Received: 30.01.2026. Revised: 18.05.2026. Accepted: 15.06.2026.

Bulletin of the Kyrgyz National Agrarian University

Vol. 24, No. 2. 2026

Journal homepage: https://knau-bulletin.com/en

UDC 633.81:581.54(433.2)

DOI: 10.63621/bknau./2.2026.62

The influence of meteorological conditions on the development and flowering of saffron (*Crocus sativus* L.) in the Chüy Valley, Kyrgyzstan

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Abstract. Trials and the introduction of saffron (*Crocus sativus* L.) were carried out between 2021 and 2025 with a view to diversifying agricultural production. Saffron is a new crop for Kyrgyzstan and is grown for its stigmas, which are a valuable export-oriented product. The aim of the study was to investigate the structure of the saffron flower, as well as the dynamics of flowering depending on meteorological conditions and agronomic practices (types of mulching). The trials were established in the collection nursery of the Kyrgyz National Agrarian University and on the fields of the "Dyikan" farm. Morphological assessment of the plants was carried out on plots arranged in triplicate. The height and number of leaves per plant, the degree of their overwintering, and the number of flowers were taken into account. Statistical processing and visualisation of the meteorological data and flowering productivity data were performed using MS Excel. The results of the trials showed that saffron flowering occurs on bright sunny days, whereas on rainy or overcast days, the flowers do not open. The duration of the flowering phase ranged from 15 to 30 days, depending on the ambient temperature. This phase was shortest in the year of planting

Suggested Citation: Aly, K., Asanaliev, A., Baataeva, Zh., Khegay, S., & Imanaliev, A. (2026). The influence of meteorological conditions on the development and flowering of saffron (*Crocus sativus* L.) in the Chüy Valley, Kyrgyzstan. *Bulletin of the Kyrgyz National Agrarian University*, 24(2), 62-73. doi: 10.63621/bknau./2.2026.62.

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(up to 15 days) and relatively longer in the third year of vegetation. The peak of flowering occurred between mid- and late October. Winter covering (mulching) of the saffron plants had a beneficial effect on generative processes, increasing the number of flowers. All types of mulching contributed to more intensive flowering. A significant difference ($p \leqslant 0.04$ for the average number of flowers per plot over 5 years) was found when covering with compost (374), transparent film (419), and paper (533) compared to the control (217). Thus, the main factors positively influencing saffron yield are the formation of a greater number of leaves and intensive flowering of the plants when using mulching materials (paper, film, and compost)

Keywords: introduction; temperature; precipitation; mulching; atrophy

Introduction

Since the 2000s in Uzbekistan and Tajikistan, and from 2021 onwards for the first time in Kyrgyzstan, research into saffron has begun on experimental fields. The results of this study will be the first regarding the adaptation of this new crop for Kyrgyzstan. Saffron (*Crocus sativus* L.) belongs to the large iris family. According to A. Zar (2024), it has been cultivated in the Middle East and Mediterranean countries since the Late Bronze Age. Saffron is grown for its stigmas, which are used as a spice in various dishes. As noted by A. Lambrianidou *et al*. (2021) noted, saffron possesses a wide range of biologically active properties, including antimicrobial, antioxidant and antitumour effects, which makes it promising not only as a spice and aromatic crop but also as a valuable raw material for the pharmaceutical and functional food industries. According to L. Cardone *et al*. (2020), it is one of the most expensive commercial crops in the world, which is why it is called "red gold". S. Sharma & D. Kumar (2022) stated that saffron stigmas are known as the most expensive spice in the world and for their benefits to human health. The price of 1 kg of stigmas ranges from USD 600 to USD 1,000. The high cost and demand for this golden spice are prompting the scientific community to make efforts towards its large-scale production. According to the article by D. Kothari *et al*. (2021), more than 418 tonnes of saffron were produced annually worldwide across the following areas: in Iran – 108,000 ha, in Afghanistan – 7,557 ha, in India – 3,674 ha, in Greece – 1,000 ha, in Morocco – 850 ha, in Spain – 150 ha, in Italy – 70 ha, and in France – 37 ha, and in small quantities in Central Asian countries.

According to H. Sahabi & F. Moallem Banhangi (2021), the growth, development and yield of saffron depend on climatic factors, specifically average and maximum temperatures. H. Eslamia *et al*. (2024) claimed that in Iran, irrigation following dormancy accelerates and prolongs flowering by 13.5 to 16 days and increases the dry stigma yield of saffron to 7.08 kg/ha. The results of experiments by S. Sudhakar *et al*. (2025) in India showed that high-altitude regions promote the formation of a large number of flowers and an increase in dry stigma yield. Saffron has significant potential for successful cultivation, contributing to the diversification of high-value crops in mountain ecosystems. Modelling by A. Kumar *et al*. (2022) showed that the main environmental variables influencing the adaptation, cultivation and yield of saffron in non-traditional locations and mountainous regions are precipitation and temperature. In Kyrgyzstan, there has been no previous research or experience in saffron cultivation, so all aspects of growing this crop are important. Since the start of the experiments, the main focus has been on the flowering stage. Based on the above, it can be noted that the flowering stage remains poorly studied, including flower structure, flowering dynamics depending on various climatic conditions and agronomic practices (types of mulching, flowering dynamics, etc.). The aim of the study was to assess the influence of meteorological conditions and various types of mulching on the flowering characteristics and productivity of saffron in the Chüy Valley of Kyrgyzstan.

