out at the beginning of vegetation in September (artificially).

During 2011-2016, an optimum variant was determined for the cultivation of saffron under the conditions of introduction. For cultivation of saffron sowing in the conditions of our republic, tubers should be planted in the second decade of August. Tubers should be planted 10 cm apart and 15 cm deep, with rows between 40 cm. During the beginning of vegetation, it is necessary to water once. If the soil is very dry during budding or flowering, then once again you should water it. After harvesting (flowering), it is not allowed to water until the end of the growing season. During six years of research phenodynamics for growing saffron in the conditions of our republic was developed (Figure 8). During 2011-2016, under various conditions of introduction, phenology, the biology of plant blooming and reproduction, were studied (Table 2).





**Figure 8:** Phenodynamics of *C. sativus* under the conditions of introduction.

S.No	Indicators	Years					
		2011	2012	2013	2014	2015	2016
Tashkent							
1	Height of a plant (sm)	5.14 ± 0.14	6.7 ± 0.41	7.84 ± 0.49	8.36 ± 0.35	9.1 ± 0.25	9.16 ± 0.22
2	Length of peduncle (sm)	2.04 ± 0.08	2.52 ± 0.12	2.42 ± 0.14	2.82 ± 0.12	3.34 ± 0.10	3.52 ± 0.09
3	Amount of leaves	3.4 ± 0.24	3.6 ± 0.24	3.4 ± 0.24	4 ± 0.32	4.4 ± 0.24	5.2 ± 0.37
4	Leaf length	2.7 ± 0.11	2.74 ± 0.08	2.76 ± 0.07	2.76 ± 0.07	3.34 ± 0.16	3.44 ± 0.10
5	Amount of roots of corms (pcs.)	23.2 ± 0.86	24 ± 0.71	27.2 ± 1.16	32 ± 0.71	32.6 ± 0.93	33.2 ± 0.97

6	Length of roots of corms (pcs.)	4.32 ± 0.31	5.52 ± 0.18	7.24 ± 0.17	7.66 ± 0.13	7.84 ± 0.15	7.76 ± 0.25
7	Amount of corms (pcs.)	1.6 ± 0.24	3.8 ± 0.37	9.4 ± 1.17	26 ± 3.90	39 ± 4.69	45.8 ± 4.95
8	Amount of flowers (pcs.)	1.4 ± 0.24	2.2 ± 0.37	7.2 ± 1.16	22.4 ± 3.75	30.4 ± 3.16	35.8 ± 3.60
<b>Fergana</b>							
S.No	Indicators	2011	2012	2013	2014	2015	2016
1	Height of a plant (sm)	6.1 ± 0.10	8.44 ± 0.35	8.18 ± 0.21	8.84 ± 0.21	8.94 ± 0.12	8.92 ± 0.12
2	Length of peduncle (sm)	2.5 ± 0.15	2.68 ± 0.11	2.86 ± 0.07	2.86 ± 0.07	2.9 ± 0.05	2.92 ± 0.06
3	Amount of leaves	3.4 ± 0.24	3.6 ± 0.24	5.2 ± 0.37	6.2 ± 0.58	6.6 ± 0.68	6.8 ± 0.58
4	Leaf length	2.96 ± 0.16	3.5 ± 0.09	3.82 ± 0.15	3.78 ± 0.20	4.04 ± 0.18	4.08 ± 0.16
5	Amount of roots of corms (pcs.)	29.8 ± 0.66	29.6 ± 0.24	30.4 ± 0.51	32.2 ± 0.86	33.2 ± 0.58	32.4 ± 0.81
6	Length of roots of corms (pcs.)	5.1 ± 0.20	7.08 ± 0.20	7.08 ± 0.20	7.34 ± 0.28	7.54 ± 0.29	7.36 ± 0.31
7	Amount of corms (pcs.)	1.4 ± 0.24	4.2 ± 0.37	10.8 ± 0.73	26.2 ± 3.17	40.6 ± 3.16	47.8 ± 3.31
8	Amount of flowers (pcs.)	1.6 ± 0.24	2.6 ± 0.24	8.2 ± 0.80	20.2 ± 2.52	32.2 ± 3.93	37.2 ± 3.56

