ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-515-x, Impact Factor: 9.23

American Academic publishers, volume 6, issue 05,2026

Journal: https://www.academicpublishers.org/journals/index.php/ijai

POSSIBILITIES OF INCREASING OIL YIELD BY SELECTING SESAME VARIETIES BELONGING TO DIFFERENT RIPENING GROUPS IN THE CONDITIONS OF KARAKALPAKSTAN

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Abstract: Sesame (Sesamum indicum L.) is one of the most valuable oilseed crops cultivated in arid and semi-arid regions due to its high oil content, drought tolerance, and adaptability to saline soils. In the Republic of Karakalpakstan, increasing demand for vegetable oil and the need for sustainable agricultural production require the introduction of highly productive sesame varieties adapted to local environmental conditions. This study analyzes the possibilities of increasing oil yield through the selection of sesame varieties belonging to different ripening groups under the soil-climatic conditions of Karakalpakstan. Special attention is paid to early-, medium-, and late-ripening varieties, their biological characteristics, adaptability, and productivity indicators. The research demonstrates that correct selection of varieties according to ripening duration significantly influences seed yield, oil accumulation, and economic efficiency. Early-ripening varieties are characterized by rapid maturation and reduced exposure to drought stress, while medium- and late-ripening varieties possess higher biomass accumulation and oil productivity under favorable irrigation conditions. The study also highlights the importance of sowing time, irrigation regime, and varietal adaptability in improving oil yield.

Keywords: Sesame, oil yield, ripening groups, Karakalpakstan, sesame varieties, oil content, productivity, irrigation, drought resistance, agricultural technology, seed yield, adaptation.

Introduction

Sesame (Sesamum indicum L.) is among the oldest cultivated oilseed crops in the world and occupies an important place in global agriculture due to its high nutritional and economic value. Sesame seeds contain approximately 50–60% oil and 20–25% protein, making them a valuable source of edible oil, food products, and industrial raw materials. The oil extracted from sesame seeds is characterized by high oxidative stability, pleasant taste, and rich content of biologically active compounds, including sesamin and sesamol, which increase its nutritional significance. In recent years, the demand for vegetable oils has increased significantly worldwide, leading to growing interest in the cultivation of oilseed crops in arid and semi-arid regions. Uzbekistan, particularly the Republic of Karakalpakstan, possesses favorable climatic conditions for sesame cultivation due to high solar radiation, long vegetation periods, and warm temperatures. However, the region also faces serious environmental challenges such as soil salinity, water scarcity, and high summer temperatures, which negatively affect crop productivity. Under these circumstances, the selection of adapted sesame varieties becomes one of the most important factors for increasing oil yield and ensuring stable agricultural production.

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The productivity of sesame largely depends on the biological characteristics of varieties, especially their ripening period. Sesame varieties are commonly divided into early-, medium-, and late-ripening groups. Early-ripening varieties complete their development within a shorter vegetation period and are more resistant to drought and heat stress. Medium-ripening varieties usually combine relatively high productivity with better adaptability to environmental conditions. Late-ripening varieties, although requiring longer growing seasons and more irrigation, often produce greater biomass and higher oil yield under optimal conditions. Therefore, studying the productivity and oil accumulation of different ripening groups is essential for determining the most suitable varieties for Karakalpakstan conditions. The correct selection of sesame varieties also contributes to efficient use of irrigation water and agricultural resources. Research conducted in Karakalpakstan showed that sowing dates, irrigation regimes, and seed quality significantly influence sesame productivity. Studies revealed that sowing in early or mid-May provides optimal conditions for plant growth and oil accumulation. Furthermore, modern irrigation technologies and crop rotation systems improve plant development and increase economic efficiency. At present, expanding sesame cultivation in Karakalpakstan is considered strategically important for strengthening food security, improving soil fertility, and increasing farmers' income. The cultivation of highly productive and oil-rich varieties adapted to saline and drought-prone soils can contribute to sustainable agricultural development in the region. Therefore, the purpose of this study is to evaluate the possibilities of increasing oil yield through the selection of sesame varieties belonging to different ripening groups under the environmental conditions of Karakalpakstan.

Main Body

Sesame cultivation in Karakalpakstan has gained increasing importance in recent years due to the growing demand for vegetable oil and the need to diversify agricultural production. The region's sharply continental climate, characterized by hot summers, low precipitation, and saline soils, creates both opportunities and limitations for sesame production. Since sesame is considered relatively drought-resistant compared with other oilseed crops, it has become one of the promising crops for cultivation in the region. However, achieving high oil yield requires careful selection of varieties adapted to local environmental conditions. One of the major factors influencing sesame productivity is the ripening duration of varieties. Early-ripening varieties usually complete their vegetation period within 90–100 days. These varieties are particularly suitable for regions where water deficiency and high temperatures occur during late summer. Their shorter growth cycle allows plants to avoid severe drought stress and reduces the risk of yield loss. In Karakalpakstan conditions, early-ripening varieties have shown stable seed formation and satisfactory oil accumulation even under limited irrigation. Additionally, these varieties allow farmers to harvest crops earlier and prepare fields for subsequent agricultural operations. Medium-ripening varieties require approximately 110–120 days to mature and are considered the most balanced in terms of productivity and adaptability.[1] They usually demonstrate stronger vegetative growth, increased capsule formation, and higher seed weight compared with early varieties. Research conducted in Karakalpakstan revealed that medium-ripening sesame varieties provide higher oil yield due to better utilization of soil nutrients and longer periods of photosynthetic activity. These varieties are particularly effective when adequate irrigation and timely sowing are applied. [2]

