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RESEARCH ARTICLE
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Effect of Different Lighting Environments on the Biomass and Dry Matter Content of Raw Materials of *Chelidonium majus* L. (Papaveraceae) Under Cultural Conditions

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ABSTRACT

In the introduction and cultivation of plants, it is important to take into account factors in naturalgrowth conditions. This is ofgreat importance in many respects, ensuring the normal course of the strategy of adaptation of plants to cultural conditions, while preserving their beneficial properties, including the quantitative and qualitative indicators of secondary metabolites. *Chelidonium majus* L. (Russian: Chistortel bolshoy; English:greater celandine), a member of the Papaveraceae family, is a medicinal plant thatgrows naturally mainly in temperate regions. In Uzbekistan, this plant is used to treat various diseases of humans and domestic animals. Since there are no natural reserves of *Chelidonium majus* L. in Uzbekistan, it wasgrown in plantation conditions and the role of environmental factors on the biomass indicators of medicinal raw materials during thegrowing season was assessed. It was observed that the biomass indicators of the raw material organs of the plant initially increased depending on the age of its vegetation and sharply decreased in the last vegetation year. It was found that the raw material biomass and dry matter content of the plantgrown under artificial shade was significantly higher than that of the plantgrown under direct sunlight.

Keywords: Chelidonium majus, Above- and below-ground organs, Wet and dry biomass, Dry matter, Sunlit and shaded plantations.

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INTRODUCTION

The rapid growth of the pharmaceutical industry in many countries, including the Republic of Uzbekistan, has led to a sharp increase in the demand for medicinal plant raw materials by pharmaceutical enterprises, which are known to make about 50% of their drugs from medicinal plant raw materials. It should be noted that the demand for medicinal plant raw materials can be satisfied primarily by growing medicinal plants; at the moment, in our country's specialized farms and forestry, they are cultivated without scientific justification due to the lack of fully developed technologies for growing medicinal plants (Habibullo et al., 2014). The development of medicinal plant cultivation technology is known to be hampered by a number of factors, including the seasonality of agricultural work, the application of agrotechnical measures at clearly defined times, the nearly total lack of consistency in weather over time, the stark differences in soil and climatic conditions of each region and many more (Nasimova et al., 2024). Natural biological resources constitute the foundation of many traditional healing systems, and natural medicine is becoming more and more popular worldwide, which has an immediate impact on the availability and demand for medicinal plants. The economic significance of medicinal plants, their role in healthcare systems, and the possibility for cultivation-based rural economic development are all highlighted in this analysis (Mofokeng et al., 2022).

