PROSPECTS OF CULTIVATION OF NASTURTIUM (TROPAEOLUM MAJUS) IN UZBEKISTAN

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Abstract. This article is dedicated to evaluating the prospects for cultivating nasturtium (*Tropaeolum majus* L.) under the climatic conditions of Uzbekistan. Through a systematic analysis of literature spanning from 2018 to 2025, the phytochemical composition, agrobiological characteristics, and adaptive strategies of the plant are examined. Nasturtium is distinguished by its substantial concentrations of vitamins, polyphenols, and glucosinolates, alongside its resilience to salinity and moisture scarcity, rendering it a valuable candidate for ornamental, culinary, and medicinal applications. The crop's potential for cultivation on degraded lands is emphasized, along with the imperative for localized field trials and the establishment of a seed repository to enhance both yield and product quality in the region..

Keywords: nasturtium, phytochemical composition, stress resistance, agrobiological characteristics, adaptation, agricultural technology, prospects.

Nasturtium (*Tropaeolum majus* L.) exemplifies a member of the Tropaeolaceae family, celebrated for its ornamental allure, abundant phytochemical composition, and resilience to diverse growing conditions. This plant hails from South America, from which it was subsequently introduced to Europe and Asia. In contemporary times, nasturtium is cultivated extensively across various nations as an ornamental species; however, recent years have witnessed a burgeoning interest in its nutritional and medicinal attributes [2,].

Nasturtium, with its vibrant blossoms and distinctive leaf morphology, captivates the attention of horticulturists and floral enthusiasts not merely for its aesthetic appeal, but also for its remarkable attributes.

Interest in nasturtium as a crop with a diverse array of applications is steadily increasing each year. Its medicinal attributes are currently under investigation for potential incorporation into traditional healing practices. Nasturtium is believed to possess anti-inflammatory and antimicrobial properties, attributable to its rich composition of flavonoids and glucosinolates. This renders it a valuable botanical for promoting well-being and combating various ailments.

The plant serves as a formidable reservoir of vitamin C, carotenoids, polyphenols, minerals, and glucotropaeolin—an active compound renowned for its antimicrobial properties [3,5]. Vitamin C plays a pivotal role in fortifying the immune system, carotenoids contribute to the maintenance of healthy skin and vision, while polyphenols function as potent antioxidants, safeguarding cells from oxidative damage.

In regions characterized by elevated temperatures, nasturtium has demonstrated remarkable tolerance to salinity and moisture deficiency, rendering it an exemplary selection for such environments [9]. In arid locales, nasturtium thrives successfully even with minimal irrigation, owing to its adeptness in moisture retention.

Nasturtium not only boasts significant nutritional value, but it is also a resilient plant capable of thriving in extreme conditions, imparting numerous health benefits to the human body. Its distinctive properties render it a prized asset in both the culinary and medicinal realms.

In Uzbekistan, agriculture constitutes a pivotal segment of the economy; however, certain regions are afflicted by salinization and a deficiency of organic matter. Consequently, it is imperative to identify crops that can thrive under adverse conditions while exhibiting high economic value. Nasturtium aligns with these criteria, yet its potential within the republic's unique environment remains largely uncharted.

To fully unveil the latent potential of nasturtium under the specific climatic conditions of Uzbekistan, it is imperative to undertake further research and experimentation. It is crucial to consider not only the agronomic facets of cultivating this plant but also its prospective market viability.

Research objective

The objective of this study is to elucidate the potential for cultivating nasturtium in Uzbekistan through a comprehensive analysis of its agrobiological characteristics and the examination of practices adopted in other nations.

The study endeavors to evaluate the potential for cultivating nasturtium, commonly referred to as cabbage white, under the climatic conditions of Uzbekistan. Nasturtium is a highly esteemed crop owing to its remarkable medicinal properties and nutritional benefits. The comprehensive analysis of its agrobiological characteristics suggests that the region offers conducive conditions for the successful cultivation of this plant.

Experience from other nations, such as Germany and the Netherlands, demonstrates that nasturtium can be adeptly integrated into agricultural practices. In Germany, nasturtium enjoys widespread utilization in culinary and medicinal applications, thereby fostering industry development and augmenting export opportunities.

The proposed study endeavors to extrapolate and implement the exemplary practices from other nations within the context of Uzbekistan, with the aim of enhancing the efficiency and profitability of nasturtium cultivation for local agrarians. Concurrently, it is imperative to consider the specific soil and climatic conditions of Uzbekistan to ensure the successful acclimatization of this particular crop plant.

Materials and methods This review article was conducted based on a systematic analysis of sources from 2018 to 2025 across various databases, including PubMed, ScienceDirect, Scopus, Google Scholar, and others. A total of 11 pivotal articles were selected, encompassing the phytochemical properties, agricultural methodologies, adaptive mechanisms, and medicinal applications of T. majus [5,6,9].