Late-ripening sesame varieties have the longest vegetation period, often exceeding 130 days. These varieties generally possess higher biomass accumulation and greater potential oil

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productivity. However, their successful cultivation requires stable irrigation supply and favorable weather conditions throughout the growing season. In Karakalpakstan, where water scarcity is a serious problem, late-ripening varieties are less widely cultivated. Nevertheless, under improved irrigation systems and fertile soils, they can produce high seed and oil yields. The challenge lies in balancing productivity with water-use efficiency. The oil content of sesame seeds is strongly influenced by both genetic and environmental factors. Studies indicate that sesame oil content ranges between 44% and 60% depending on variety and cultivation conditions. [3] High temperatures during flowering and seed filling stages may reduce oil accumulation, especially in poorly adapted varieties. Therefore, selecting varieties with stable oil content under stress conditions is essential for improving oil productivity in Karakalpakstan. Among the varieties studied in the region, Tashkent-122 demonstrated high adaptability and productivity. Research showed that this variety produced greater plant height, more capsules per plant, larger seed size, and higher oil content compared with other tested varieties. The variety also responded positively to optimal irrigation regimes and early sowing dates. Due to these characteristics, Tashkent-122 is considered one of the most promising sesame varieties for the environmental conditions of Karakalpakstan.[4]

Sowing time is another important factor affecting oil yield. Experimental results demonstrated that sowing sesame during the first half of May creates the most favorable conditions for germination, flowering, and seed maturation. Early sowing allows plants to utilize spring soil moisture and avoid excessive heat during reproductive stages. Conversely, delayed sowing reduces plant growth duration and negatively affects seed yield and oil accumulation. Irrigation management also plays a crucial role in sesame productivity. Although sesame is drought tolerant, adequate moisture during flowering and capsule formation stages significantly increases seed yield and oil content.[5] Modern irrigation methods such as drip irrigation help improve water-use efficiency and reduce salinity stress. Research in northern Karakalpakstan demonstrated that combining drip irrigation with mineral and organic fertilizers improved sesame productivity under water-deficit conditions. Soil salinity remains one of the major limiting factors in Karakalpakstan agriculture. High salt concentration negatively affects seed germination, root development, and nutrient uptake. Therefore, selecting salt-tolerant sesame varieties is an important direction of breeding research. Medium-ripening varieties generally show greater tolerance to moderate salinity due to stronger root systems and improved physiological adaptation.

The role of breeding in improving sesame productivity should also be emphasized. Modern breeding programs focus on developing varieties with high oil content, resistance to capsule cracking, drought tolerance, and synchronized maturation. Studies on sesame genetics revealed that oil content and yield traits are controlled by both additive and non-additive genetic effects. Therefore, hybridization and selection of genetically stable varieties can significantly increase productivity. Economic efficiency is another important aspect of sesame cultivation. Sesame seeds possess high market value, making the crop economically attractive for farmers. Research conducted in Karakalpakstan showed that correct sowing dates and adapted varieties increase profitability by more than 40%. Additionally, sesame cultivation contributes to crop diversification and improves sustainability of farming systems in arid regions.[6] Thus, increasing oil yield in Karakalpakstan depends on a combination of factors including selection of suitable ripening groups, optimal sowing time, efficient irrigation, salinity management, and improved agricultural technologies. Medium-ripening and adaptable high-oil varieties currently appear to be the most effective option for stable production in the region.

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Conclusion

The Republic of Karakalpakstan possesses considerable potential for the development of sesame cultivation due to its warm climate and long growing season. However, environmental challenges such as water scarcity, soil salinity, and high summer temperatures require scientifically based approaches for increasing crop productivity. Under these conditions, the selection of sesame varieties belonging to different ripening groups represents one of the most effective methods for increasing oil yield and improving economic efficiency. The conducted analysis demonstrated that sesame varieties differ significantly in their biological characteristics, adaptability, and productivity indicators. Early-ripening varieties are characterized by short vegetation periods and increased resistance to drought stress, making them suitable for areas with limited irrigation resources. Medium-ripening varieties combine stable productivity, good adaptability, and relatively high oil accumulation, which makes them particularly promising for Karakalpakstan conditions. Late-ripening varieties possess high productive potential but require stable water supply and favorable environmental conditions for full realization of their yield capacity. Among the studied varieties, Tashkent-122 showed superior performance in terms of plant growth, capsule formation, seed productivity, and oil content. This variety demonstrated high adaptability to the soil-climatic conditions of Karakalpakstan and responded positively to optimal irrigation and sowing dates. Research results also confirmed that sowing sesame in early or mid-May provides the most favorable conditions for plant development and oil accumulation. Timely irrigation during critical growth stages further contributes to increased seed and oil yield.

In conclusion, increasing oil yield in Karakalpakstan is possible through the scientifically grounded selection of sesame varieties belonging to different ripening groups combined with improved cultivation technologies. Medium-ripening and highly adaptable varieties currently provide the most stable and economically efficient results under local conditions. Further research on breeding, irrigation optimization, and salinity tolerance will contribute to the development of sustainable sesame production systems in the Republic of Karakalpakstan.

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