Materials and Methods

The study design corresponded to a single-factor field experiment with three replicates, in which the main factor under investigation was the type of winter cover (mulching) for saffron plants. The experimental trials were established at the collection nursery of the Kyrgyz National Agrarian University and on the premises of the "Dyikan" farm. All observations and records were carried out in accordance with the methods and rules established and approved by the Kyrgyz National Agrarian University. The plot was situated on northern ordinary chernozems at an altitude of 803 metres above sea level. A HANNA HI2002-02 pH meter was used to determine the soil pH, which ranged from 7.5 to 8.0. The humus content was 2.5-2.7% in the topsoil and 0.7-1.3% in the subsoil, as determined using the Tyurin method. The previous crop was winter wheat. The saffron variety 'Mancha' was the subject of the study; one of the high-yielding varieties, it was obtained from the company Guerrero Muñoz-Dalfó Pagés, Spain. On 21 September 2021, saffron was planted in the Chüy Valley. In each plot, 8 rows of saffron were planted with a row spacing of 45 cm to a depth of 10 cm. The plot area was 25 m^2. All observations were carried out in the afternoon on 20 marked plants across all experimental treatments, with three replicates. There were 30 plants per m^2. The experimental design included four plot treatments:

1) uncovered (control);
2) covered with compost;

3) covered with polyethylene film;

4) covered with two layers of kraft paper.

The number of leaves per plant, plant height, the degree of spring overwintering, and the number of flowers per plot were recorded. The degree of overwintering was determined by counting plants in rows 2, 4 and 6; 1-metre-long stakes were fixed in each row, and the number of plants before and after overwintering was counted along this section. Flower dissection was carried out according to the method of P. Mahmoudi *et al*. (2025) using medical tweezers and a scalpel manufactured in Russia. A Soptop SZN71 microscope was used to study the structure of the stamens and pollen grains. During the full flowering phase, flower dissection and organ identification were carried out (Fig. 1).

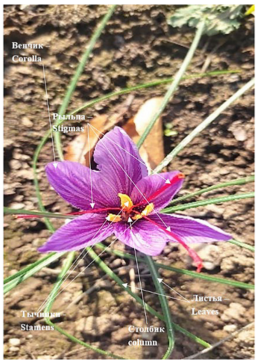

Figure 1. Mature flower

Source: authors' photo

Figure 1 illustrates the main morphological organs of saffron, including the corolla, stigmas, stamens, style, and leaves. Weeds in the plots were removed mechanically. Irrigation was carried out manually along furrows using water from the canal. Annually, the first irrigation took place on 1 September with an irrigation rate of 500 m^3/ha, and the second irrigation followed on 15 September at the same rate. To cover the plants, a two-layer polyethylene film of the M 40 μm × 3 × 100 μm grade and two-layer "A" grade kraft paper with good thermal insulation properties were used. Compost was prepared from fallen leaves from the apple orchard in a concrete pit. The plants were covered when average daily air temperatures turned below zero in November. Flower stigmas were collected by hand using medical tweezers. Stigmas of a dark burgundy colour, without a white base, are considered to be of high quality. A comparative analysis of the average monthly temperature from June to September (diapause) was used to stimulate flowering in October; a gradual transition during the summer is required: ~30°C (2-3 weeks) → ~25°C (1-2 months) → 15-20°C (flowering stage) according to the method of Z. Wang *et al*. (2021). MS Excel was used to process statistical data and create charts. A one-way analysis of variance (ANOVA) was used to examine the effect of mulch. The significance level for the 5-year average flower count was determined at $p \leqslant 0.04$. A correlation analysis (Pearson's correlation coefficient) was conducted to determine the linear relationship between air temperature and the number of flowers. The study was conducted in accordance with the ethical principles set out in the Convention on Biological Diversity (1992).

Results and Discussion

The results of the observations revealed the following phases of saffron: emergence, budding and flowering. The duration of these phases was within one month. The saffron flower consisted of six bright purple petals, with clearly visible longitudinal veins (Fig. 2).

