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PROSPECTS FOR THE DEVELOPMENT OF ONION SEED PRODUCTION IN UZBEKISTAN

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Abstract. This article examines the agrotechnological practices applied to the development of onion seed production in Uzbekistan and explores measures aimed at improving their effectiveness. Particular attention is given to the advancement of agricultural technologies and the improvement of seed production practices. Based on the issues examined, the article presents relevant scientific conclusions concerning the prospects for further development of onion seed production in the country.

Keywords: onion cultivation, yield, agrotechnology, plant breeding, seeds, seed production, land resources, soil, mechanization, scientific advancements, crop varieties, efficiency, cultivated area, agricultural enterprises, agricultural sector.

Аннотация. В статье рассматриваются агротехнологические методы, применяемые для развития семеноводства репчатого лука в Узбекистане, а также исследуются направления повышения их эффективности. Особое внимание уделяется совершенствованию агротехнологий и методов организации семеноводства. На основе рассмотренных вопросов сформулированы соответствующие научные выводы относительно перспектив дальнейшего развития семеноводства репчатого лука в стране.

Ключевые слова: выращивание репчатого лука, урожайность, агротехнологии, селекция растений, семена, семеноводство, земельные ресурсы, почва, механизация, научные достижения, сорта, эффективность, посевные площади, сельскохозяйственные предприятия, аграрный сектор.

INTRODUCTION

As emphasized by the President of the Republic of Uzbekistan, Shavkat Mirziyoyev, "...there will be no development in the sector unless agriculture is placed on a scientific footing" (Address, 2022) [3].

At present, the agricultural sector plays an increasingly important role in ensuring a sustainable and adequate food supply for the world's growing population. In this context, the rational and efficient utilization of Uzbekistan's existing agricultural production potential and resources, the consistent satisfaction of the population's demand for high-quality food products, the improvement of production efficiency, and the strengthening of economic incentives for agricultural producers are among the key priorities for the sector's development.

The successful implementation of these priorities requires the systematic integration of scientific research findings into agricultural production, the widespread adoption of innovative technologies, and the application of modern management approaches. These measures constitute important factors in ensuring the sustainable and efficient development of the agricultural sector.

The Republic of Uzbekistan's agricultural development framework through 2030 identifies several priority areas for continuing structural reforms in agricultural production. These include the comprehensive mechanization of agriculture through the introduction of innovative agrotechnologies, increasing the production of finished consumer goods through the advanced processing of agricultural raw materials, meeting domestic food demand through the effective utilization of national production resources, and implementing other promising measures aimed at strengthening the agricultural sector.

Within the framework of ongoing structural reforms, particular attention is being paid to the gradual reallocation of agricultural land from relatively low-yielding and less profitable cotton cultivation to higher-value fruit and vegetable crops, potatoes, fodder crops, and other agricultural products. These reforms also envisage the establishment of intensive orchards and the further development of plant breeding and seed production systems.

In this regard, improving the efficiency of onion cultivation requires particular attention to the development of seed production. The use of high-quality seeds obtained through improved breeding practices and characterized by enhanced resistance to diseases can significantly increase crop productivity while reducing the risks of premature bolting and disease development.

One of the effective approaches identified in the literature is the direct cultivation of onions from seeds, which, under appropriate growing conditions, can increase yields by 20–30% compared with traditional planting methods [4].

The development of crop seed production in Uzbekistan is also closely associated with the implementation of relevant regulatory and institutional measures. In particular, the implementation of Resolution No. PQ-3683 of the President of the Republic of Uzbekistan, dated 27 April 2018, “On Measures to Fundamentally Improve the Seed Production System in the Republic of Uzbekistan” [1], and Resolution No. 733 of the Cabinet of Ministers of the Republic of Uzbekistan, dated 5 September 2019, “On Measures to Further Improve the Activities of the Seed Production Development Center under the Ministry of Agriculture of the Republic of Uzbekistan” [2], is of considerable importance.

