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GROWING ONION IN ROMANIA: CHALLENGES AND OPPORTUNITIES

Elena BARCANU TUDOR, Ovidia Loredana AGAPIE, Ion GHERASE, Eliza TEODORESCU

Vegetable Research and Development Station Buzău, 23 Mesteacănului Street, 120024, Buzău, Romania

Corresponding author email: teodorescu.eliza@gmail.com

Abstract

This research examines the current status of Allium cepa (onion) cultivation in Romania, highlighting its significance for food security and sustainable agriculture. Despite Romania's rich agricultural heritage and favourable conditions, onion production faces challenges like outdated practices, reliance on imported seeds, and inefficient supply chains. Although Romania ranks sixth in the EU for onion cultivation area, domestic consumption often exceeds production, leading to increased imports. The study explores opportunities to enhance yield and quality through modern breeding techniques, technological advancements, and international collaborations. It also underscores the need for preserving native onion landraces to maintain genetic diversity and promote resilience against climate change. Strengthening agricultural infrastructure, improving organization among farmers, and optimizing supply chains are critical for reducing market imbalances and waste. An integrated approach combining scientific research, sustainability principles, and market knowledge is essential to unlock Romania's onion industry potential, support rural livelihoods, and contribute to national food security and economic growth.

Key words*: Allium cepa, landrace, sustainable cultivation.*

INTRODUCTION

Onions (*Allium cepa* L.) hold a pivotal role in global agriculture as one of the oldest and most versatile cultivated crops. Native to southwestern Asia, onions have spread worldwide, becoming integral to culinary traditions and food systems across cultures (Devi et al., 2015; Rabinowitch and Currah, 2002). Their significance lies not only in their culinary uses but also in their resilience as a crop suitable for storage, transport, and processing into value-added products like powders and flakes. Furthermore, onions are a crucial source of bioactive compounds, such as flavonoids and sulfur-containing compounds, which contribute to human health (Griffiths et al., 2002).

Globally, onion production exceeded 110 million tons in 2022, with India and China as the largest producers, contributing nearly half of the total output (FAOSTAT, 2022). Within the European Union, Romania ranks sixth in onion cultivation area, with 16,300 hectares dedicated to the crop in 2021 (Eurostat, 2021). Despite this, the country struggles to meet domestic demand, importing significant quantities to fill the gap (KeysFin, 2022). This paradox highlights inefficiencies in the supply chain, limited adoption of modern agricultural practices, and a heavy reliance on imported hybrid seeds.

Romania’s rich agricultural heritage includes the cultivation of traditional onion varieties, locally known as landraces, which are valued for their adaptability and contribution to biodiversity (Străjeru et al., 2009). However, the rise of imported hybrid seeds and the decline of local seed production pose a threat to the preservation of this genetic diversity. Climate change, fluctuating market demands, and insufficient infrastructure further exacerbate these challenges, making it difficult for farmers to achieve consistent yields and quality (Hammer & Laghetti, 2005; Sarli et al., 2016).

This study investigates the current status of onion cultivation in Romania, examining its economic, cultural, and environmental significance. The research provides actionable insights to strengthen Romania's onion industry and enhance its contribution to food security and economic growth.

MATERIALS AND METHODS

This study employed a multidisciplinary approach to analyse the status of onion cultivation in Romania, focusing on production practices, economic impact, and sustainability. The methodology combined an in-depth review of literature, statistical analysis, and an assessment of ongoing research efforts.

Statistical data were collected from reputable sources, including Eurostat, FAOSTAT, and the Romanian National Institute of Statistics (INS, 2021, Romanian Statistical Yearbook, 2020), to evaluate trends in onion production, cultivated areas, and consumption patterns. These datasets provided valuable insights into the agricultural sector's structure and performance at the national and European levels. Additional economic insights were gathered from reports by the Ministry of Agriculture and Rural Development and independent market analysis firms, such as KeysFin.

A thorough review of peer-reviewed articles, research reports, and contemporary data sources was conducted to understand the broader context of onion cultivation, focusing on breeding programs, landrace conservation, and climate resilience.