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In Turkey, *Chelidonium majus* is referred to as "kırlangıç otu."The various plant components, particularly the latex and aerial portions, have been utilized as traditional medicines for a variety of ailments, including liver, eye, skin and digestive issues. Despite *Chelidonium* historical applications, no thorough anatomical research has been done on this species. The anatomical analysis clarified epidermal sections with trichome and stomata characteristics. The leaves are hypostomatic and bifacial. In the paradermal portion, the stomata are anomocytic. The stem's cross-section revealed a single-layered endodermis with basic eglandular trichomes and multi-layered parenchymatous cells in the cortex. The cross-section of the root showed that the epidermis was replaced with the periderm. Under the phloem, which had few layers, the xylem was composed of tracheary elements surrounded by sclerenchymatous cells (Zare et al., 2021). The yield of the plant Chelidonium majus varied depending on the years of cultivation and the phases under investigation. The herb yield peaked at the start of flowering, after which it started to decline until the seed harvest phase, when it increased. In both years, the herb that started flowering had the lowest alkaloids content (0.608%). The average flavonoid concentration was the same in both years, ranging from 0.310% at the start of blooming to 0.522% at the seed harvest. The fall rosette phase showed a consistent high concentration of specific alkaloids, flavonoids, and total alkaloids (Seidler et al., 2016). Small basic proteins known as plant non-specific lipid transfer proteins (nsLTPs) are primarily involved in intracellular lipid transport and antimicrobial defense. Using a shotgun proteomic technique, it was recently demonstrated that *Chelidonium majus* L. (Papaveraceae) has a comparatively high concentration of nsLTPs in the whole plant extract. Thus, the work's objective was to separate and describe nsLTP from C. majus latex (Nawrot et al., 2017). In both traditional Chinese medicine and western phytotherapy, *Chelidonium majus* L. is a significant plant. A wide range of biological effects (anti-inflammatory, antibacterial, antitumoral, analgesic, and hepatoprotective) are demonstrated by crude extracts of C. majus and purified compounds obtained from it, supporting some of the plant's traditional applications. Herbal medicine, however, also asserts that this plant possesses a number of significant qualities that have not yet been investigated scientifically: It is believed that C. majus has antitussive, diuretic, and eye-regenerating properties (Gilcă et al., 2010). It was investigated how production practices affected the phytochemical profile and biological activity of *Chelidonium majus* L. aqueous ethanol extracts. Aerial portions of the same plant population that were gathered in the wild and cultivated using organic farming methods were used to make extracts. Alkaloids and flavonoid derivatives were analyzed qualitatively and quantitatively using LC/MS techniques, and the cytotoxicity of lyophilized extracts was investigated in B16-F10, HepG2, and CaCo-2 cells. After cultivation, chelidonine was the most prevalent alkaloid, but copolysine dominated extracts made from wild-grown plants (Krizhanovska et al., 2021). The goal of wound healing is to restore tissue integrity through a complex physiological process that involves numerous cellular and molecular activities. Recent years have seen an increase in interest in using natural compounds' medicinal potential to create sophisticated wound dressings. Notably, the silk-derived protein sericin and the plant compound *Chelidonium majus* L. have become attractive contenders, offering a special blend of organic components that could transform traditional wound care techniques. Known for its many qualities, sericin exhibits special qualities that hasten the healing of wounds (Borges et al., 2024). Herbal product-based novel nanotechnology aims to be an effective therapeutic platform. In order to overcome the limitations imposed by low stability, toxicity, absorption, and targeted and prolonged release, this study reports the development of an original engineering carrier system that combines the pharmacological action of AuNPs and *Chelidonium majus*. Seventy-four phytochemicals from eight different secondary metabolite categories—including alkaloids, amino acids, phenolic acids, flavonoids, carotenoids, fatty acids, sterols, and other substances—are present in the metabolite profile of Romanian wild-grown *Chelidonium majus* (Segneanu et al., 2024). The anti-inflammatory, anticancer, and cytotoxic properties of *Chelidonium majus* L. are attributed to its abundance of isoquinoline alkaloids. Chelidonine, berberine, coptisine, sanguinarine, and chelerythrine are the primary alkaloids found in *Ch. majus* L. and are found in various plant sections. This study used a two-step extraction process to extract alkaloids from the aerial and terrestrial parts of *Ch. majus*. The first step (SFE) used only supercritical carbon dioxide (scCO2) as the solvent, and the second step (ESE) used scCO2 along with a co-solvent mixture made up of diethylamine (alkaline conditions) and alcohol (ethanol or isopropanol) (Nicolás et al., 2016). The medicinal plant *Chelidonium majus* L. is well-known for being a rich source of isoquinoline alkaloids, which have a number of pharmacological characteristics, such as antiviral and antibacterial activities. However, the identification and verification of raw materials are complicated by the significant intraspecific bio-morphological heterogeneity in *Ch. majus*. Five populations of *Ch. majus* subsp. *majus* from various places were brought into cultivation for the first time, and their agro-morphological, microanatomical, and molecular cytogenetic characterizations were carried out. High yields of seed (18.6–19.9 kg/ha) and raw materials (0.84–1.08 t/ha) were produced by all populations under study; the total alkaloid concentrations ranged between 0.30 and 0.38% (Samatadze et al., 2020). Extracts were made using a traditional extraction method from the plant species *Ch. majus*, which is a very rich source of secondary metabolites. Three different solvents—ethyl acetate, methanol, and water—that vary in polarity were utilized to extract the bioactive compounds. The resulting extracts were analyzed for cytotoxic effects, antioxidant activity, chemical composition, and enzyme inhibitory activity. The solvent's polarity, or chemical makeup, was the primary factor in the extraction of flavonoids and alkaloids (Terzić et al., 2024). For many years, homeopathy and traditional