These regulatory measures provide an institutional foundation for improving seed production practices, strengthening the scientific and technological capacity of the agricultural sector, and creating favourable conditions for the development of high-quality seed production.

Accordingly, the development of onion seed production represents an important direction for improving agricultural productivity, increasing the efficiency of land use, and strengthening the sustainability of vegetable production in Uzbekistan.

LITERATURE REVIEW

The development of onion seed production has been examined in scientific studies focusing on seed quality, germination, storage conditions, breeding technologies, and the improvement of agricultural production practices.

In their research, D. Thirusendura Selvi and S. Saraswathy investigated the effects of seed moisture content, temperature, and relative humidity on the germination capacity and storage longevity of onion seeds. According to their findings, reducing seed moisture content and maintaining low-temperature, moisture-protected storage conditions contribute to preserving seed viability and germination capacity over an extended period.

The researchers demonstrated that maintaining seed moisture content at approximately $6 \pm 1\%$ and applying appropriate temperature and humidity conditions are effective measures for preserving onion seed quality during storage [10].

Another important area of research concerns improving field germination and the early developmental characteristics of onion seedlings.

A. Pagano and co-authors examined the significance of pre-sowing seed treatment, particularly seed priming technology, in crops belonging to the genus *Allium* [6]. Their research highlights the importance of seed quality as a major factor influencing seedling emergence, early plant development, and tolerance to unfavourable environmental conditions.

The application of seed priming technologies can therefore be considered a promising approach to improving seed performance and supporting more uniform crop establishment under varying agroecological conditions.

C. S. Pathak devoted particular attention to the production of F1 hybrid onion seeds [7]. The study considers the development and production of hybrid varieties using male sterility as one of the promising technological approaches in onion seed production.

This research demonstrates that modern onion seed production extends beyond the multiplication of existing varieties and increasingly focuses on developing high-yielding hybrids adapted to specific agroecological conditions.

The use of hybrid breeding technologies creates additional opportunities to improve crop productivity, enhance the genetic characteristics of planting material, and increase the efficiency of commercial onion production.

Scientific and applied research on onion seed production is also being conducted in Uzbekistan.

In particular, Sh. Solijonov, H. Kodirova, X. Abduraxmanova, and D. Mamadaliyev examined the agrotechnological aspects of onion cultivation and the organization of seed production [9].

Their research contributes to the scientific understanding of onion cultivation practices and provides a basis for further consideration of approaches to improving seed production under the agricultural conditions of Uzbekistan.

Overall, the review of the existing scientific literature indicates that the efficiency of onion seed production is determined by several interconnected factors. These include the selection of genetically superior varieties and hybrids, the production of high-quality seeds, the maintenance of seed viability and germination capacity, the improvement of storage technologies, and the regional adaptation of varieties to specific agroecological conditions.

Consequently, the sustainable development of onion seed production requires an integrated approach combining modern breeding methods, scientifically based agrotechnological practices, effective seed storage systems, and the adaptation of production technologies to local agricultural conditions.

The findings of the reviewed studies provide a scientific foundation for identifying promising directions for the further development of onion seed production in Uzbekistan.

RESEARCH METHODOLOGY

The methodological framework of this study is based on scientific and theoretical perspectives, as well as established research approaches to the development of onion seed production in Uzbekistan, the improvement of seed quality, and the enhancement of production efficiency. The research adopts an integrated approach to assessing the agrotechnological and economic aspects of onion seed production, with particular emphasis on identifying factors influencing productivity, production costs, and profitability.

The object of the research is onion seed production in Uzbekistan, including its agrotechnological characteristics and economic efficiency. The empirical component of the study focuses on the activities of the “Jilg’alisoy shabadasi” farm, located in Zomin district, Jizzakh region. Using the farm’s production and economic data for 2020–2025, the study examines key performance indicators, including onion seed yield, total production costs, gross revenue, profit, profitability, selling price per kilogram of onion seed, and production cost per kilogram.