The Vegetable Research Development Stations (VRDS) in Bacău, Buzău, and Iernut are currently involved in a collaborative project aimed at revitalizing and improving onion seed varieties in Romania. While results from these studies are not yet published, these initiatives are crucial for addressing key challenges, such as genetic erosion and the development of climate-resilient onion varieties. This research acknowledges the ongoing efforts of these institutions and their importance in shaping the future of Romanian vegetable sector.

RESULTS AND DISCUSSIONS

Romania's onion cultivation is a testament to its agricultural heritage and ongoing research efforts to modernize the sector. The State Institute for Testing and Registration of Varieties (ITRV) lists 15 onion genotypes in its official 2024 catalogue, comprising 12 seed-propagated varieties (Figure 1) and 3 bulb-propagated types (Official Catalogue of Crop Plants in Romania, 2024).

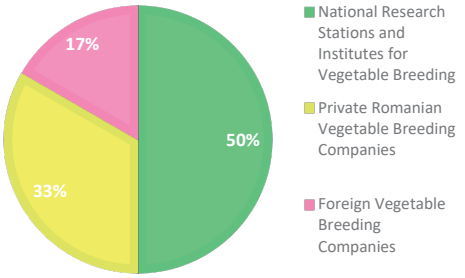

Figure 1. Origin of onion seed cultivars and hybrids listed in the ITRV Catalogue

Among the seed-propagated varieties, 6 were developed by national research institution and stations, including the Vegetable Research and Development Stations (VRDS) in Bacău (Orizont), Buzău (De Buzău and Rubiniu), and Iernut (Arieșana and Chibed), as well as the Institute of Vegetable Breeding Vidra (Universal de Vidra). These varieties have been meticulously bred over decades to improve yield, disease resistance, and adaptability to diverse environmental conditions in Romania.

The remaining six seed-propagated varieties include two hybrids developed by an Italian seed company and three varieties (one hybrid and two open-pollinated types) created by a private Romanian seed company. While these hybrids are valued for their high yield potential and disease resistance, they require higher levels of inputs, including fertilizers and irrigation, and are often less adaptable to local conditions than traditional varieties.

Romania's research stations have historically been instrumental in the development and testing of certified seeds, particularly onion varieties tailored to local conditions. However, in recent decades, these institutions have faced significant challenges due to the loss of much of their agricultural land. Once managing extensive acreage dedicated to seed production and field trials, these stations now operate with limited areas for cultivating seed material. Consequently, the production of certified onion seeds has declined, and supply often fails to meet market demand. This gap has contributed to an increased reliance on imported hybrid seeds, limiting the availability of locally bred varieties and raising concerns about genetic erosion (Hammer & Laghetti, 2005; Străjeru et al., 2009).

The conservation of onion (*Allium cepa* L.) landraces remains a cornerstone of sustainable agriculture in Romania, where traditional agro-ecosystems have historically served as vital repositories of genetic diversity. Landraces, which are locally adapted varieties developed over centuries, are invaluable for their resilience to pests, diseases, and environmental stressors. Romania's onion landraces, such as De Buzău, exemplify this genetic richness, offering traits that are increasingly critical in the face of climate variability (Străjeru et al., 2009; Brush & Stabinsky, 1996).

However, the rise of hybrid seeds and the decline of traditional farming practices have accelerated biodiversity loss globally. Esteemed scientists, including Harlan (1972), Frankel et al. (1970), and Hammer and Laghetti (2005), have warned of the erosion of genetic diversity and the displacement of landraces by genetically uniform, high-yielding cultivars. These trends are not limited to onions but extend to many crops essential to global food security.

In Romania, landrace conservation efforts have been hindered by declining vegetable-cultivated areas (Ibănescu et al., 2002), the advanced age of seed producers (71% of whom are over 60 years old), and underfunding of research centers. Additionally, traditional knowledge associated with landrace cultivation is at risk of disappearing, further threatening these genetic resources. Programs like ADER 6.3.6 aim to address these challenges by emphasizing the preservation and use of landrace germplasm in breeding programs. By integrating traditional genetic resources into modern agricultural systems, these initiatives can help safeguard Romania's agricultural biodiversity while supporting sustainable agricultural development in Eastern Europe.