medicine have utilized the milky juice of the larger celandine herb to cure viral warts. However, the characteristics of celandine herbs are not used by traditional medicine to cure papillomavirus-induced disorders. However, individuals frequently visit dermatological outpatient clinics to claim that the milky sap extracted from celandine herb works well for treating their own viral warts (Joanna et al., 2020). The perennial herbaceous plant known as greater celandine (*Chelidonium majus* L., Papaveraceae) has huge leaves, an upright, spreading stem, and yellow flowers that are gathered in an uncommon umbel inflorescence on top of the stems. After the horses were treated with extracts from the roots and stems of *Ch.majus* that were collected from both rural and urban agglomerations, the study's primary goal was to evaluate the oxidative stress biomarkers [2-thiobarbituric acid reactive substances (TBARS), carbonyl derivatives content of protein oxidative modification (OMP), and total antioxidant capacity (TAC)] as well as the activity of antioxidant enzymes (catalase, ceruloplasmin) in the equine plasma (Stefanowski et al., 2021). This bibliographic analysis provides a comprehensive overview of contemporary non-invasive technologies for soil mapping, with a particular focus on their implications for agricultural management, agroecology, and food security. We explored the advantages and limitations of remote and proximal sensing methods for soil moisture assessment (Zeyliger et al., 2025). The quality of semen deteriorates as storage time progresses, which may compromise the fertilizing capacity of spermatozoa. This study investigated the storability of Lusitu boar semen (LBS) for 4 days. The study employed repeated measures factorial design that considered storage time and boar factors to generate the data. A total of 36 ejaculates, with six collected per boar, were preserved at 17℃ in BTS extender, followed by analysis after 2 (D0), 48 (D2), and 96 (D4) hours of storage (Abigaba et al., 2025). The cluster analysis helped to identify that 50% of the farmers are sensitive towards climate changes and its adverse effects, 22% of the farmers have a moderate attitude, and 28% classify less sensitive. Educated farmers and owners of large-scale production turn out to be more sensitive towards the environment and humanmade implications. The results can be used in several theoretical and practical implications for sustainable management of crop production (Bolatova et al., 2025). This study investigates the anatomical structure of the vegetative organs—leaves, petioles, and stems—of promising artichoke varieties, specifically Imperial Star and Violettto. A particular focus was placed on the anatomy of the petiole, alongside a comparative analysis of biometric indicators, to explore the relationship between organ strength and plant life forms (Isomov et al., 2025). The article presents an ecological analysis of *Leontice* L. species in the Navoi region. The genus *Leontice* grows mainly in mountainous areas and some are distributed in arid climates (Bobokandov, 2024). The paper does not specifically address the ecological implications of Chelidonium majus L. on local biodiversity. It focuses on the overall plant diversity in urban green spaces and the importance of native species for urban sustainability (Mogîldea & Biţă-Nicolae, 2024). The paper does not specifically address the ecological implications of Chelidonium majus L. on local biodiversity. It focuses on broader pesticide impacts on various organisms and their habitats in agricultural landscapes (Brühl, 2019). Climate change threatens local biodiversity through habitat destruction, species survival challenges, and ecosystem degradation. This loss undermines ecosystem stability and resilience, highlighting the critical need for biodiversity conservation to mitigate climate change's adverse effects and sustain ecosystem functionality (Wu, 2025). Climate change affects local biodiversity by altering species distribution, population dynamics, and reproductive patterns. These changes can lead to increased extinction risks and disrupt community interactions, ultimately impacting ecosystem functioning and the services they provide (Al Bayati, 2024). Climate change leads to shifts in species distributions, increased extinction risks, and ecosystem disruptions, threatening local biodiversity. Extreme weather events and habitat loss further exacerbate these challenges, undermining the essential services ecosystems provide to humans and overall biodiversity preservation (Warren et al., 2021). These variations, attributed to climatic factors rather than phylogeny, indicate particular regional adaptations to environmental conditions (Akhmedov et al., 2025) growing the medicinal plant *Helichrysum maracandicum* Popov ex Kirp. in ecological conditions similar to its natural habitat has little effect on its biological properties, according to a study on the in vitro propagation, plantation organization, and chemical composition of the biomass of this plant, which is found in Uzbekistan's flora (Tashpulatov et al., 2024). Research on adaption strategies and the ontogenesis phases of promising medicinal plants in the Lamiaceae family under natural conditions has demonstrated that climatic factors play a major role in medicinal plant biomass (Akhmedov et al., 2023). The area of *Leontice incerta* Pall. (Berberidaceae), a medicinal plant that is infrequently found in Uzbekistan's coastal regions, has been drastically declining in recent years, according to the findings of a study on its ontogenetic structures, plant cover, and senopopulation features (Bobokandov et al., 2024a, b). Highlights how crucial it is to use selected management techniques in order to protect healthy rangeland areas and lessen the adverse effects of degradation drivers such unplanned road networks, uncontrolled mining, deforestation, population density, andgrazing intensity (Muminov et al., 2025). The adaptive characteristics of its anatomical structure revealed a variety of alterations in the plant's leaves and stems when assessing the stress tolerance of artichoke kinds cultivated in Uzbekistan's low-saline soils (Isomov et al., 2024a). These characteristics show that it has adapted to soil and coastal salinity (Isomov et al., 2024b). Analysis of available scientific sources shows that the biomass indices of the above-ground and underground organs of the Ch. major raw material have not been studied in different periods of vegetation. For the first time, studies have been conducted on the influence of different lighting conditions on plantgrowth and development, as well as biomass indices, and accurate conclusions have been made.