The research employs monographic analysis, economic and statistical analysis, comparative analysis, data grouping, time-series analysis, and a systems approach. The monographic method was applied to examine the onion seed production practices, cost structure, and economic performance of the “Jilg’alisoy shabadasi” farm. Economic and statistical analysis was used to identify annual trends in yield, production costs, revenue, and profit.

ANALYSIS AND RESULTS

Comparative analysis was employed to assess changes in production and economic indicators between 2020 and 2025, thereby evaluating variations in economic efficiency over the study period. Time-series analysis was used to examine the dynamics of onion seed yield, total production costs, gross revenue, profit, and profitability. In particular, onion seed yield at the farm increased from 8.9 centners per hectare (c/ha) in 2020 to 9.5 c/ha in 2025, while total production costs increased from UZS 353,750 thousand to UZS 371,616 thousand over the same period.

The information base of the study comprises national and international scientific publications on onion seed production, relevant regulatory and legal documents of the Republic of Uzbekistan concerning agriculture and seed production, and the production and financial records of the “Jilg’alisoy shabadasi” farm for 2020–2025. International research addressing onion seed storage and viability, seed priming techniques, and hybrid seed production was also reviewed to establish the scientific foundations of the study.

Previous scientific studies indicate that the use of improved seed varieties in combination with modern agrotechnical practices can contribute to increased onion yields per hectare, a reduction in the proportion of undersized and damaged bulbs, and lower losses during prolonged storage and transportation [8]. These improvements can enhance the economic efficiency of agricultural production and contribute to national food security.

The integration of modern agrotechnologies, plant breeding methods, and scientifically based cultivation practices is therefore considered an important factor in improving resource-use efficiency, environmental sustainability, and the stability of agricultural production. Such an integrated approach creates favourable conditions for obtaining consistently high-quality yields.

According to specialists, improving the efficiency of onion cultivation requires particular attention to seed production, the selection of appropriate varieties, seed quality, and the determination of optimal spacing between plants [5]. These factors influence crop establishment, plant development, and the overall productivity of onion cultivation.

The institutional and regulatory framework for developing seed production in Uzbekistan is supported by relevant government measures. In particular, Resolution No. PQ-3683 of the President of the Republic

of Uzbekistan, dated 27 April 2018, “On Measures to Fundamentally Improve the Seed Production System in the Republic of Uzbekistan” [1], and Resolution No. 733 of the Cabinet of Ministers of the Republic of Uzbekistan, dated 5 September 2019, “On Measures to Further Improve the Activities of the Seed Production Development Center under the Ministry of Agriculture of the Republic of Uzbekistan” [2], are of particular relevance to the development and modernization of the national seed production system.

The economic performance of different onion seed production methods varies depending on a combination of natural, technological, and organizational factors. These include soil moisture and fertility, the selection of suitable agricultural land, appropriate soil tillage, field preparation, the quality of pre-sowing seed treatment, uniform seed distribution, optimal sowing depth, compliance with recommended crop management practices, harvesting methods, and the organization of crop rotation.

The interaction of these factors influences onion seed productivity, the efficiency of resource utilization, and the economic outcomes of agricultural production.

Accordingly, the economic efficiency of a particular onion seed production method is primarily determined by the yield obtained per unit of cultivated area, the volume of production and associated costs, and the economic return generated per unit of expenditure.

These indicators provide the analytical basis for comparing onion seed production methods and assessing the economic performance of the studied farm, as presented in Table 1.

