



## CULTIVATION TECHNOLOGY OF SOYBEAN (GLYCINE MAX (L.) MERR.) IN THE SAMARKAND REGION

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### ABSTRACT

*This study focuses on identifying promising and high-yield soybean varieties suitable for saline soils in the region, with high protein content. It also aims to determine the physical and chemical composition of soybean grains and evaluate the technological properties of selected varieties based on their processing potential. Agro-technological practices for soybean cultivation in various soil and climatic conditions across the country were examined, focusing on the botanical-morphological traits, biological characteristics, growth and development dynamics, yield, and economic indicators of different soybean varieties. Additional research was conducted on the effects of soybean-wheat flour mixtures on wheat bread quality, comparing control samples without soybean flour. The final products were analyzed 16–18 hours after baking, and comparisons were made with soybean-enriched samples.*

In the years of independence, Uzbekistan has adopted several laws and resolutions aimed at developing grain and leguminous crops, improving soil fertility, and increasing crop yields. In recent years, irrigated lands in the country have predominantly been used for two crops—wheat and cotton. Continuous cultivation of these crops on the same land depletes the soil of the same micro- and macronutrients. Additionally, the amount of fertilizer applied to the soil has significantly decreased due to difficulties in collecting manure from farming enterprises.

During the President's visit to Andijan on May 21, 2020, he emphasized the cultivation of soybeans as a protein-rich and oil-yielding crop that matures in a short growing season. He noted that soybean cultivation is vital for addressing food security challenges. Among leguminous crops, soybeans not only replenish the soil with nutrients but also significantly improve its fertility. It is estimated that one hectare of soybean cultivation can leave 85–100 kg of pure nitrogen in the soil, making soybeans an invaluable crop for sustainable agriculture. Moreover, over 400 types of products can be derived from soybean grains, which are essential for human needs.

Soybean cultivation contributes to enriching the soil with natural nitrogen compounds and is a critical step toward ensuring food security by increasing soil fertility. Soybeans are currently cultivated on nearly 100 million hectares worldwide. However, in countries with short growing seasons, late-maturing varieties and repeated sowing often fail due to insufficient heat. Thus, selecting the appropriate soybean variety is essential for successful cultivation. Early-maturing varieties require temperatures of 12–15°C, medium-maturing varieties need 18–21°C, and late-maturing varieties thrive at 22–24°C.

Research Objectives:

The following tasks were undertaken during the study:

1. Selecting soybean ecotypes suitable for cultivation in the soils of the Samarkand region.
2. Developing agro-technological practices adapted to the soil and climatic conditions for selected soybean ecotypes.
3. Determining the agrochemical properties of the soil before sowing and after harvesting soybeans.
4. Assessing the population of earthworms in soybean-cultivated fields.
5. Evaluating the yield of wheat and cotton varieties cultivated after soybeans.
6. Providing farmers with specific recommendations on the most economically viable soybean varieties to cultivate based on soil and climatic conditions.

#### QUALITY INDICATORS, GROWTH DYNAMICS, AND YIELD OF SOYBEANS; IMPROVING SOIL FERTILITY

The cultivation of soybeans improved soil fertility by 2% and reduced soil salinity by 0.2%. As a leguminous plant, soybeans absorb pure nitrogen from the air through their roots, enriching the soil with nitrogen. During its growing period, the soybean plant leaves behind a certain amount of nitrogen, not only for its growth but also for subsequent crops. Thus, soybeans are considered a biologically clean crop that enhances soil structure and renews biological processes.

Research has shown that the humus content in soil increased from 0.65–0.72% before soybean cultivation to 0.97–1.05% in the autumn after soybean cultivation, as evidenced by scientific findings.

#### PHYSICAL, CHEMICAL, AND TECHNOLOGICAL PROPERTIES OF SOYBEAN GRAINS

**Moisture Content of Grains:** Moisture content refers to the percentage of water in the total mass of the grain. Moisture significantly impacts grain storage and processing. Moist grains are prone to spontaneous heating, which, if not promptly addressed, can degrade the entire grain mass. High-moisture grains also promote the rapid development of microorganisms and pests, rendering the grains unsuitable for processing. Based on moisture content, grains are categorized into four groups: Dry, Moderately dry, Moist, Wet.

**Standard Method for Determining Moisture Content:**

An average sample of 300 grams is placed in a hermetically sealed container. Once the grain's temperature equals the ambient temperature, a portion of the sample is taken for moisture measurement using a moisture meter to determine the drying time and method. If the moisture content does not exceed 15.0% for oats and maize or 17.0% for other grains, the experiment is conducted without pre-drying.

For direct measurement, two 5.0-gram samples of ground grain are heated at 13°C for 40 minutes. After cooling in a desiccator, the samples are weighed, and the moisture content is calculated using a specific formula.

Determining Grain Weight in a One-Liter Container:

1. The container is placed on a flat surface, and its components are removed.
2. A balance is set up on the upper surface, with a tray for weights on the left and a measuring cylinder on the right. The balance is calibrated.
3. Grain is poured into the funnel-shaped cylinder.
4. The funnel is gently opened, allowing the grain to fill the measuring cylinder.
5. The cylinder's weight, including the grain, is measured to calculate the grain's bulk density.

Nutritional Value of Soybeans:

Soybeans are among the most nutritious crops due to their high amino acid content and digestibility. Soy protein stands out in three aspects: Amino acid composition, High digestibility, Abundance of minerals and vitamins.

Approximately 85–90% of soybean protein is water-soluble, contributing to its excellent digestibility. Adding soybean protein to food products enhances their nutritional value. For instance, incorporating 10% soybean flour into wheat flour increases the protein content of bread by 1.11% and boosts its energy value threefold.