MATERIALS & METHODS

Object of Study

Greater celandine – *Chelidonium majus* L. is a short-lived perennial herb belonging to the poppy family – Papaveraceae. The inner part of the root of the plant is yellow, and the outer part is red. The stem is erect, sparsely pubescent or not pubescent, 25-100cm long. The leaves aregreen, 7-20cm long, 2.5-9cm wide. The leaves located in the upper part of the stem are unbranched, the lower ones are long-branched. The shape of the leaves is ovate or rounded, the leaf margins are entire, in some cases cut. The flowers are yellow, with a long peduncle, 15-20mm in diameter. The fruit is a capsule, 3-6cm long, 2-3mm wide. The seeds are ovoid, brown, located in two rows in the capsule. In the conditions of Samarkand region, depending on the age of vegetation, the plant blooms in March-November, fruiting is observed in May-November. It is propagated from plant seeds (Zare et al., 2021).

Climate and Soil Composition of the Study Area

Research work was carried out in the fields of the Elbek-Shukrona farm in the Toyloq district of the Samarkand region and at the Samarkand station of the Institute of Vegetable and Melongrowing in 2021-2024.

The studies were conducted in the meadow-gray soils of the Samarkand region during 2022-2024. Despite the fact that this is a foothill zone in terms of climate, the study area belongs to regions with a sharply continental climate and is located at an altitude of 800 m above sea level. The average annual precipitation is 358.8mm. The average annual air temperature is 14.9ºC, the lowest average temperature in January is 3.4ºC. The average annual relative humidity is 59%. The average temperature in January-March was 4.4ºC. In January and February 2023, precipitation was 35.5mm more than the annual precipitation amount, and the precipitation amount in March, April, May, June averaged 31.3mm, which is 8.8mm less than the annual precipitation amount for this period. The average number of frost-free days (not below 0ºC) is 235 days. The average air temperature is 15-16ºC, the absolute maximum is +42ºC and the absolute minimum is - 17ºC. The wind speed was 6-9 meters per second (Fig. 1-3).

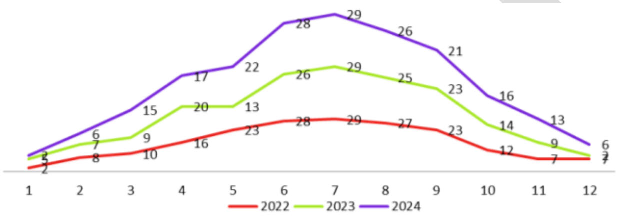

Fig. 1: Average annual air temperature,ºC.

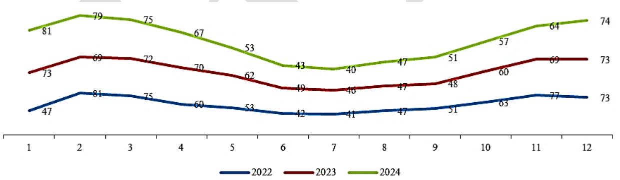

Fig. 2: Average annual air humidity**.**

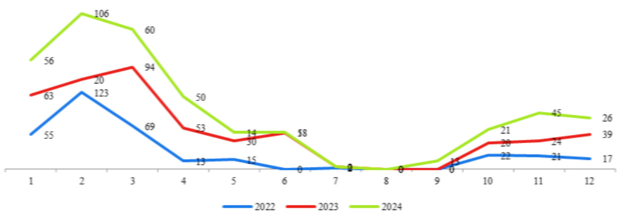

Fig. 3: Average annual precipitation.

The soils of the experimental area are divided into 2groups according to theirgenetic origin: typicalgray soils and meadowgray soils. Such soils are provided with high carbonate bases. The reaction of such soil solution is weakly alkaline. The mechanical composition of the meadowgray soils on which the experiment was conducted is medium loam,groundwater is located at a depth of 5-6 meters, and irrigation is carried out through a canal from the Zarafshan River. The corresponding humus content in the soil layers was 1.32; 1.11; total nitrogen 0.13; 0.09; total phosphorus 0.20; 0.16; total potassium 2.53; 2.34 percent, mobile nitrogen 18.6; 13.4, phosphorus 21.8; 16.4; potassium 230; 198 mg/kg, with a decrease in this amount as itgoes down the soil profile.

Research Methods

In plantation conditions, plants were grown in direct sunlight and artificially shaded environments. Plants were planted in a 60×30 planting scheme in the plantation. The phytomass productivity of underground and aboveground organs of plants at 1-4 vegetative years was determined. Wet and dry biomass at the beginning of vegetation and at the end of vegetation were comparatively determined by weighing. The amount of dry matter accumulated in underground and aboveground organs was determined from the ratio of wet and dry biomass. The results obtained were processed in the laboratory and statistically analyzed.

RESULTS & DISCUSSION

Results and their Analysis

Seeds of thegreat Dane were sown on the previously plowed land on March 12 in two different environments in a 60x30 planting scheme. Seedgermination began on March 15-16 in both conditions. Plantgrowth and development were measured every 5 days and continued until the end of vegetation. In the years of the study, the beginning of the vegetation of the plant in the experimental area shifted from year to year in the spring, depending on the age of the plant, while the end of vegetation was delayed.

During this period, the indicators of the biomass of the aboveground organs of the plant in both environments were determined after the beginning of vegetation, when the plant began its first flowering, and when it finished flowering.