Onion production in Romania faces a myriad of challenges, many of which stem from the country's fragmented agricultural landscape. According to Eurostat (2015), 97% of Romania's agricultural holdings are small-scale farms of less than 10 hectares, with an average size of 3.3 hectares per farm. This fragmentation limits economies of scale, making it difficult for farmers to invest in modern technologies, irrigation systems, and storage infrastructure (Rusu et al., 2011). The prevalence of subsistence and semi-subsistence farming further exacerbates inefficiencies, as many smallholders prioritize production for personal consumption rather than for commercial markets.

While traditional breeding and hybrid development have been the primary methods for onion improvement in Romania, modern biotechnological tools offer promising avenues for increasing productivity and sustainability. Advancements in onion (*Allium cepa* L.) breeding have significantly improved yield potential, disease resistance, and adaptability to climate change. Traditional breeding methods, such as backcross breeding and hybridization, have been widely used to enhance traits like bulb size, storage life, and pest resistance (Singh et al., 2018). However, modern biotechnological approaches are now revolutionizing onion breeding.

Recent research has focused on marker-assisted selection (MAS) and genome-editing techniques like CRISPR-Cas9 to accelerate breeding cycles and introduce targeted improvements (Khosa et al., 2016). These techniques allow for precise modifications in genes responsible for disease resistance and stress tolerance, reducing dependency on chemical inputs.

The development of male-sterile lines has facilitated hybrid onion varieties with higher yield potential and uniformity (Manjunathagowda et al., 2021). Hybrid onions, while requiring more inputs, have shown greater resistance to pests and diseases, making them more suitable for large-scale commercial production.

Tissue culture methods, such as somatic embryogenesis and meristem culture, are being utilized to produce disease-free planting material (Singh & Khar, 2021). This technique ensures uniform plant growth and speeds up the multiplication of elite onion varieties, particularly those with desirable agronomic traits.

Technological advancements, including remote sensing, automated irrigation, and artificial intelligence (AI)-driven crop monitoring, are helping optimize resource use in onion cultivation (Ochar and Kim, 2023). GPS-guided planting and drone-assisted pest control are being increasingly adopted to improve efficiency and reduce environmental impact.

While these technologies are widely used in developed agricultural markets, their adoption in Romania remains limited due to financial constraints and the predominance of small-scale farming.

Romania's continental climate, characterized by seasonal extremes and irregular precipitation, poses additional risks to onion cultivation. High summer temperatures often lead to water stress, resulting in smaller bulb sizes and reduced yields, while late spring frosts can damage seedlings and delay planting schedules (Rabinowitch & Currah, 2002; Devi et al., 2015). Despite the fertility of Romania's Chernozem soils, which are well-suited for onion cultivation (Stănilă et al., 2011), the lack of irrigation infrastructure leaves farmers vulnerable to prolonged droughts and heavy rains, both of which have become more frequent due to climate change (Sarli et al., 2016).

Post-harvest losses present another significant challenge. According to KeysFin (2022), a substantial proportion of domestically produced onions is lost due to inadequate storage facilities, poor transportation networks, and inefficient supply chains. Modern cold storage systems, sorting equipment, and transport logistics are essential for preserving bulb quality and extending shelf life, yet such infrastructure remains underdeveloped across much of the country.

Unlike Romania, where cold storage facilities remain underdeveloped, the Netherlands has invested in precision-controlled storage technologies, significantly reducing onion losses - by up to 30% in some cases (Currah & Cools, 2012). Adopting similar measures could improve Romania's onion market stability and reduce post-harvest losses. Smart cold storage solutions, controlled atmosphere storage, and blockchain-based supply chain management are improving onion preservation and reducing market fluctuations (Sidhu et al., 2004).

Despite these challenges, Romania's onion sector has immense potential for growth and revitalization. With 16,300 hectares dedicated to onion cultivation in 2021, Romania produced approximately 357,000 tons of onions, ranking as the sixth-largest producer (5.7%, Figure 2) in the European Union (Eurostat, 2021).

