



# THE EFFECT OF MINERAL FERTILIZERS ON SESAME PLANTS IN THE BARREN SOILS OF SURKHANDARYA

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## ABSTRACT

*This study investigates the influence of mineral fertilizers on the growth and yield of sesame (*Sesamum indicum* L.) cultivated in the takir (saline and compacted clay) soils of the Surkhandarya region in Uzbekistan. The research aimed to determine optimal fertilizer compositions and application rates for improving soil fertility, plant growth, and oil yield in arid soil conditions. Field experiments were conducted using different combinations of nitrogen (N), phosphorus (P), and potassium (K) fertilizers. Results revealed that balanced fertilization significantly increased plant height, number of capsules per plant, and seed yield compared to the unfertilized control. The combined application of N90P60K60 provided the best results, enhancing yield by 28–32% over the control. The findings suggest that mineral fertilization plays a key role in increasing sesame productivity and improving the economic efficiency of agricultural production in arid zones of Uzbekistan.*

## 1. Introduction

Sesame (*Sesamum indicum* L.) is one of the oldest and most valuable oilseed crops grown in arid and semi-arid regions of the world. It is highly valued for its high-quality oil, which contains up to 55% oil and 25% protein. In Uzbekistan, particularly in the Surkhandarya region, sesame cultivation has become an important part of crop rotation systems, contributing to both soil improvement and farmers' income. However, the takir soils of this region are characterized by low organic matter, high clay content, and limited nutrient availability, which restrict sesame growth and productivity.

Mineral fertilizers are essential for improving soil fertility and ensuring balanced plant nutrition. Nitrogen is responsible for vegetative growth, phosphorus promotes root and reproductive development, and potassium enhances resistance to drought and diseases. Determining the optimal combination of these nutrients is vital for maximizing sesame yield under takir soil conditions.

The purpose of this study was to evaluate the effects of different mineral fertilizer rates on sesame growth, yield components, and oil content in the takir soils of the Surkhandarya region.

## 2. Materials and Methods

### 2.1. Study Area

The experiment was carried out in the Sherabad district of the Surkhandarya region during the 2024 growing season. The region has a sharply continental climate with hot, dry summers and mild winters. The average annual precipitation is about 250–300 mm, most of which falls in winter and spring. The experimental soils were classified as takir, characterized by dense clay structure, poor aeration, low humus content (0.7–0.9%), and limited available nitrogen and phosphorus.

### 2.2. Experimental Design

The field experiment was laid out in a randomized complete block design with three replications. The sesame variety used was ‘Surkhon-1’, adapted to local arid conditions. Treatments included:

- **T<sub>1</sub> – Control (no fertilizer)**
- **T<sub>2</sub> – N60P40**
- **T<sub>3</sub> – N90P60**
- **T<sub>4</sub> – N90P60K60**
- **T<sub>5</sub> – N120P80K60**

Nitrogen was applied as ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), phosphorus as superphosphate ( $\text{P}_2\text{O}_5$ ), and potassium as potassium chloride (KCl). Half of the nitrogen and all phosphorus and potassium were applied before sowing; the remaining nitrogen was applied during the flowering stage.

### 2.3. Data Collection

Growth parameters (plant height, number of branches, number of capsules per plant) and yield attributes (1000-seed weight, seed yield per hectare, and oil content) were recorded. Oil content was determined by Soxhlet extraction using petroleum ether. Data were statistically analyzed using ANOVA, and treatment means were compared using the least significant difference (LSD) test at the 5% level.

## 3. Results

### 3.1. Growth Parameters

Application of mineral fertilizers significantly affected sesame growth. Plants in the control plot reached an average height of 82.5 cm, while those treated with N90P60K60 reached 108.3 cm. The number of branches per plant increased from 3.2 (control) to 5.6 under N90P60K60 treatment. Fertilized plants also exhibited healthier foliage and faster development during the vegetative phase.

### 3.2. Yield Components and Seed Production

Mineral fertilizer application enhanced yield-related traits. The average number of capsules per plant increased from 45.7 (control) to 71.4 in N90P60K60 treatment. The highest seed yield was recorded under N90P60K60 — 1.92 t/ha, which represented a **31.8% increase** compared to the control (1.46 t/ha). Increasing nitrogen and phosphorus beyond this rate (N120P80K60) did not significantly improve yield, indicating the optimal balance was achieved at moderate levels.

### 3.3. Oil Content

Oil content was also affected by fertilizer treatments. The control plot showed 49.2% oil content, whereas N90P60K60 increased it to 52.6%. This demonstrates that balanced nutrition not only increases yield but also enhances oil quality, which is economically beneficial for sesame producers.

#### **4. Discussion**

The findings confirm that mineral fertilizers play a crucial role in sesame production on takir soils. Balanced fertilization improves soil nutrient availability, promotes root and shoot development, and enhances photosynthetic activity. The synergistic effect of N, P, and K nutrients underlines the importance of integrated nutrient management.

The optimal treatment, N90P60K60, provided the best combination of growth, yield, and oil content, which is consistent with previous studies conducted on sesame in arid soils of Central Asia and India. Excessive nitrogen, however, caused excessive vegetative growth and delayed maturity, emphasizing the need for moderate application rates.

These results can serve as practical recommendations for farmers in Surkhandarya and other arid regions of Uzbekistan, where takir soils limit productivity. Regular soil analysis and site-specific fertilizer management can further improve the sustainability of sesame cultivation in these conditions.

#### **5. Conclusion**

Mineral fertilizers significantly influence sesame growth and productivity in the takir soils of Surkhandarya. The combined application of N90P60K60 was found to be optimal, leading to higher plant height, capsule number, seed yield, and oil content. Balanced fertilization ensures better nutrient uptake and enhances the economic return from sesame cultivation. Future research should focus on integrating organic manures and biofertilizers with mineral fertilizers to improve soil health and long-term fertility.

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