Biomass of Aboveground Organs of *Ch. majus* in a Plantation with Direct Sunlight

Our initial observations were conducted on October 30 (2021) to determine the wet mass of the underground organs of a 1-year-old plantgrown in a plantation where the sun falls directly on the plant. At this time, the wet mass was 10.3±0.5g. It was dried in a thermostat at a temperature of 65ºC for 12 days in laboratory conditions. At this time, the weight of the roots was 4.1±0.2g. Observations in the 2nd year (2022) determined the wet and dry biomass indicators of the underground organs at the beginning and end of the vegetation period. That is, on March 23, the wet mass was 25.6±1.3g and the dry mass was 8.4±0.4g. The plant was found to have an aboveground wet mass of 48.5±2.4g and a dry mass of 15.2±0.8g on November 5, at the end of flowering. On March 16, the wet mass of the roots of the 3-year-old plant (2023) was found to be 49.5±2.5g and a dry mass of 15.9±0.8g. On November 9, these values were 64.8±3.2g and 20.6±1.0g, respectively. On March 10, the wet and dry biomass values of the aboveground organs of the 4-year-old plant (2024) were found to be 42.4±2.1g and 11.8±0.6g, respectively. The last days of flowering at the end of thegrowing season of this age plant fell on November 15, and the wet biomass of the aboveground organs at this time was 58.7±2.9g, and the dry biomass was 18.6±0.9g (Fig. 4).

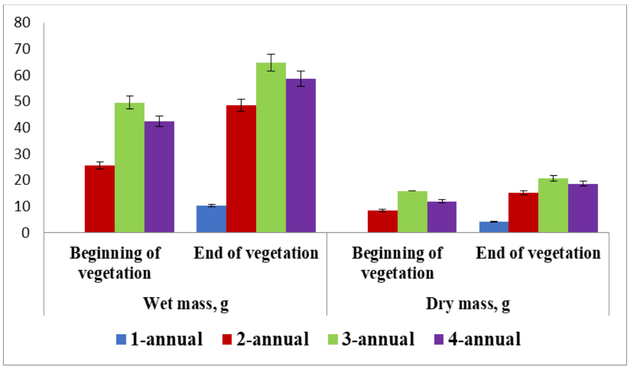

Fig. 4: Biomass indicators of the aboveground organs of *Ch. majus* L. grown in plantation conditions with direct sunlight

Biomass of Aboveground Organs of *Ch. majus* in Artificially Shaded Plantations

Further observations were carried out to determine the biomass indicators of the aboveground organs of *Ch. majus* L.grown in shade conditions. Under these conditions, the last days of flowering of the 1-year-old plant fell on November 5, and the wet mass indicators of the aboveground organs obtained at this time were 11.2±0.6g, and the dry mass indicators were 4.8±0.2g. The beginning of flowering of the 2-year-old plant fell on March 28, and the wet mass of the roots obtained on this day was 31.4±1.6g, and the dry mass was 10.3±0.5g. During the vegetation period, the last days of flowering of the plant fell on November 10, and the following results were obtained for the wet and dry biomass indicators of the aboveground organs at this time: 53.6±2.7g and 17.2±0.9g. The first flowering period of the plant in the 3rd year was observed on March 22, and the biomass values of the aboveground organs obtained at this time were 55.6±2.8g, and the dry mass values were 18.7±0.9g.

The last flowering period of this year was observed on November 14, and the wet and dry biomass values of the aboveground organs at this time were determined to be: 69.3±3.5g and 23.6±1.2g. The first flowering period of the 4th year was observed on March 15, and the wet and dry biomass values of the roots obtained on this day were determined to be: 46.5±2.3g and 14.4±0.7g. The last flowering of this age group was observed on November 20, and the wet and dry biomass of the roots obtained on that day were determined to be: 58.1±2.9g and 18.1±0.9g (Fig. 5).

Comparative analyses of the biomass indices of the aboveground organs of *Ch. majus* L.grown in plantation conditions with direct sunlight and in shade showed that the amounts of wet and dry biomass at the beginning and end of flowering during thegrowing season depended on the age of the plant, increasing during the first 1-3 years and decreasing during the 4th year ofgrowth. This feature was repeated in plantsgrown in both environmental conditions.

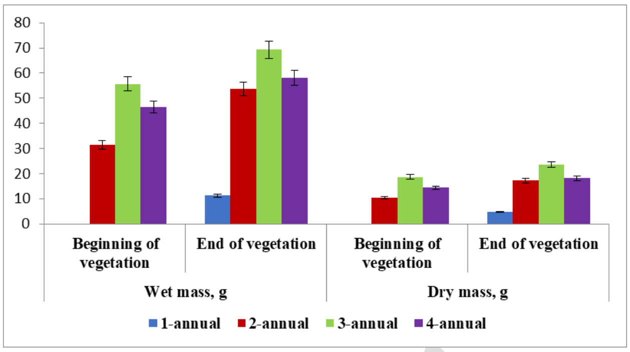

Fig. 5: Biomass indicators of the aboveground organs of *Ch. majus* L.grown in shade plantation conditions

The Amount of Dry Matter Accumulated in the Underground Organs of a Plant Under Different Lighting Conditions

