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# AGROTECHNOLOGY OF GROWING PUMPKIN IN THE SOIL AND CLIMATE CONDITIONS OF THE REPUBLIC OF KARAKALPAKSTAN

**Orazymbetov Edilbek Kaypbekovich**
Head of the Laboratory of Agrotechnics and Plant Protection of Vegetables, Melons and Potatoes

**Abstract.** The Republic of Karakalpakstan is characterized by arid climatic conditions, limited water resources, high soil salinity, and sharp fluctuations in temperature. Under such circumstances, the cultivation of drought-resistant and economically valuable crops is of great importance. Pumpkin (Cucurbita spp.) is considered one of the most promising vegetable crops due to its adaptability to unfavorable environmental conditions, high nutritional value, and economic significance. This article examines the agrobiological characteristics of pumpkin, analyzes the soil and climatic conditions of Karakalpakstan, and proposes effective agrotechnological measures for increasing pumpkin productivity. Special attention is paid to soil preparation, irrigation management, fertilization systems, planting methods, pest and disease control, and harvesting techniques. The study concludes that the application of scientifically based agrotechnologies can significantly improve pumpkin yield and quality under the environmental conditions of Karakalpakstan.

**Key words:** pumpkin, agrotechnology, Karakalpakstan, soil salinity, irrigation, climate conditions, crop productivity, vegetable cultivation, sustainable agriculture, drought resistance.

**Introduction.** Agriculture remains one of the most important sectors of the economy in the Republic of Karakalpakstan, providing food security, employment opportunities, and raw materials for various industries. However, agricultural production in the region faces numerous environmental and climatic challenges that have intensified over recent decades. The ecological consequences of the Aral Sea crisis, increasing soil salinization, water scarcity, desertification, and climate change have significantly affected crop productivity and agricultural sustainability. Under these conditions, the selection of resilient crop species and the development of scientifically based cultivation technologies have become essential priorities for ensuring stable agricultural production and sustainable rural development. The Republic of Karakalpakstan is situated in the northwestern part of Uzbekistan and occupies a vast territory characterized by arid and semi-arid ecosystems. The region experiences a sharply continental climate with extremely hot summers, cold winters, low annual precipitation, high solar radiation, and frequent dry winds. Average summer temperatures often exceed 40°C, while annual rainfall rarely surpasses 100–150 mm. Such climatic conditions create substantial limitations for crop cultivation and necessitate the implementation of efficient irrigation systems and adaptive agronomic practices. One of the most serious environmental problems affecting agriculture in Karakalpakstan is soil salinity. The shrinkage of the Aral Sea has accelerated the accumulation of salts in agricultural lands and contributed to the formation of saline dust storms that negatively impact soil fertility and crop growth. According to regional agricultural assessments, a significant proportion of irrigated lands in Karakalpakstan are affected by varying degrees of salinity, resulting in reduced crop yields and lower water-use efficiency. Therefore, the cultivation of crops capable of tolerating drought, heat stress, and moderate salinity is becoming increasingly important for the region's agricultural sustainability. Among vegetable crops, pumpkin (Cucurbita spp.) has attracted considerable attention due to its high ecological adaptability, nutritional value, and economic potential. Pumpkin belongs to the Cucurbitaceae family and includes several cultivated species, such as Cucurbita maxima,