#### RECOMMENDATIONS FOR FARMERS

With the decline of traditional crop rotation systems, such as cotton-alfalfa, soybeans are an ideal alternative for restoring soil fertility. Soybeans provide nitrogen to the soil and offer economic benefits comparable to alfalfa.

Studying soybean agro-technologies in various soil and climatic conditions across the country involves gathering information on the characteristics of different varieties, including their botanical-morphological traits, biological features, growth dynamics, yield, and economic indicators. These findings help determine the most suitable soybean varieties for specific soil types and provide farmers with tailored recommendations.

Soybean Cultivation, Harvesting, and Product Utilization

Planting Standards and Methods

Planting Norms: The planting density and row spacing depend on the soybean variety and soil type. Proper spacing ensures optimal growth and root development.

Bacterial Fertilizers: When applied, these fertilizers form nodules on soybean roots, allowing the plant to fix atmospheric nitrogen, improving soil fertility for subsequent crops.

Varietal Study: Research on regionally zoned soybean varieties focuses on their drought resistance, growth stages, flowering, pod formation, and photosynthetic productivity.

Recommendations for High Yield

1. Develop agro-technological methods to increase yield based on the unique characteristics of each variety.
2. Introduce resource-efficient farming practices to maximize the benefits of soybeans and improve soil fertility.
3. Conduct chemical composition analysis of soybean varieties, focusing on protein, oil, and amino acid content.

Soybean Products and Their Impact

**Soy Flour in Breadmaking:** Soy flour is blended with wheat flour in proportions of 5%, 10%, 15%, and 20% to improve protein content and energy value. For example, adding 10% soy flour increases bread's protein content by 1.11%.

**Main Soybean Products: Soy Flour:** Used in confectionery, fillers, and as a substitute for meat, milk, and cheese products.

**Soy Oil:** Utilized in food production, including mayonnaise and margarine.

Soybean protein contains 320–450 g of protein per kg of grain, closely resembling animal protein in its amino acid composition. Additionally, soybeans provide up to 35% carbohydrates, including sucrose, raffinose, and stachyose, essential for balanced nutrition.

**Processing Recommendations**

**1. Seed Cleaning and Grading:**

Use self-cleaning machines like the “Pektus-Gigant K-531/1” or modified OS-4.5A and SM4 machines. For precision grading, employ ZAV-25 or ZAV-40 aggregates equipped with sieves of varying sizes and shapes.

**2. Grinding and Separation:**

Machines with specialized sieves (round, triangular, or elongated) ensure effective separation and cleaning. Examples:

**Round sieves:** Diameter 16–18 mm for primary separation.

**Triangular sieves:** Size 11–12 mm for finer cleaning.

**Elongated sieves:** Size 4–5 mm for final sorting

**Effects of Soy Flour on Bread Quality**  
A study tested bread made with wheat flour partially replaced by soy flour (5%, 10%, 15%, and 20%). The dough was prepared without pre-fermentation, using hydrated soy flour (1:2 water ratio at 20–22°C for 30–40 minutes). Soy protein's low swelling ability required pre-soaking. Higher soy flour content increased nutritional value but affected bread texture and taste.

**Conclusion**

Soybeans are a versatile and nutritionally rich crop. When integrated into farming systems and food production, soybeans enhance soil fertility, provide high-quality plant protein, and offer economic benefits. For sustainable agriculture, following precise agro-technological methods and utilizing soybean products effectively are key to unlocking their full potential.

**Quality Indicators of Soy-Wheat Bread and Soy Cultivation Technology**

**Impact of Soy Flour on Bread Quality**

According to the research results, bread made with a mixture of wheat flour and soy flour demonstrated improved organoleptic properties:

**1. Appearance:** Bread with 5-10% soy flour had a light-yellow crust and a soft yellow crumb. Bread with 15-20% soy flour produced a crumb with a golden-yellow color and a roasted nut-like shade.

**2. Taste and Aroma:** The bread acquired a roasted nut-like taste with a mild nutty aroma.

**3. Structure and Properties:** Adding up to 10% soy flour positively influenced the dough fermentation process and ensured a high-quality final product. Adding more than 10% soy flour increased the bread's acidity, reduced crumb elasticity, and caused stickiness.

**Drawbacks:** Due to the low gluten content of soy flour, the overall gluten structure of the dough weakened. This resulted in reduced crumb porosity and a smaller specific volume.

The specific volume decreased by 4.9–9.2%, while crumb compressibility increased by 8.7–26%. Adding up to 10% soy flour in wheat dough enhances bread quality and ensures a more nutritious and flavorful product. Soy Cultivation and Yield Indicators

1. Cultivation Areas and Yield: In Uzbekistan, soybean cultivation spans approximately 10,000 hectares, with an average yield of 8–10 quintals per hectare. In irrigated fields, yields can reach 30–40 quintals per hectare.

2. Technological Characteristics: The technological properties of soybean grain depend on its size, fullness, the relative amount of endosperm, and moisture content.

The geographic distribution and growth of soybeans are closely related to day length. Long-term cultivation in the same region can neutralize the soybean variety's sensitivity to day length changes.

#### Importance of Soy Cultivation

##### In the Food Industry:

Soybeans are used to produce soy flour and oil. Soy flour is used in confectionery, baked goods, and meat and dairy substitutes.

As Animal Feed: Soybeans have been cultivated as a protein-rich feed crop since the 1950s.

Today, they remain a crucial component of livestock feed. As a Protein Source: Soybeans contain 320–450 g of protein per kilogram, which is highly comparable to animal protein in terms of amino acid composition.

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