Table 1

Analysis of the main factors affecting the efficiency of onion seed production [1]

№	Factor	Nature of effect	Effect on efficiency (economic and agrotechnical)
1	Soil moisture level	Moisture deficiency reduces seed germination, while excess moisture increases the risk of rot	Optimal moisture ensures 85–90% seed emergence and increases overall yield by 10–15%
2	Soil fertility	A sufficient content of organic matter, nitrogen, phosphorus and potassium is required	In fertile soil plant growth accelerates, and seed quality and harvest weight are high
3	Choice of land	Different soil and climate conditions affect onion varieties differently	Planting on suitable land increases yield by 20–25%, while on unsuitable land there is a possibility of losses of up to 30%
4	Tillage	Plowing, cultivation and leveling before sowing	Soil air and water permeability improves, and the emergence rate rises by 10–12%
5	Preparing the field for sowing	Properly preparing the flatness, row spacing and drainage system	With good field preparation, mechanization efficiency rises by 15% and labor input decreases
6	Preparing seed for sowing	Sorting, calibration, disinfection, treatment with microelements	Seed emergence accelerates, disease resistance increases, and the harvest is of good quality
7	Even distribution of seeds across the nutrition area	Uniformity of spacing between seeds and of row depth	Plants grow without competition, a uniform onion crop is formed, and yield rises by 8–10%
8	Sowing depth	Sowing at a depth of 1.5–2 cm is recommended, depending on variety and soil type	Sowing at the wrong depth can reduce emergence by 20–25%
9	Compliance with agrotechnical measures	Irrigation, fertilization, weeding and protection work	Complete agrotechnology increases yield by up to 30–35% and improves quality
10	Harvest timing	If onion seed becomes over-ripe, seed shattering increases	Timely harvesting can reduce seed losses by 10–12%
11	Crop rotation system	Repeated planting in the same place increases the risk of phytopathogen buildup	Crop rotation preserves soil fertility, prevents the spread of diseases, and keeps total yield stable

Usually, the higher the yield achieved with production costs at a minimum or unchanged, the higher the production efficiency. In this, the sustainable development of the sector, i.e., onion seed production, takes the leading place. If such development is achieved, a long-term economic effect is ensured (Table 2).

Table 2

Economic efficiency of onion seed production at the
“Jilg’alisoy shabadasi” farm in Zomin district, thousand soums [1]

№	Indicators	Years					
		2020	2021	2022	2023	2024	2025
1	Planted area, ha	2.5	2	1.7	2	2	2
2	Yield, c/ha	8.9	9.3	10	11	10	9.5
3	Gross yield, tons	2.225	1.86	1.7	2.2	2.0	1.9
4	Seed costs, thousand soums	183750	153000	134980	165000	176000	188000
5	Fuel and lubricant costs	1250	1200	1054	1300	1200	1200
6	Mineral fertilizer costs	9000	7200	6290	8000	8200	10000
7	Chemical costs	5250	4600	3910	5000	5340	5500
8	Drip irrigation system installation	20000	16000	14620	18000	19000	20000
9	Electricity costs	13500	10800	9180	10800	21600	24000
10	Transport service costs	4250	3600	3060	3800	4000	4000
11	Wage costs (including contributions)	114250	94000	83946	101800	108960	115472
12	Other costs	2500	2800	2380	2900	3000	3444
13	Total costs	353750	293200	259420	316600	347300	371616
14	Gross income	600750	520800	425000	770000	1600000	950000
15	Profit	247000	227600	165580	453400	1252700	578384
16	Profitability level, %	69.8	77.6	63.8	143.2	360.7	155.6
17	Price of 1 kg of onion seed, thousand soums	270	280	250	350	800	500
18	Cost of 1 kg of onion seed, thousand soums	158	156	152	144	174	195

As onion seed yield per hectare increased, the production cost per kilogram of seed tended to decrease. At the same time, seed-related expenses accounted for approximately 50% of total production costs, while labour costs, including associated contributions, represented 34%. These findings highlight the importance of further mechanizing onion seed production processes to optimize production costs, improve labour productivity, and enhance overall economic efficiency.

The economic efficiency of onion seed production at the “Jilg’alisoy shabadasi” farm in Zomin district, examined through a monographic study, was found to be higher than that of other farms included in the comparison (Table 3.4).