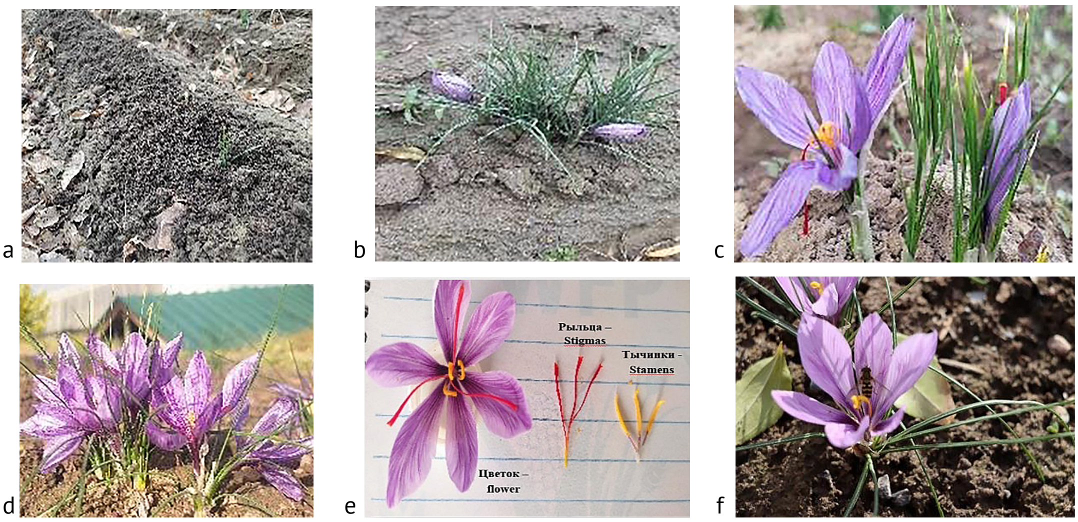

Figure 2. Developmental stages and main parts of the flower

Note: a – germination stage; b – budding stage; c – flowering stage; d – flowering shoot; e – main parts of the flower; f – a fly (*Episyrphus balteatus*) on the flower

Source: authors' photo

Germination occurs 8-10 days after planting the bulbs. The budding phase begins 5-7 days after germination. The flowering phase of an individual flower lasted 5-6 days on average. When the flower opens, the three stigmas are arranged vertically in a single column within the flower. As the petals open fully, the stigmas spread apart and droop downwards in a heliocentric manner. The flowering shoot consists of leaves and flower stalks. At the base of the flower, the stigma forms a column, with three stamens arranged around it. The flower consists of six petals, three stigmas and three stamens. The stamens are bright yellow and elongated-elliptical in shape. The stigmas are burgundy in colour with a slight thickening at the apex and are covered in a sticky liquid. The petals retain their bright colour for 4-5 days and then wilt, turning a pale blue. The saffron flower is pollinated by various groups of pollinators, the most common of which are hymenopteran and lepidopteran insects. As bright sunlight becomes available, the pollen sacs open, and the pollen falls onto the petals and is visible to the naked eye. The opening of the stamens begins at the base, and the pollen grains fall onto the base of the flower's corolla (Fig. 3).

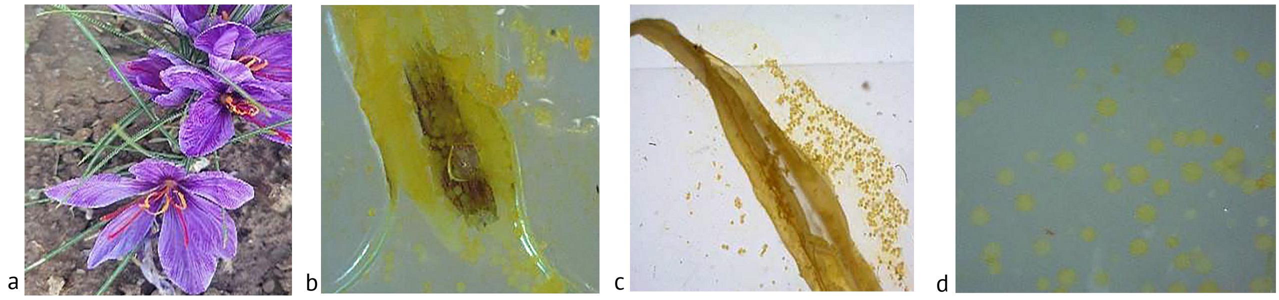

Figure 3. Flower stamens and pollen grains

Note: a – flower and pollen on the petals; b – base of an open anther; c – upper part of an open anther; d – pollen grains

Source: authors' photo

The opening of the pollen sacs begins after the bright rays of the sun have set, which can be seen as a yellow layer at the base of the petals on the inner side. The anther begins to open from its base, with faint cracks. The upper part of the anther opens with the formation of large cracks, accompanied by a profuse release of pollen grains from the anther. The pollen grains are bright yellow in colour, spherical in shape, and show no obvious surface deformities. Most plants complete their growing season in autumn, whereas for saffron, flowering is only just beginning. Purple flowers emerge from the bulbs. In 2021, it took approximately one month from the date of planting to the start of flowering (Fig. 4).