**Table 2:** Bio morphological features of *C. sativus* under different conditions of introduction.

### Phytochemical research

For phytochemical analysis of plants under the introduction conditions, ground parts (flowers) of plants in the flowering phase were used in the conditions of Tashkent and Fergana. To isolate the secondary metabolites, the raw materials of the plant (2 grams each) were isolated with organic solvents of hexane and benzene at room temperature with 3-fold repetition. Features analysis of the components obtained are compared with the database of electronic libraries W8N05STL and NIST08. As a result, it was revealed that the *C. sativus* plant contains 34 volatile compounds. The composition of the hexane extract of *C. sativus* contains a large amount of the components 2,6,6-trimethyl-1,3-cyclohexadiene-1-carbaldehyde (23.40%), 4-hydroxy-3,5,5-trimethyl-2-cyclohexen-1-one (8.29%) and 2,4,4-trimethyl-3-carboxaldehyde-5-hydroxy-1-cyclohexanone-2,5-diene (8.20%), in the benzene extract of this plant in a large amount, the dibutyl phthalate 10.56%, dihydro-4-hydroxy-2 (3H) -furanone (9.43%) and n-tetradecane (4.78%). Figures of the hexane and benzene extract of the chromatography-mass spectrum are reflected below (Figures 9 and 10).

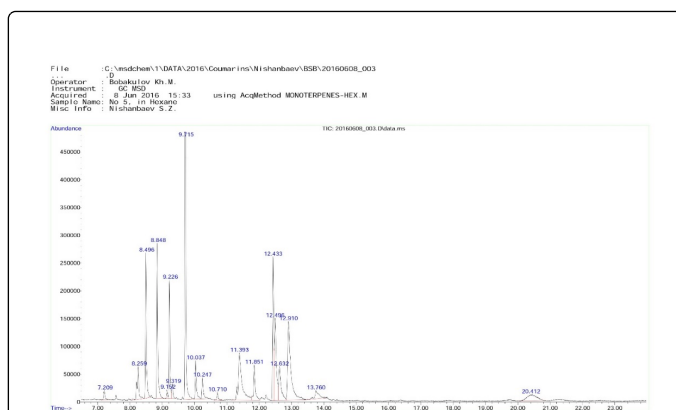


Figure 9: Spectrum of hexane extract of *C. sativus*.

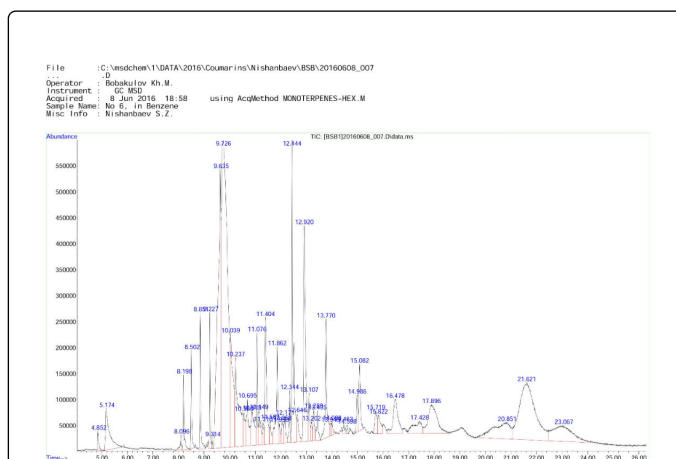


Figure 10: Spectrum of benzene extract of *C. sativus*.

## Conclusion

Because of studies on the introduction of *C. sativus* in Uzbekistan, the following conclusions are presented:

1. In the growth and development of *C. sativus*, the transition to budding and flowering phases is observed at 10-13°C air temperature, 17-20 mil/lux illuminance and 50-60% relative humidity.
2. In the conditions of Tashkent and Fergana, the flowering process is associated with weather conditions, that is, with increasing air temperature and relative humidity, the number of flowers also

increases. During the day, the highest flower opening corresponds to 800-1200 hours. In this case, the opening in *C. sativus* is observed at 20-22°C air temperature and 50-60% relative humidity. This is explained by the close spring and autumn weather parameters under two different conditions.

3. The phytochemical composition of the generative organs of plants is revealed. The composition of the hexane extract of *C. sativus* contains 8, and in the composition of the benzene extract, 26 species of compounds.
4. It has been revealed that *C. sativus* is not damaged even in the winter season, when a decrease in air temperature to 0°C and freezing of the soil surface is observed.
5. For *C. sativus*, the best option is breeding with corms. Developed agrotechnical measures such as the timing and rates of sowing corms, the depth of sowing, the interval of beds, care of plants, cleaning from weeds and irrigation regime will be recommended in forestry.

Thus, bioecological features, growth and development, morphological indices, endurance to various diseases and pests, their full adaptation to introductory conditions indicate the possibility of reproduction and cultivation in irrigated foothill regions of our republic.

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