Further observations were made on the percentage of dry matter accumulated in the aboveground organs of the plant in both conditions. In this case, the differences between the wet and dry biomass of the aboveground organs at the initial flowering and late flowering stages of the vegetation of different ages of the plant were analyzed in percentage terms. According to this, the amount of dry matter in the aboveground organs of Ch. majus L.grown in a plantation under direct sunlight increased during the 1st-3rd year, while the amount of dry matter accumulated in the roots remained almost unchanged in the 3rd-4th year (Fig. 3). A significant increase (10.6-14.9%) was observed in the transition period from the beginning of flowering to the 1st-3rd year of the plant's vegetation. It was observed that the increase (15.1%) was very insignificant after the 4th year. However, at the end of thegrowing season, the dry matter content of the biomass during the flowering period first increased during the 1st-3rdgrowing season (14.46 - 16.29 - 18.00%) and then significantly decreased (14.2%) in the lastgrowing season (Fig.-6).

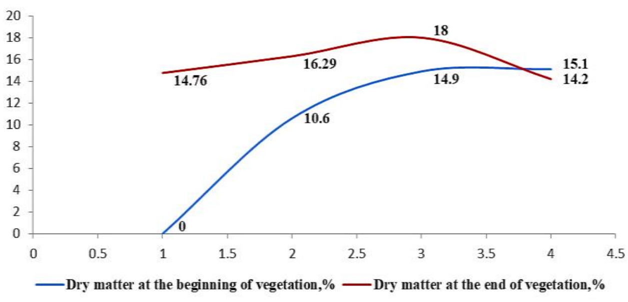

Fig. 6: Dry matter content in the underground organs of *Ch. majus* L.grown in plantation conditions with direct sunlight, %

The change in the dry matter content of the aboveground organs of plants grown in the shade plantation at different ages was similar to the biomass indicators. The dry matter content at the beginning of vegetation increased from the 1st year to the 2nd year (32.8%), a slight decrease was observed in the 3rd year (32.1%), and a significant decrease was observed in the 4th year (27.8%). Based on the data obtained in the last days of vegetation, the analysis shows that the dry matter content decreased significantly from the 1st year (39.8%) to the 2nd year (31.3%), and almost imperceptibly increased during the transition to the 3rd year (31.8%). In the 4th year, this indicator showed a regularity, with a slight decrease (31.7%) (Fig.-7).

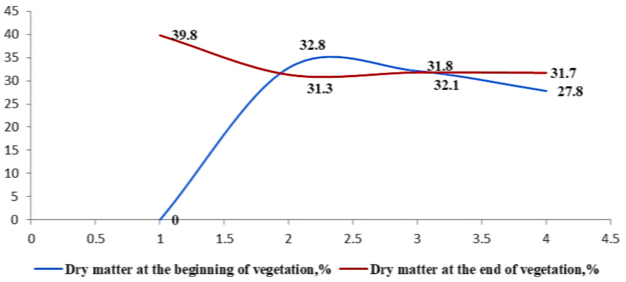

Fig. 7: Dry matter content in the underground organs of *Ch. majus* L.grown under shade plantation conditions, %

Aboveground Biomass *of Ch. majus* in a Shaded Plantation

The last flowering period of the large bloodroot at the end of the firstgrowing year under artificial shade was observed on November 5. At this time, the wet mass of the above-ground organs was 68.2±3.4g and the dry mass was 10.2±0.5g. The initial measurements during the secondgrowing year were made on March 28 and at this time the wet mass was 98.5±4.9g, and the dry mass was 13.7±0.7g. At the end of thegrowing season (November 10), these indicators were 212.1±10.6g and 36.1±1.8g, respectively. The initial measurements of the third year were made on March 22. At this time, the wet mass was 265.1±13.3g, and the dry mass was 40.3±2.0g. The end of the vegetation period of this year was observed on November 14, and the indicators at this time were determined to be 405.3±20.3g and 74.8±3.74g, respectively. The initial measurements of the plant in the fourth year were carried out on March 15. At this time, the fresh mass was 224.2±11.2g and the dry mass was 34.2±1.7g.

Measurements at the end of the vegetation period were carried out on November 20, and at this time the fresh mass of the medicinal raw material was 379.3±19.0g and the dry mass was 54.4±2.7g (Fig. 8).