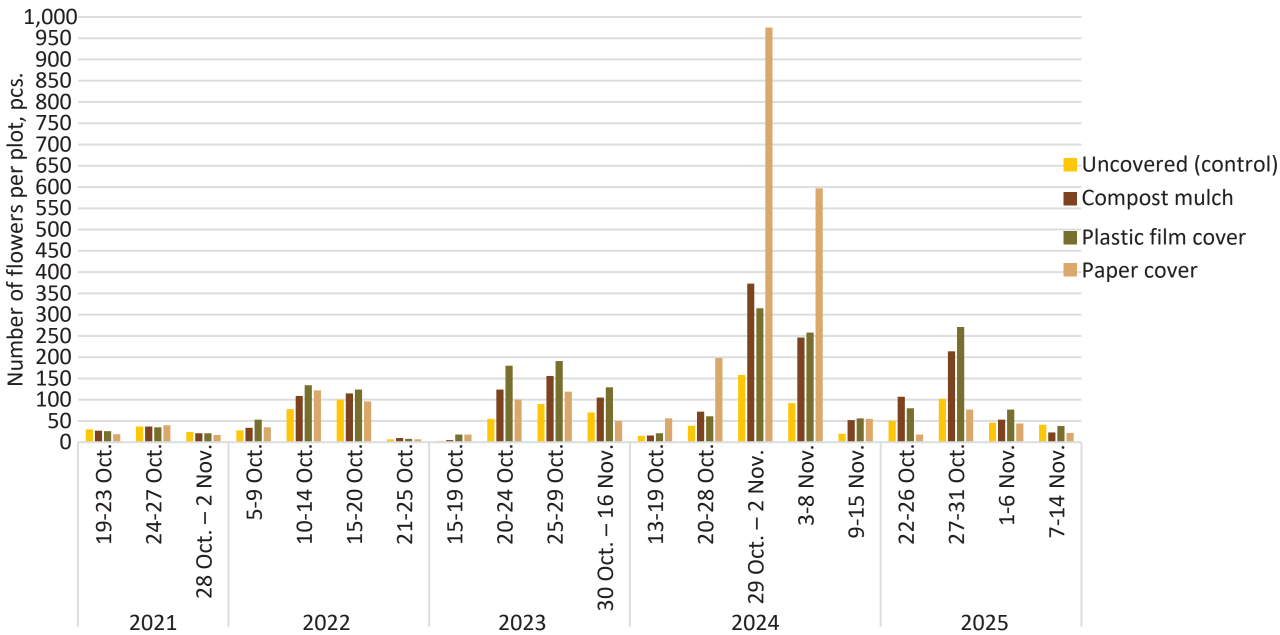

Figure 4. Flowering dynamics of saffron from 2021 to 2025

Source: compiled by the authors

During this period, the bulbs become fully established and shoots emerge above the soil surface, leading to flowering. It should be noted that, in the plants' first year, they were covered with protective materials after flowering to protect them over winter. There was no difference in the onset of flowering across all variants. Flowering peaked between 24 and 27 October. Upon completion of the flowering phase, the transition to winter dormancy began on 2 November. In 2022, flowering began two weeks earlier than in the year of planting. In the variants covered with plastic film and paper, mass flowering began two weeks earlier than in the control. The first flowering peak in the paper-covered treatment occurred on 11 October, five days after flowering began. Five days later, on 16 October, a second peak was observed, with 30 flowers appearing per day. In the other treatments, maximum flowering occurred 10 days after the start of flowering. Plants covered with compost and plastic film stood out for their large number of flowers, producing up to 37-38 flowers per day. A decline in flowering was observed between 15 and 21 October; on 22 October, flowering ceased due to rain, and the end of flowering was noted on 24 October. The duration of the flowering phase in the Chüy Valley of Kyrgyzstan was 20 days. According to A. Khaliq *et al.* (2024), the duration of flowering in Pakistan was 17 days, and in Iran – 16 days, according to H. Eslamia *et al.* (2024). In the Chüy Valley, the duration of saffron flowering was longer than in traditional growing countries due to temperature conditions and the mountainous climate. H. Farrokhi *et al.* (2021) noted that the duration of the flowering period depends on environmental and climatic conditions; as summer maximum temperatures increase, the number of flowers and stigma yield decrease. O. Mykhailenko *et al.* (2020) reported that in the lowland regions of Ukraine, the best saffron yield was obtained in the Kherson region, amounting to 4 kg/ha of dry stigmas. Meanwhile, in Iran, according to H. Pirasteh-Anosheh *et al.* (2023), optimal growing conditions and a sufficient number of warm, sunny days in spring had a positive impact on the subsequent flowering season and on yield, which amounted to 20.8 kg/ha. M. Beyrouthy (2023) calculated that each saffron flower produces three stigmas and, according to his estimate, an average of 150,000 flowers are required to obtain 1 kg of dry saffron stigmas. In 2023, between 15 and 19 October, due to rainy weather, the number of flowers was minimal across all treatments. From 20 October, flowering accelerated, reaching up to 30 flowers per plot in the plastic-covered treatment. The highest flowering productivity was recorded on 24 October at 100 flowers per plot in the plastic-covered treatment, followed by the compost-covered and paper-covered treatments. The lowest saffron flowering productivity was observed in the uncovered variant. A second flush of flowering in all variants occurred between 28 and 30 October. The flowering phase lasted one month, until 16 November.