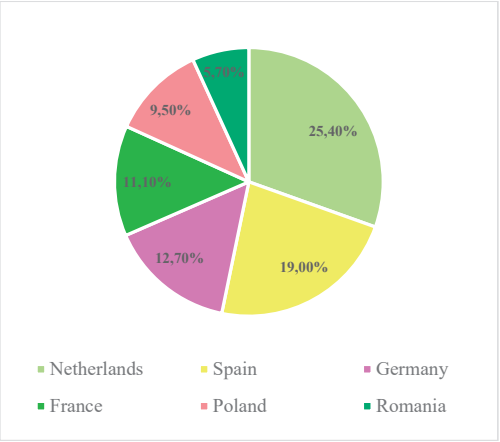

Figure 2. Percentage of EU onion production

However, domestic demand exceeds production, with consumption reaching 400,000 tons annually, resulting in imports worth 40 million euros in 2021 (KeysFin, 2022). Addressing this supply-demand gap requires a multifaceted approach, including investments in research, infrastructure, and sustainable farming practices.

Breeding programs led by VRDS Buzău, Bacău, and Iernut, as well as Institute of Vegetable and Floriculture Breeding Vidra, have developed cultivars such as De Buzău, Rubiniu, Orizont, Arieșana and Chibed and Universal de Vidra, which are tailored to Romania's agro-climatic conditions. Expanding the capacity of these research centers to produce certified seeds could help reduce reliance on imported hybrids, which often require high inputs and are less adapted to local conditions (Străjeru et al., 2009). Additionally, the ADER 6.3.6 program offers a promising framework for developing climate-resilient onion varieties by leveraging Romania's genetic diversity.

Modernization of agricultural practices is also critical. Precision agriculture technologies, such as automated irrigation systems and GPS-guided machinery, can optimize resource use and reduce production costs. Integrated pest management (IPM) strategies can further enhance sustainability by reducing the reliance on chemical inputs (Rabinowitch & Currah, 2002). Improving post-harvest infrastructure is another priority.

Investments in cold storage facilities and mechanized sorting systems can reduce losses, improve product quality, and enable better access to both domestic and export markets. Furthermore, the formation of farmer cooperatives could help smallholders pool resources, access financing, and strengthen their bargaining power with retailers, ultimately improving market organization and reducing inefficiencies (Agarwal et al., 2021).

CONCLUSIONS

Romania's onion cultivation sector exemplifies the intricate balance between tradition and modernization in agriculture. Despite its historical significance and favourable agro-climatic conditions, the country faces systemic challenges that limit the full potential of onion production. Key issues include outdated farming practices, insufficient post-harvest infrastructure, and heavy reliance on imported hybrid seeds, all of which threaten the sustainability and competitiveness of the sector. Efforts to address these challenges must prioritize the modernization of agricultural practices, including the adoption of precision technologies, the establishment of farmer cooperatives, and investments in cold storage and processing facilities. Additionally, policy frameworks should incentivize local seed production to preserve native onion landraces, which are vital for maintaining genetic diversity and fostering resilience against climate change.

The ADER 6.3.6 program and similar initiatives offer promising pathways for sustainable development by integrating advanced breeding techniques and biodiversity conservation. Collaborative research at national and international levels is essential to develop climate-resilient onion varieties that can withstand the environmental variability characterizing Romania's agricultural landscape.

Market organization remains a critical area for improvement. Strengthening supply chains, reducing waste, and ensuring consistent pricing mechanisms will bolster both farmer incomes and consumer satisfaction. By addressing these systemic inefficiencies, Romania can reduce its dependency on imports, improve its self-sufficiency, and position itself as a competitive player in the European onion market.

Sustainability must remain at the core of future strategies, encompassing environmentally friendly practices, resource-efficient technologies, and the preservation of Romania's rich agricultural heritage. To secure Romania's onion industry for the future, integrating cutting-edge breeding techniques, improving post-harvest infrastructure, and expanding farmer support programs will be essential. Strengthening policies that encourage local seed production and investing in sustainable storage solutions can help reduce reliance on imports, improve competitiveness, and enhance food security.

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