According to the data presented in the table, the profitability of onion seed production at the farm was 69.8% in 2020, 77.6% in 2021, 63.8% in 2022, 143.2% in 2023, 360.7% in 2024, and 155.6% in 2025.

In 2025, the farm’s total profit amounted to UZS 578,384 thousand, which was approximately 2.3 times the level recorded in 2020. These results indicate that onion seed production can generate substantial economic returns when appropriate agrotechnological practices are combined with effective production and cost management.

CONCLUSION AND RECOMMENDATIONS

The findings of the study demonstrate that the development of onion seed production in Uzbekistan plays an important role in ensuring the sustainability of agricultural production, strengthening the domestic seed production base, and improving the economic efficiency of farms and household agricultural producers engaged in onion cultivation.

The efficiency of onion seed production is directly influenced by several interrelated factors, including the genetic and biological quality of seed material, the adaptation of varieties to regional agroclimatic conditions,

the timely implementation of agrotechnological measures, the rational utilization of production resources, and effective cost management.

Based on the research findings, the following recommendations are proposed to support the further development of onion seed production in Uzbekistan and enhance its economic efficiency.

1. Expanding the domestic onion seed production base.

It is recommended to establish specialized onion seed production farms and expand the activities of existing producers, taking into account the soil and climatic characteristics of different regions.

This approach will contribute to increasing domestic seed production, diversifying seed supply sources, reducing reliance on externally sourced seed material, and ensuring a stable supply of high-quality seeds to agricultural producers.

The development of specialized seed production enterprises will also create favourable conditions for improving production efficiency and strengthening the sustainability of the domestic agricultural sector.

2. Improving state support mechanisms for seed-producing farms.

Considering the substantial share of seed material in the total production costs of onion seed production, it is proposed to introduce a targeted subsidy mechanism to compensate for up to one-third of the costs of selected seed material purchased by seed producers that meet established quality requirements.

The amount of subsidies, eligibility criteria, allocation procedures, and monitoring mechanisms should be determined by the relevant authorized institutions on the basis of economically justified criteria.

The implementation of this proposal could contribute to expanding domestic seed production, improving the financial capacity of specialized farms, and reducing the cost burden associated with the acquisition of high-quality seed material.

3. Promoting the widespread adoption of scientifically based agrotechnologies.

To improve onion seed production efficiency, it is recommended to strengthen the application of scientifically based agrotechnological practices throughout the production cycle.

Before sowing, onion seeds should be sorted according to established quality indicators and tested for germination capacity. Optimal sowing dates and seeding rates should be determined with consideration of regional soil and climatic conditions.

Furthermore, irrigation and fertilization practices should be organized in accordance with scientifically substantiated recommendations, taking into account the biological characteristics of individual onion varieties and the agroecological conditions of cultivation areas.

The consistent implementation of these measures will contribute to improving seed quality, enhancing crop productivity, and ensuring the efficient use of agricultural resources.

4. Increasing the mechanization of onion seed production processes.

It is recommended to expand the use of modern agricultural machinery and mechanized technologies in seed sowing, inter-row cultivation, weed control, irrigation, and harvesting operations.

The introduction of appropriate mechanization solutions will help reduce dependence on manual labour, increase labour productivity, improve the timeliness and quality of agricultural operations, and optimize production costs.

Particular attention should be given to selecting machinery and equipment that correspond to the production scale and economic capacity of individual farms.

Overall, the sustainable development of onion seed production in Uzbekistan is closely associated with strengthening the domestic seed production base, introducing scientifically based agrotechnologies, optimizing production costs, expanding mechanization, and improving targeted state support mechanisms.

The implementation of measures in these priority areas will create favourable conditions for improving onion seed quality and productivity, increasing the profitability of specialized seed-producing farms, and supporting the long-term development of vegetable seed production in Uzbekistan.

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