In 2024, the flowering phase began, as in the previous year, on 13 October. Flowering proceeded slowly and continued until the end of October. From November, peak flowering was observed in all the variants studied. The maximum number of flowers (1,881 per plot in 2024) was observed in the variant covered with paper. During the overwintering period and subsequently the dormant phase, plants under artificial coverings experienced a favourable combination of light and temperature conditions, which contributed to an increase in flowering shoots. The lowest number of flowers was recorded in the control treatment. Rainy weather in early November had an inhibitory effect on the flowering process. The flowering phase lasted 28 days and continued until 15 November, as in the previous year. In 2025, the flowering phase began on 23 October, somewhat later than in previous years of observation. The delay in flowering was due to rainy weather, during which the flowers do not open. As in previous years of observation, a large number of flowers were noted in the covered plots, with the exception of the paper-covered plot compared to the control. It is possible that in the previous year, following abundant (maximum) flowering, insufficient nutrition and overwintering conditions during the fourth year of life affected the biological processes of flower formation. Overall, the duration of the flowering phase in 2025 was 24 days. The statistical data are presented in Table 1. Based on the cumulative data presented in Table 1, the 5-year average number of flowers per plot demonstrated a statistically significant increase in all mulched variants compared to the control. The highest productivity was observed in the plot covered with kraft paper, yielding an average of 533 flowers. The variants covered with transparent film and compost produced 419 and 374 flowers, respectively, whereas the uncovered control plot showed the lowest productivity with an average of 217 flowers.

Table 1. Number of flowers formed, depending on cover by year

Year/Indicator	No cover	Compost	Plastic film	Paper
2021 total from the plot, pcs.	91	85	81	76
per plant, pcs.	2.2	2.07	1.98	1.85
SD	±3.60	±3.47	±3.25	±3.49
SE	±0.56	±0.54	±0.51	±0.55
2022 total from the plot, pcs.	213	268	319	260
per plant, pcs.	5.20	6.54	7.78	6.34

Table 1. Continued

Year/Indicator	No cover	Compost	Plastic film	Paper
SD	8.16	10.48	11.77	10.03
SE	1.27	1.64	1.84	1.57
2023 total from the plot, pcs.	219	390	518	287
per plant, pcs.	5.34	9.51	12.63	7.00
SD	8.86	17.83	22.18	12.16
SE	1.38	2.78	3.46	1.90
2024 total from the plot, pcs.	324	730	711	1,881
per plant, pcs.	7.90	17.80	17.34	45.88
SD	14.68	35.73	30.72	93.54
SE	2.29	5.58	4.80	14.61
2025 total from the plot, pcs.	239	397	466	161
per plant, pcs.	5.83	9.68	11.37	3.93
SD	10.15	19.54	23.04	7.93
SE	1.58	3.05	3.60	1.24
Total for 5 years, units	1,086	1,870	2095	2,665
per plant over 5 years, pcs.	5.29	9.12	10.22	13
5-year average per plot, pcs.	217	374	419	533

Source: compiled by the authors

Table 1 shows that all mulching methods resulted in a higher number of flowers compared with the control (without cover). There is a significant difference between the use of covering materials as mulch and the control ($p \leqslant 0.04$). Table 2 presents the results of an analysis of the relationship between air temperature and the intensity of saffron flower formation in different years of the study.

Table 2. Correlation between air temperature and the number of flowers during flowering by year (R^2)

Indicators	2022	2023	2024	2025
Without cover	0.44	0.14	0.16	0.17
Compost	0.53	0.12	0.18	0.19
Film	0.56	0.11	0.17	0.15
Paper	0.50	0.12	0.20	0.01

Source: compiled by the authors

The data in Table 2 indicate that there is a moderate and significant correlation (44-56%) between the second year of the saffron plant's life, air temperature and the number of flowers, and that the number of flowers is influenced by other factors. In the third, fourth and fifth years of the plants' life, the correlation remains positive but insignificant. This is explained by the fact that as the plants age, the size of the bulbs increases and new daughter bulbs appear, thereby increasing the number of flowers. At the same time, the coefficient of determination was higher in the variants covered with compost and plastic film, which create favourable conditions during the plants' winter growth. The data obtained show that the 'Mancha' variety, of the Spanish ecotype, possesses good productive characteristics. Experiments conducted by K. Erden (2025) in the Harran province of Turkey showed that the highest-quality stigmas were obtained from the Greek ecotype of saffron, whilst the highest stigma yield was obtained from the Spanish ecotype of saffron under the conditions of south-eastern Anatolia. Tests on the Indian ecotype of saffron yielded low yields and quality compared to the Greek and Spanish ecotypes. Experiments by S. Sudhakar *et al.* (2025) in India revealed significant differences between locations, with Kantalur-Perumalai showing the highest flower density, yield of fresh flowers and dry stigmas, which is explained by favourable temperature conditions, altitude and soil characteristics and contributes to the diversification of high-value crops in mountain ecosystems. A. Khaliq *et al.* (2024) demonstrated that in Pakistan, the maximum number of flowers (1.35 per plant) was recorded at the Haigala site at a temperature of 26°C. In autumn, it took 30 days for flowering to begin at the Alisojal site, and the flowering period lasted 17 days. According to Z. Wang *et al.* (2021), the following principles of saffron cultivation apply: a two-stage method of saffron cultivation; saffron flowers best when warm, moderate and cool temperatures alternate; high temperatures during the dormancy period are necessary for the onset of saffron flowering; optimal temperatures promote early flower formation and shorten the flowering period. The influence of mulch types and meteorological factors on saffron flowering. Studies were also conducted to investigate the relationship between the flowering phase and meteorological indicators such as air temperature and precipitation (Fig. 5).