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Cucurbita moschata, and Cucurbita pepo. These species are widely cultivated in different parts of the world and are known for their ability to produce satisfactory yields under relatively unfavorable environmental conditions. Their deep and extensive root systems allow efficient utilization of soil moisture, making them particularly suitable for arid and semi-arid regions. Pumpkin is recognized not only as an important food crop but also as a valuable source of vitamins, minerals, antioxidants, dietary fiber, and bioactive compounds. Pumpkin fruits contain significant amounts of beta-carotene, vitamin A, vitamin C, potassium, calcium, magnesium, and various phytochemicals that contribute to human health. Pumpkin seeds are rich in proteins, unsaturated fatty acids, vitamins, and medicinal compounds, making them highly valuable for both nutritional and pharmaceutical purposes. Additionally, pumpkin by-products can be utilized as livestock feed, thereby increasing the economic efficiency of agricultural production systems. The growing global interest in healthy nutrition and functional foods has led to increased demand for pumpkin products in domestic and international markets. Consequently, improving pumpkin production technologies has become a strategic objective in many countries, particularly in regions facing environmental constraints. In Karakalpakstan, pumpkin cultivation offers a promising opportunity to diversify agricultural production, increase farm income, and enhance food security while utilizing limited natural resources more efficiently. Modern agricultural science emphasizes the importance of developing climate-smart and resource-efficient production systems. In this context, agrotechnology plays a decisive role in determining crop productivity and quality. Agrotechnology encompasses a comprehensive set of agricultural practices, including soil preparation, seed selection, planting techniques, fertilization strategies, irrigation management, weed control, pest and disease management, harvesting, and post-harvest handling. The effectiveness of these practices largely determines the success of crop cultivation under specific environmental conditions. For pumpkin cultivation in Karakalpakstan, the adaptation of agrotechnological measures to local soil and climatic conditions is particularly important. High temperatures and water deficits require efficient irrigation scheduling and water-saving technologies. Soil salinity necessitates appropriate soil management practices and balanced fertilizer application. Furthermore, increasing climatic variability demands the development of resilient production systems capable of maintaining stable yields under changing environmental conditions. The relevance of this research is determined by the necessity to improve vegetable production systems in Karakalpakstan, enhance the efficient use of natural resources, and contribute to regional food security. Understanding the interaction between pumpkin plants and the challenging environmental conditions of the region is essential for developing effective cultivation strategies and promoting sustainable agricultural development. The main objective of this study is to investigate the agrotechnology of pumpkin cultivation under the soil and climatic conditions of the Republic of Karakalpakstan and to identify scientifically grounded agricultural practices that ensure high productivity, efficient resource utilization, and sustainable crop production. The findings of this research may serve as a practical basis for farmers, agricultural specialists, researchers, and policymakers involved in the development of climate-resilient agriculture in the Aral Sea region.

**Literature Review.** The cultivation of pumpkin (Cucurbita spp.) has been extensively studied by agricultural scientists due to its economic importance, nutritional value, environmental adaptability, and potential contribution to sustainable agricultural systems. Numerous scientific investigations conducted in different regions of the world have focused on the biological characteristics of pumpkin, cultivation technologies, water and nutrient requirements, responses to abiotic stresses, and productivity under various soil and climatic conditions. The analysis of existing literature demonstrates that pumpkin is among the most adaptable vegetable crops and can successfully grow under conditions where many other crops experience significant yield reductions. The scientific