Only original studies or comprehensive reviews encompassing data on phytochemical composition, agronomic practices, or stress tolerance were deemed worthy of consideration in this work. Notably, the research conducted by Jakubczyk et al. (2018) offered an in-depth analysis of the phytochemical characteristics of T. majus, elucidating significant components that underpin its medicinal applications [6].

In addition, this study juxtaposes statistical data pertaining to agriculture in Uzbekistan (FAO, 2020–2024; GGGI, 2021) to evaluate soil and climatic conditions as well as opportunities for crop adoption. A comparative analysis of FAO and GGGI data has enabled the

identification of potential avenues for growth and advancement in the region's agricultural sector, drawing on the agricultural practices and adaptive mechanisms examined herein.

Botanical description Nasturtium (*Tropaeolum majus* L.) is a herbaceous plant that may be either annual or perennial in nature. It belongs to the Tropaeolaceae family and is indigenous to South America. This remarkable plant features fleshy stems that can either creep along the ground or ascend, achieving lengths of up to 2–3 meters and frequently branching to create a luxuriant display. The leaves of the nasturtium are arranged alternately, exhibiting a shield-shaped morphology with diameters ranging from 3 to 10 cm. They may be entirely whole or exhibit slight lobing, adorned with a smooth and waxy surface..

Nasturtium flowers are solitary, positioned within the leaf axils on elongated peduncles. They exhibit zygomorphic symmetry and possess a diameter ranging from 4 to 6 cm, adorned in vibrant hues of yellow, orange, or red, frequently embellished with darker spots. A distinctive characteristic of these blossoms is their elongated spur, which harbors nectar, thereby enticing pollinators such as bees and hummingbirds.

The nasturtium fruit is a substantial, three-celled, indehiscent capsule that disintegrates into three single-seeded segments. Nasturtium seeds are relatively large, measuring up to 1 cm in diameter, characterized by their grooved texture and hues ranging from light green to pale yellow. Remarkably, these seeds can retain their viability for a period of 3 to 4 years. The root system is predominantly taproot, shallow, and features numerous lateral roots that confer stability and nourishment to the plant.

The plant thrives in sun-drenched locales, favoring light, well-drained soils, and exhibits a commendable tolerance for moderate drought conditions. Nasturtium flourishes from June through October, subsequently bearing fruit until the onset of frost [8].

Results

Phytochemical and Nutritional Value

Nasturtium is an esteemed reservoir of vitamin C, providing as much as 200 mg per 100 g of fresh weight. This essential vitamin plays a pivotal role in bolstering immunity and enhancing skin health. Furthermore, nasturtium is abundant in lutein, carotenoids, polyphenols, and anthocyanins—potent antioxidants that contribute significantly to the holistic well-being of the body.

Nasturtium leaves and flowers are replete with a diverse array of micro- and macroelements, including potassium, calcium, magnesium, phosphorus, iron, and zinc, all of which are essential for the optimal functioning of the human body.

Nasturtium seeds are composed of up to 30% fatty oils, which find extensive application in both the culinary and cosmetic industries. These oils possess moisturizing and nourishing properties, rendering them a sought-after component in the formulation of cosmetics and facial masks.

When freshly harvested, nasturtium leaves and blossoms possess a piquant flavor attributed to the presence of glucotropaeolin, a variant of mustard glycosides. This distinctive taste imparts a unique aroma to culinary creations.

Medicinal Uses

Herz et al. (2023) discovered that nasturtium, commonly referred to as black cumin, possesses the capacity to mitigate levels of the pro-inflammatory mediator PGE_2 in humans [5]. This revelation bears substantial implications for the medical domain, as it intimates that

nasturtium may serve as a prospective anti-inflammatory agent within the body. Notable examples of other botanicals exhibiting anti-inflammatory properties encompass turmeric, ginger, and aloe vera.

Saad et al. (2021) conducted a study that elucidated the protective effects of nasturtium extracts on the male reproductive system in various animal models [7]. These extracts of nasturtium may mitigate inflammation and enhance reproductive function across multiple male species.

Das et al. (2019) elucidate the traditional application of nasturtium in the treatment of respiratory and urinary tract infections, as well as dermatological ailments [3]. This underscores the plant's multifaceted attributes that contribute to the enhancement of human health. Nasturtium has demonstrated efficacy in addressing various respiratory disorders.

Overall, its anti-inflammatory and protective attributes render it a compelling candidate for further investigation and potential applications within the realms of medicine and healthcare.

Adaptation to stress conditions

The research conducted by Targino et al. (2025) demonstrated that nasturtium exhibits a notable degree of resilience to both salinity and drought conditions [9]. This remarkable plant is capable of flourishing even in environments characterized by elevated soil salinity and insufficient moisture. Various studies have indicated that nasturtium can adeptly acclimate to saline stress, preserving its viability and productivity.