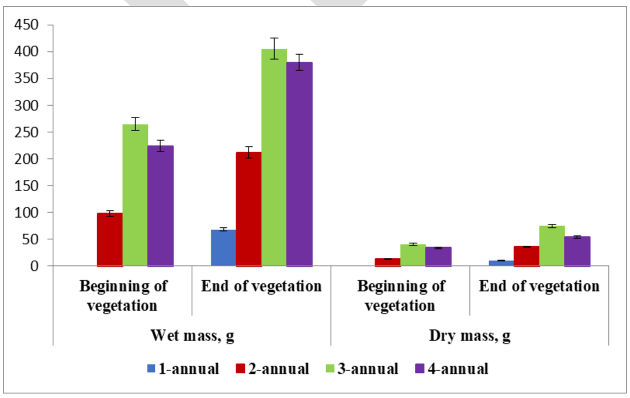

Fig. 8: Biomass indicators of above-ground organs of *Ch. majus* L.grown in shade conditions

Analysis of the data obtained shows that the amount of dry matter accumulated in the plant depends on the age of the plant, which increases during the first 1-3 years and decreases in the 4th year. This situation was also reflected in the results of spring and autumn measurements. It was found that the dry matter of the plant of the second vegetation age in spring was 13.9%, and the dry matter of the third and fourth years was 15.2% each. These indicators were reflected in the results of autumn measurements as follows: the dry matter of the plant in the first vegetation year was 14.4%, the dry matter of the plant in the second year was 17.02%, the dry matter of the plant in the third year was 18.45%, and the dry matter of the plant in the fourth year was 14.34% (Fig. 9).

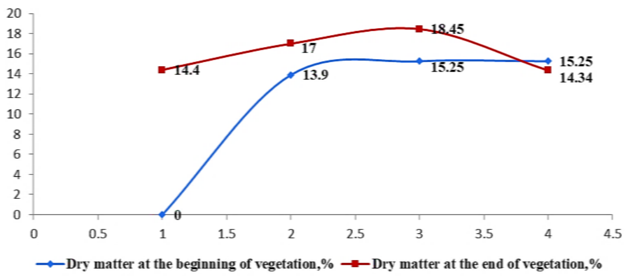

Fig. 9: Dynamics of changes in the dry matter content of above-ground organs of Chelidonium majus L.grown in shade conditions depending on thegrowing season

Biomass of the Aboveground Organs of *Ch. majus* in a Plantation with Direct Sunlight

The wet and dry masses of the aboveground organs of *Ch. majus* at the beginning and end of the vegetation period under natural direct sunlight conditions were comparatively studied. Under these conditions, thegrasses planted from seeds began togrow 1 day earlier than in shaded conditions, and the end of the vegetation period was observed on October 30 and the wet mass was determined at that time. According to it, the wet mass was 56.2±2.8g, and the dry mass was 8.3±0.4. The first measurements in the second vegetation year were carried out on March 23. At this time, the wet mass was found to be 90.1±4.5g and the dry mass was 10.6±0.5g. Autumn measurements were carried out on November 5, and the wet mass was observed to be 195.2±9.8g and the dry mass was 31.8±1.6g. Spring measurements in the third year were carried out on March 16, and it was found that the plant's wet mass was 243.4±12.2g and the dry mass was 36.4±1.8g**.**In autumn measurements (November 9), the wet mass was 402.3±20.1g and the dry mass was 72.3±3.5. Spring measurements of the fourth year of the plant were carried out on March 10, when the wet mass was 210.4±10.5g and the dry mass was 31.8±1.6g, while in autumn measurements (November 15) these Fig.s were 362.1±18.1g and 51.3±2.6g, respectively (Fig. 10).

Chelidonium majus is a relatively weak competitor, particularly against Urtica dioica and Alliaria petiolata, leading to a depression in biomass and growth height of these plants. Its strong association with human settlements and nitrophilous behavior suggest it thrives in disturbed environments, potentially impacting local biodiversity by outcompeting native species in these areas.

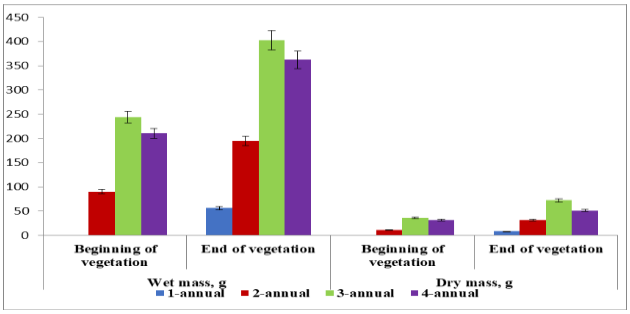

Fig. 10: Biomass indicators of underground organs of *Ch. majus* L.grown in sunny conditions.

Additionally, its myrmecochorous dispersal mechanism indicates limited long-distance spread, which may restrict its ecological influence beyond human-altered landscapes (Steingräber & Brandes, 2019). The paper does not specifically address the ecological implications of Chelidonium majus L. on local biodiversity. However, it highlights that C. Majus grows in diverse habitats, such as mountainous southern slopes and riverbanks, indicating its potential role in these ecosystems. Its presence among various plant communities suggests it may contribute to local biodiversity, but the study primarily focuses on its distribution and habitat characteristics rather than direct ecological impacts (Dostemessova et al., 2024). The paper does not provide specific information regarding the ecological implications of Chelidonium majus L. on local biodiversity. It primarily focuses on the various taxonomic classifications and synonyms associated with the species. Therefore, insights into its ecological impact or role within ecosystems are not addressed in the provided details (Paniagua-Zambrana et al., 2024). The paper does not provide specific information on the ecological implications of Chelidonium majus L. on local biodiversity. However, as a plant that can accumulate heavy metals, it may influence soil health and the surrounding ecosystem. Its presence could affect the diversity of soil organisms and plant communities, potentially leading to shifts in local biodiversity. Further research would be necessary to fully understand its ecological role and impacts in urban environments (Rahmonov et al., 2023).