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foundations of pumpkin cultivation are largely based on studies devoted to the biology and ecology of cucurbit crops. Robinson and Decker-Walters (2017) emphasized that pumpkin species possess a well-developed root system capable of penetrating deep soil layers, allowing plants to utilize moisture reserves more effectively than many other vegetable crops. According to these authors, the physiological characteristics of pumpkin contribute to its ability to tolerate temporary drought conditions and maintain stable productivity under water-limited environments. The work of Paris (2016) provides a comprehensive overview of the genetic diversity and breeding potential of pumpkin species. The author highlights that Cucurbita maxima, Cucurbita moschata, and Cucurbita pepo exhibit considerable variation in growth habits, fruit characteristics, stress tolerance, and adaptation to environmental conditions. These genetic differences play a crucial role in developing cultivars suitable for arid and saline regions such as Karakalpakstan. Modern breeding programs increasingly focus on improving drought tolerance, salinity resistance, disease resistance, and yield stability in pumpkin cultivars. Several researchers have investigated the nutritional and economic significance of pumpkin production. Rubatzky and Yamaguchi (2018) reported that pumpkin fruits contain high concentrations of carbohydrates, vitamins A, C, and E, dietary fiber, antioxidants, and mineral elements essential for human health. The authors noted that pumpkin products have gained increasing popularity due to their nutritional benefits and wide range of industrial applications. Pumpkin seeds, in particular, are recognized as valuable sources of vegetable oil, proteins, and bioactive compounds used in food and pharmaceutical industries. The role of pumpkin in sustainable agricultural systems has also attracted considerable scientific attention. Lal (2020) emphasized that crop diversification is one of the key principles of sustainable agriculture, especially in regions vulnerable to climate change and environmental degradation. According to the author, pumpkin can serve as an effective component of crop rotation systems due to its relatively low input requirements and positive effects on soil health. The large leaf canopy of pumpkin plants protects the soil surface from excessive evaporation and erosion, while organic residues contribute to improving soil fertility. The issue of drought tolerance has become increasingly important in agricultural research due to global climate change. Numerous studies indicate that pumpkin possesses significant adaptive mechanisms that allow it to withstand water stress. Smith (2019) reported that pumpkin plants demonstrate relatively high water-use efficiency compared to many vegetable crops. The extensive root system enables plants to extract moisture from deeper soil horizons, while physiological adaptations help reduce water loss under high-temperature conditions. These characteristics make pumpkin particularly suitable for cultivation in arid regions such as Karakalpakstan. Water management is considered one of the most critical components of pumpkin agrotechnology. Research conducted by various international agricultural institutions has shown that irrigation methods significantly influence crop productivity and resource efficiency. FAO (2023) recommends the adoption of modern irrigation technologies, including drip irrigation systems, to optimize water use and improve crop yields. Studies indicate that drip irrigation not only reduces water consumption but also enhances nutrient availability, improves plant growth, and decreases the incidence of certain diseases. In Central Asia, where water scarcity is becoming an increasingly serious challenge, researchers have paid particular attention to water-saving technologies. Abdullaev and Khamraev (2021) investigated the effectiveness of drip irrigation in vegetable production systems of Uzbekistan and concluded that the technology can increase crop yields while reducing irrigation water use by 30–40%. Their findings are especially relevant for Karakalpakstan, where irrigation water resources are limited and efficient water management is essential for sustainable agriculture. The analysis of available literature demonstrates that significant progress has been made in understanding the biological and agronomic aspects of pumpkin cultivation. However, several research gaps remain. Most international studies focus on temperate or moderately arid regions,

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while limited attention has been given to the specific agroecological conditions of the Aral Sea basin. Furthermore, there is insufficient information regarding the interaction between pumpkin cultivars and saline soils, the optimization of irrigation scheduling under water-limited conditions, and the development of integrated agrotechnological systems tailored to Karakalpakstan. Therefore, the present study seeks to contribute to the existing body of knowledge by examining pumpkin cultivation technologies within the unique environmental context of the Republic of Karakalpakstan. The findings are expected to support the development of scientifically grounded recommendations aimed at improving productivity, resource-use efficiency, and sustainability of pumpkin production in one of the most environmentally vulnerable agricultural regions of Central Asia.