The utilization of proline under saline stress, as elucidated by Targino et al. (2025), fosters enhanced photosynthetic activity and augments the antioxidant profile of the plant [9]. This adaptation enables nasturtium to more adeptly counteract detrimental environmental influences and sustain its viability over an extended duration.

Andrzejak et al. (2024) conducted a study that revealed Trichoderma treatment significantly enhanced the flowering intensity of nasturtium while concurrently augmenting the nutrient content of the soil [1].

Studies investigating the rhizosphere microbiome of *Tropaeolum majus*, published in Frontiers in Microbiology(2022), unveiled a remarkable diversity of plant growth-promoting (PGP) bacteria, including Serratia, Klebsiella, and Raoultella [10]. These beneficial microorganisms enhance the absorption of essential nutrients by the plant while simultaneously conferring protection against various pathogens, thereby rendering nasturtium more resilient to adverse environmental influences.

Agrotechnological features

Nasturtium is a botanical specimen characterized by a brief growing season, typically spanning a mere 70 to 90 days. The seeds of nasturtium exhibit rapid germination and attain maturity in a relatively short timeframe. For optimal sowing, it is advisable to pre-soak nasturtium seeds, a practice that expedites the germination process. This plant thrives in sun-drenched locales and favors well-drained, light soils.

Under optimal growing conditions, the yield of green biomass can attain an impressive 15 to 25 tons per hectare. Furthermore, the production of flowers can reach 4 to 6 tons per hectare, underscoring the significant practical value of cultivating nasturtium.

It is imperative to consider various methodologies for the care of nasturtium, including fertilization, irrigation, and pest management, to ensure the robust growth and development of the plant.

Discussion

The climate of the Republic of Uzbekistan is distinguished by its arid conditions and elevated temperatures during the summer months. Nasturtium emerges as an invaluable botanical species for saline terrains and regions with restricted access to water, exhibiting remarkable resilience with minimal water consumption.

The application of proline and biopreparations derived from Trichoderma can substantially enhance the resilience of plants in the face of stressors. The utilization of such formulations augments their phytochemical attributes. Consequently, crops exhibit heightened resistance to diseases and pests while also possessing an elevated nutritional profile.

Thus, the synergy between the resilience of nasturtium and the efficacy of biopreparations unveils new avenues for agriculture amid the evolving climate and constrained resources. The adoption of innovative methodologies and technologies is pivotal in safeguarding food security and fostering the sustainable advancement of agriculture.

In the culinary realm, fresh nasturtium leaves and blossoms are employed as exquisite salad components, can serve as an alternative to capers, or can be utilized as a spice to impart a distinctive flavor. Within the pharmaceutical and cosmetic industries, nasturtium extracts are frequently harnessed as a valuable reservoir of antioxidants and glycosides, contributing to the enhancement of skin health and overall well-being.

In addition, nasturtium assumes a pivotal role in the cultivation of ornamental plants. Its vibrant blossoms and lush foliage are ideally suited for enhancing the aesthetics of urban landscapes.

The demand for edible flowers and functional nasturtium products in Central Asian countries is experiencing a consistent upsurge. Data regarding the importation of comparable crops corroborate this trend [4].

The principal constraint is the insufficiency of tailored varieties and seed materials in Uzbekistan. Irregular maturation and seed loss culminate in considerable yield reductions, which may escalate to 40-60% of the potential output [11].

To address this issue, it is imperative to undertake pilot studies across diverse soil and climatic zones. Such investigations can be conducted in various regions of the country to ascertain the optimal conditions for seed collection and the enhancement of crop yields. Furthermore, it is essential to devise effective irrigation techniques and plant protection strategies to ensure conducive environments for their growth and development.

The establishment of a seed production base will facilitate access to high-quality seed material tailored to local conditions. This strategy will contribute to enhancing agricultural productivity and fortifying resilience against external challenges. Addressing these issues necessitates a holistic approach and collaborative efforts among experts and organizations within the agricultural sector.

Conclusion

Nasturtium (*Tropaeolum majus* L.) emerges as a promising cultivar for Uzbekistan, owing to its resilience, aesthetic appeal, and nutritional attributes, along with its remarkable capacity to withstand adverse conditions. With its vibrant blossoms and lush foliage,

nasturtium can serve not merely as an ornamental feature in gardens but also as a valuable source of vitamins and nutrients conducive to a healthy diet.

Moreover, nasturtium lends itself to the production of natural dyes, fragrant oils, and culinary applications, enhancing salads and various dishes with its unique flavor and vibrant color.

It is imperative to undertake localized field research, carefully selecting varieties and agricultural technologies that account for salinity and moisture deficiency. This strategic approach will enhance the cultivation of nasturtium and significantly augment the yield. The application of biostimulants, such as proline and trichoderma, alongside microbial fertilizers, can markedly bolster the plants' resilience against diseases and pests, while simultaneously elevating the quality of the final product. Such innovative methodologies are pivotal to the progressive advancement of agriculture and the development of environmentally sustainable products.

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