The Amount of Dry Matter Accumulated in the Underground Organs of the Plant under Different Lighting Conditions

The dynamics of dry matter in the raw material of the large-leaved plantgrown in direct sunlight over the years and in the spring-autumn seasons, as in the raw material grown in the shade, was observed to increase during the 1st-3rd vegetation years and decrease in the 4th year. In this case, the dry matter of the plant of the second vegetation age in spring was 32.8%, the dry matter of the third year was 33.6%, and the dry matter of the fourth year was 30.1%. These indicators were reflected in the results of autumn measurements as follows: the dry matter content of the plant of the first vegetation year was 42.8%, the dry matter content of the plant of the second year was 32.1%, the dry matter content of the plant of the third year was 34.1%, and the dry matter content of the plant of the fourth year was 31.2% (Fig. 11).

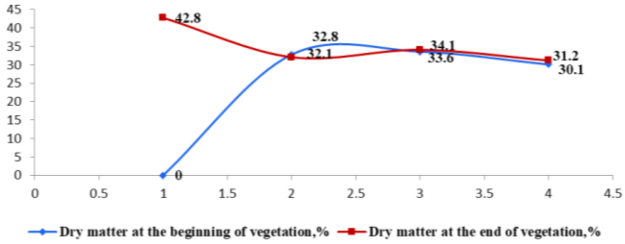

Fig. 11: Dynamics of changes in dry matter content in *Ch. majus* L.grown under conditions of direct sunlight depending on thegrowing season.

Analysis of the wet and dry mass of aboveground and underground organs of *Chelidonium majus* L. grown in the meadow soils of the Samarkand region under different lighting conditions and the amount of dry matter accumulated in them showed that the plantgrown in both environments increased in both wet and dry mass in the 1st-3rd vegetation year, and a significant decrease was observed in the 4th vegetation year. In addition, this feature was also observed in the indicators of the amount of dry matter accumulated in it. The amount of dry matter in the aboveground and underground organs of the plantgrown in both conditions increased in the first 1st-3 vegetation years, and a significant decrease in the amount of dry matter was observed in the 4th vegetation year.

Chelidonium majus L. is a short-lived perennial plant, and its naturalgrowth conditions are humid and shaded areas in temperate climate regions. The research was conducted in the Samarkand region, where itgrew for 4 years. During the vegetation years, differences were observed between the biomass indicators of the above-ground and underground organs of the plant in the conditions of direct sunlight and artificially shaded plantations. Analysis of the above-mentioned data shows that the biomass indicators of plant raw materials in artificially shaded plantations were significantly higher than in direct sunlight. Taking this into account, the differences between the plant indicators in shaded conditions and those in sunny conditions were determined (Fig. 12).

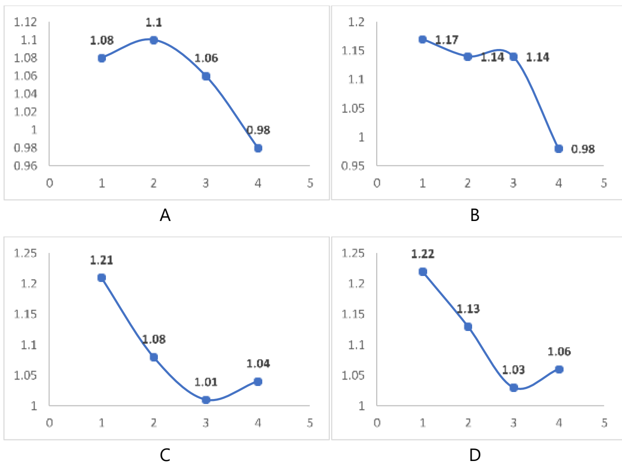

Fig. 12: Differences in the biomass of wet (A) and dry (B) underground organs and wet (C) and dry (D) above-ground organs of plantsgrown in artificially shaded plantations from plantsgrown in direct sunlight.

According to it, the difference in biomass indicators of underground organs of plantsgrown in shade conditions

(Fig. 12-A-B) compared to those in sunny conditions increased in 1-2 years and decreased in 3-4 years. However, this situation was observed in the above-ground organs (Fig. 12-A-B) in 1-3 years, the difference decreased. In the 4th year, a significant increase was observed.

Conclusion

The soil and climatic conditions of the Samarkand region are suitable forgrowing *Chelidonium majus* L. and medicinal raw materials. For the preparation of raw materials of the plant, it is advisable to use plants with a 2-3-year vegetation period in plantation conditions with direct sunlight and artificial shading.

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