**Results and Discussion.** The results of the study indicate that pumpkin cultivation possesses considerable potential under the soil and climatic conditions of the Republic of Karakalpakstan. Despite numerous environmental constraints, including water scarcity, high summer temperatures, soil salinity, and the ecological consequences of the Aral Sea crisis, pumpkin demonstrates a relatively high capacity for adaptation and stable productivity when appropriate agrotechnological measures are implemented. The findings confirm that the successful cultivation of pumpkin depends not only on the biological characteristics of the crop but also on the effective integration of soil management, irrigation practices, fertilization systems, and crop protection strategies adapted to local conditions. One of the most significant factors influencing pumpkin productivity in Karakalpakstan is the region's sharply continental climate. The growing season is characterized by prolonged periods of high temperatures, low atmospheric humidity, intense solar radiation, and limited precipitation. These environmental conditions create substantial stress for many agricultural crops. However, pumpkin exhibits several physiological and morphological characteristics that enable it to tolerate such stresses. The crop's extensive root system allows efficient extraction of water from deeper soil layers, while its large leaf surface contributes to effective photosynthetic activity under high solar radiation conditions. These adaptive features explain why pumpkin can maintain acceptable productivity levels even in years with severe climatic stress. The analysis further revealed that soil salinity remains one of the primary challenges limiting agricultural development in Karakalpakstan. The accumulation of soluble salts in the root zone negatively affects water absorption, nutrient availability, and overall plant growth. Nevertheless, compared with many vegetable crops, pumpkin demonstrates moderate salinity tolerance. Experimental observations and published research indicate that pumpkin plants are capable of maintaining growth and fruit formation under moderate saline conditions, although excessive salinity still results in yield reduction. This finding highlights the importance of selecting suitable fields, implementing effective drainage systems, and conducting regular soil monitoring to minimize the negative effects of salinization. The study emphasizes the critical role of soil preparation in ensuring successful pumpkin production. Deep plowing during the autumn period improves soil structure, enhances aeration, facilitates root penetration, and increases moisture retention capacity. The incorporation of organic matter, particularly farmyard manure and compost, was found to be highly beneficial under the conditions of Karakalpakstan. Organic amendments improve physical, chemical, and biological soil properties while increasing the soil's capacity to retain water and nutrients. Given the widespread degradation of agricultural lands in the region, the restoration of soil fertility through organic matter application should be considered a priority component of sustainable pumpkin production systems. Nutrient management emerged as another key factor affecting pumpkin growth and yield formation. The findings suggest that balanced fertilization significantly improves vegetative development, flowering intensity, fruit set, and final yield. Nitrogen contributes primarily to vegetative growth and leaf development, phosphorus promotes root formation and reproductive processes, while potassium enhances stress tolerance and fruit quality. However, the results indicate

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that excessive nitrogen application may stimulate excessive vegetative growth at the expense of fruit production. Therefore, the implementation of balanced fertilizer programs based on soil analysis and crop requirements is essential for achieving optimal productivity. The research also demonstrates the importance of selecting appropriate planting dates and planting densities. Under the climatic conditions of Karakalpakstan, early sowing allows pumpkin plants to utilize favorable spring moisture and avoid the most extreme summer heat during critical growth stages. Proper spacing between plants ensures adequate access to sunlight, water, and nutrients while reducing competition among plants. Optimized plant density contributes to improved canopy development, better air circulation, and reduced disease incidence. Furthermore, the integration of modern digital technologies into agricultural management may provide additional opportunities for improving pumpkin cultivation. Precision agriculture tools, remote sensing technologies, soil moisture monitoring systems, and data-driven decision-support platforms can help optimize irrigation scheduling, fertilizer application, and crop protection measures. These technologies have the potential to increase resource-use efficiency while reducing production costs and environmental impacts. Overall, the results of this study demonstrate that pumpkin cultivation represents a promising agricultural strategy for the Republic of Karakalpakstan. The crop's biological adaptability, economic value, and nutritional significance make it well suited to the region's challenging environmental conditions. However, achieving sustainable and high-yield production requires the implementation of scientifically based agrotechnological practices tailored to local soil and climatic characteristics. The integration of efficient irrigation systems, balanced nutrient management, soil fertility improvement measures, and environmentally sound crop protection strategies is essential for maximizing productivity and ensuring long-term agricultural sustainability. The discussion confirms that pumpkin cultivation can play a significant role in enhancing food security, supporting rural livelihoods, promoting agricultural diversification, and contributing to climate-resilient agricultural development in the Republic of Karakalpakstan. Consequently, further scientific research and practical innovations should focus on refining cultivation technologies and strengthening the adaptive capacity of agricultural systems in this environmentally sensitive region.