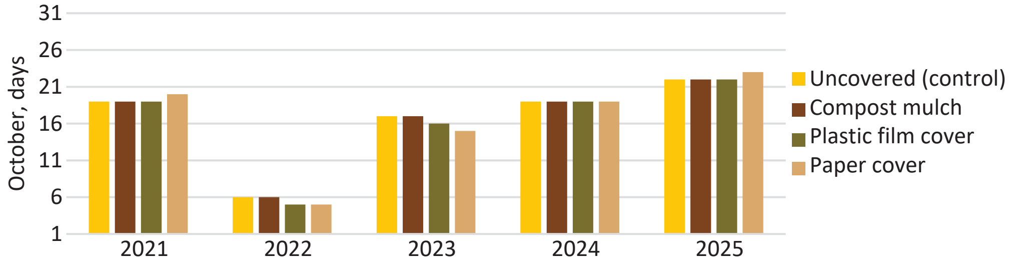

Figure 5. The onset of saffron flowering depending on the type of cover by year
Source: compiled by the authors

No use of mulch is observed at the time of the first saffron flower's emergence; the first flowers appear in October across all plots, with a variation of up to two days. An analysis of monthly average temperatures and precipitation in the Chüy Valley for the period 2021-2025 allows an assessment of the conditions for saffron cultivation, based on the incubation temperature regime proposed by Z. Wang *et al.* (2021). Temperature conditions (monthly averages) during the diapause and flowering periods of saffron are shown in Table 3.

Table 3. Average monthly temperature conditions during saffron dormancy and flowering

Year	June (°C)	July (°C)	August (°C)	October (°C)	Average temperature during dormancy and flowering (°C)	The effect of temperature on plant development
	30	30	25	15-20		Model by Z. Wang *et al.* (2021)
2021	17.6	21.2	18.4	14.5	17.93	Unfavourable: temperatures too low for initiation (below 25-30°C)
2022	17.8	19.9	16.4	15.1	17.30	Unfavourable: risk of daughter bulb atrophy and reduced flower count due to cool temperatures during dormancy
2023	25.8	26.6	24.9	18.4	23.93	Optimal: temperatures in July-August (25-26°C) and September (18.4°C) are close to the ideal pattern
2024	25.6	26.5	26.2	17.2	23.88	Favourable: steady warming in summer and a gradual decline in September
2025	26.4	28.1	25.7	9.6	22.45	Risky: high summer temperatures are favourable, but a sharp drop in September to 9.6°C could halt development

Source: compiled by the authors based on data from Kyrgyzhydromet (n.d.), Bishkek

The data in Table 3 show that conditions during the period 2023-2025 were favourable and better align with the model proposed by Z. Wang *et al.* (2021) (high summer temperatures stimulate bud set). In 2021-2022, temperatures were relatively low for effective shoot and root system development. Thus, the model proposed by Z. Wang *et al.* (2021) does not fully correspond to the actual temperature conditions and flower formation. This is due to the need for further research in various regions of Kyrgyzstan. Other researchers believe that the optimal temperature for shoot growth (23-25°C) was also optimal for flower bud formation (Molina *et al.*, 2004). In studies, the optimal temperature for the diapause and initiation of saffron flowering was 25-27°C. The results of studies by A. Khaliq *et al.* (2024) in Pakistan showed that the maximum number of flowers (1.35 per plant), fresh flower weight (29.03 mg/plant), stigma length (1.21 cm), fresh stigma weight (8.97 mg/plant) and stigma yield (8.60 mg/pot) were recorded at the Haigala site (loamy soil) at a temperature of 26°C. Z. Wang *et al.* (2021) reported that unsuitable incubation temperatures, such as a constant temperature of 15°C or 25°C, lead to a failure to flower, interruption of flowering and atrophy, respectively. Consequently, incubation of tubers at a higher temperature (around 30°C) for 2-3 weeks, followed by transfer to a suitable temperature (around 25°C) for 1-2 months and, finally, transfer to a lower temperature (around 15-20°C) for flowering, constitutes a suitable temperature regime for stimulating flowering, resulting in saffron entering the full flowering stage in early October. Research by D. Gao *et al.* (2023) showed that the number of flowers, the proportion of daily flowering, and dry weight were significantly correlated ($p \leqslant 0.01$) with the total daily integral of sunlight intensity. According to K. Kour *et al.* (2022), corm size has the greatest influence on saffron growth. In percentage terms, the priority of corm size as a variable is 34%, followed by water availability (27%), as well as temperature and mineral nutrients (24% and 17% respectively). In this regard, Table 4 presents the results of an analysis of meteorological conditions during the dormancy period and factors contributing to the initiation of saffron flowering.