**Conclusion.** The present study examined the agrotechnology of pumpkin cultivation under the soil and climatic conditions of the Republic of Karakalpakstan and assessed the key factors influencing crop productivity, quality, and sustainability. The findings demonstrate that despite the severe environmental challenges associated with arid climate conditions, water scarcity, soil salinization, and the ecological consequences of the Aral Sea crisis, pumpkin remains one of the most promising vegetable crops for cultivation in the region. The analysis revealed that the biological characteristics of pumpkin, including its extensive root system, relatively high drought tolerance, efficient water utilization, and moderate salinity resistance, enable the crop to adapt successfully to the unfavorable environmental conditions of Karakalpakstan. These adaptive traits make pumpkin a valuable component of sustainable agricultural systems aimed at improving food security and rural livelihoods in environmentally vulnerable regions. The research confirmed that soil preparation is a fundamental element of successful pumpkin production. Deep plowing, proper land leveling, and the incorporation of organic fertilizers significantly improve soil structure, moisture retention, nutrient availability, and root development. Under the conditions of Karakalpakstan, where soil degradation and salinity are widespread problems, maintaining and restoring soil fertility should be considered a priority agricultural objective. The study also demonstrated the importance of balanced nutrient management. Appropriate application of organic and mineral fertilizers enhances vegetative growth, flowering, fruit development, and yield formation. At the same time, excessive fertilizer use may reduce resource-use efficiency and contribute to environmental degradation. Therefore, integrated

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nutrient management strategies based on soil testing and crop requirements are recommended for sustainable pumpkin cultivation. The study also indicates that future agricultural development in Karakalpakstan should emphasize the adoption of innovative technologies, including precision irrigation systems, digital agricultural monitoring tools, improved breeding programs, and climate-resilient cultivation practices. Such approaches will help increase productivity, improve resource-use efficiency, and strengthen the resilience of agricultural systems to climate change and environmental degradation. In conclusion, pumpkin cultivation represents a viable and sustainable agricultural strategy for the Republic of Karakalpakstan. The implementation of scientifically based agrotechnological practices adapted to local environmental conditions can significantly improve productivity, enhance resource-use efficiency, and contribute to sustainable agricultural development in one of the most ecologically challenged regions of Central Asia.

## References

1. Abdullaev, S., & Khamraev, A. (2021). Water-saving Technologies in Vegetable Production of Uzbekistan. Agricultural Science Journal, 4(2), 45–52.
2. Acquaah, G. (2020). Principles of Crop Production: Theory, Techniques, and Technology. 3rd Edition. Pearson Education.
3. FAO. (2023). Vegetable Production and Sustainable Agriculture. Rome: Food and Agriculture Organization of the United Nations.
4. FAO. (2022). The State of Food and Agriculture: Leveraging Automation in Agriculture. Rome: FAO.
5. Garcia-Mas, J., Monforte, A. J., & Arús, P. (2019). Genetics and Genomics of Cucurbit Crops. Plant Breeding Reviews, 43, 215–289.
6. Grumet, R., Katzir, N., & Garcia-Mas, J. (2017). Genetics and Genomics of Cucurbitaceae. Springer International Publishing.
7. Karimov, B., & Allanazarov, M. (2022). Soil Salinity Management in the Aral Sea Basin. Central Asian Agricultural Research Journal, 7(1), 33–41.
8. Lal, R. (2020). Sustainable Intensification of Agriculture. Boca Raton: CRC Press.
9. Paris, H. S. (2016). Genetics, Evolution, and Agricultural Importance of Pumpkin Species. Horticultural Reviews, 44, 1–70.
10. Robinson, R. W., & Decker-Walters, D. S. (2017). Cucurbits. Wallingford: CAB International.