Table 4. Precipitation, mm

Month	Year				
	2021	2022	2023	2024	2025
January	14.4	17	29.8	25	25
February	33.3	20.7	42.2	29	94
March	69.1	112.7	91.2	110	59
April	33.5	65.4	53.1	27	93
May	38	128.6	18.9	8	61
June	28	32.3	2.8	11	19
July	27.6	39.8	17.4	9	5
August	19.1	23.4	19.2	6	1
September	1.8	1.7	24.3	23	18
October	46.7	44.8	38.9	55	20
November	33.7	58.5	64.5	38	21
December	15.3	17.1	60.3	29	51
Total precipitation	360.5	562	462.6	370	467

Source: compiled by the authors based on data from Kyrgyzhydromet (n.d.), Bishkek

The data in Table 4 show that September 2021 was extremely dry (1.8 mm), which, combined with cooler temperatures, may have delayed the start of the growing season, despite moderate rainfall in October (46.7 mm). 2022: a very wet November (58.5 mm) following a dry autumn may have promoted leaf growth, but not flowering itself. In 2023, balanced rainfall (September 24.3 mm, October 38.9 mm, November 64.5 mm) created the best conditions for soil moisture during the flowering period. In 2024, October was the wettest (55 mm), which was favourable for the active flowering phase that began after a warm summer. In 2025, there was a moisture deficit in October (20 mm) and rainfall in November (21 mm) compared to previous years, which caused a delay in the start and end of flowering. Meanwhile, Iranian researchers H. Sahabi & F. Moallem Banhangi (2021) noted that in the provinces of Khorasan Razavi and South Khorasan there was a negligible difference in three climatic parameters, namely summer precipitation, temperature and hours of sunshine, which cannot be the cause of lower saffron quality; rather, saffron quality can be significantly improved through other factors, such as better planning and management. According to T. Pashayev & İ. Mammadov (2019), saffron, due to its biological characteristics, is highly adaptable to various climatic conditions and can be successfully cultivated at different altitudes above sea level, as well as with variations in the timing and depth of bulb planting. The authors note that these characteristics of the crop ensure high profitability and economic efficiency of its cultivation. Based on the results obtained by T. Ali *et al.* (2025), the following conditions must be taken into account for the effective cultivation of saffron in non-traditional regions: altitude above sea level (>600 m), soil texture, air temperature during flowering (October-November) not exceeding 17°C, and precipitation levels prior to flowering.

Conclusions

The weather conditions in 2023 and 2024 were most favourable for the resumption of flowering in October, as the temperature regime during dormancy provided the necessary "incubation" for the tubers (25-26°C), and autumn rainfall was sufficient to sustain physiological processes. In 2025, despite ideal dormancy conditions, a sharp drop in temperature in September and a dry autumn may have had a negative impact on flower formation. The best results for the resumption and completion of the full flowering cycle in October were observed in 2023 and 2024. In these years, the following sequence was observed: bulbs warmed to above 25°C in July-August, a gentle drop in temperature in September to 17-18°C, and sufficient rainfall (38-55 mm) in October to maintain soil moisture. Forecasting the saffron harvest in Kyrgyzstan is complicated by the fact that key agronomic practices have not yet been studied: planting dates and rates, irrigation regimes, testing of other varieties under a sharply continental climate, and other factors that may influence the growth and development of saffron. Winter protection of saffron plants had a beneficial effect on the flowering process, increasing the number of flowers – the marketable yield of this crop. The flowering phase lasted up to 30 days. Abundant (maximum) flowering lasted for 10 days. Prospects for further research involve studying the influence of various irrigation regimes, planting dates and saffron variety characteristics on flowering processes and crop yield in different regions of Kyrgyzstan. The adaptation mechanisms of saffron to changing climatic conditions and the effectiveness of various agronomic practices in its cultivation also require further study.

Acknowledgements

None.

Funding

None.

Conflict of Interest

None.

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Кыргызстандын Чүй өрөөнүндө шафрандын (*Crocus sativus* L.) өнүгүшүнө жана гүлдөшүнө метеорологиялык шарттардын таасири

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Аннотация. Өндүрүштү диверсификациялоо максатында 2021-2025-жылдары эгилме шафранды (*Crocus sativus* L.) сыноо жана интродукциялоо иштери жүргүзүлдү. Шафран Кыргызстан үчүн жаңы өсүмдүк болуп саналат жана экспортко багытталган продукция болгон гүлдүн мамычасын алуу үчүн өстүрүлөт. Изилдөөнүн максаты шафран гүлүнүн түзүлүшүн, ар кандай метеорологиялык шарттарга жана агротехникалык ыкмаларга (мульчалоо түрлөрүнө) жараша гүлдөө динамикасын изилдөө болгон. Эксперименттик тажрыйбалар Кыргыз улуттук агрардык университетинин коллекциялык питомнигинде жана "Дыйкан" фермердик чарбасынын талаасында жүргүзүлгөн. Өсүмдүктөрдүн морфологиялык баалоосу үч жолку кайталануу менен жайгаштырылган аянтчаларда жүргүзүлгөн. Өсүмдүктүн бийиктиги, жалбырактарынын саны, кыштоодон өтүү деңгээли жана гүлдөрүнүн саны эсепке алынган. Статистикалык эсептөөлөрдү жүргүзүү жана алынган маалыматтарды визуалдаштыруу үчүн метеорологиялык маалыматтар жана шафран гүлдөрүнүн саны боюнча MS Excel компьютердик программасы колдонулган. Изилдөөлөрдүн жыйынтыгында шафран ачык күн тийген күндөрү гүлдөп, жаанчыл жана булуттуу күндөрү гүлдөрү ачылбагандыгы аныкталган. Шафрандын гүлдөө фазасы айлана-чөйрөнүн температурасына жараша 15-30 күнгө созулган. Гүлдөө фазасынын эң кыска мөөнөтү отургузулган жылы байкалган – 15 күнгө чейин, ал эми жашоо циклинин үчүнчү жылында салыштырмалуу узагыраак болгон. Гүлдөрдүн эң көп саны октябрь айынын ортосунан аягына чейин байкалган. Шафран өсүмдүктөрүн кышында жабуу гүлдөө процессине оң таасирин тийгизип, гүлдөрдүн санын көбөйткөн. Мульчалоонун бардык түрлөрү шафранда гүлдөрдүн көбүрөөк пайда болушуна өбөлгө түзгөн. Компост (374 даана), тунук пленка (419 даана) жана кагаз (533 даана) менен жабууда контролго (217 даана) салыштырмалуу олуттуу айырмачылык байкалган ($p \leq 0{,}04$, 5 жылдагы бир аянтчадагы гүлдөрдүн орточо саны). Шафрандын түшүмдүүлүгүнө таасир эткен негизги көрсөткүчтөр мульча – компост жана пленка колдонулганда өсүмдүктөгү жалбырактардын жана гүлдөрдүн санынын көбөйүшү болгон

Негизги сөздөр: интродукция; температура; жаан-чачын; мульчалоо; атрофия

Влияние метеорологических условий на развитие и цветение шафрана (*Crocus sativus* L.) в Чуйской долине Кыргызстана

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Аннотация. В период с 2021 по 2025 год проводились испытания и интродукция шафрана посевного (*Crocus sativus* L.) с целью диверсификации сельскохозяйственного производства. Шафран является новой культурой для Кыргызстана и выращивается ради получения рылец – ценной экспортно-ориентированной продукции. Целью работы было изучение строения цветка шафрана, а также динамики цветения в зависимости от метеорологических условий и агротехнических приемов (вариантов мульчирования). Опыты были заложены в коллекционном питомнике Кыргызского национального аграрного университета и на полях фермерского хозяйства «Дыйкан». Морфологическая оценка растений проводилась на делянках в трехкратной повторности. Учитывались высота и количество листьев на растении, степень их перезимовки и количество цветков. Статистическая обработка и визуализация метеорологических данных, а также данных по продуктивности цветения выполнялись с помощью программы MS Excel. По результатам испытаний установлено, что цветение шафрана происходит в яркие солнечные дни, тогда как в дождливую и пасмурную погоду цветки не раскрываются. Длительность фазы цветения составляла 15-30 дней в зависимости от температуры окружающей среды. Наиболее короткой эта фаза была в год посадки (до 15 дней), а относительно удлиненной – на третий год вегетации. Пик цветения приходился на период с середины до конца октября. Зимнее укрытие (мульчирование) растений оказало благоприятное воздействие на генеративные процессы, увеличивая количество цветков. Все типы мульчирования способствовали более интенсивному цветению. Выявлена существенная разница ($p \leqslant 0{,}04$ по среднему количеству цветков на делянке за 5 лет) при укрытии компостом (374 шт.), прозрачной пленкой (419 шт.) и бумагой (533 шт.) по сравнению с контролем (217 шт.). Таким образом, основными факторами, положительно влияющими на урожайность шафрана, являются формирование большего количества листьев и интенсивное цветение растений при использовании мульчирующих материалов (бумаги, пленки и компоста)

Ключевые слова: интродукция; температура; осадки; мульчирование; атрофия