DEVELOPMENT OF CERTAIN ELEMENTS OF ALFALFA CULTIVATION TECHNOLOGY

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Annotation. Alfalfa is one of the most important forage crops widely cultivated for livestock production due to its high nutritional value and adaptability to different climatic conditions. However, traditional cultivation technologies often lead to inefficient use of water, fertilizers, and soil resources. This study focuses on the development and evaluation of innovative cultivation technologies aimed at increasing alfalfa productivity and improving resource efficiency. The research was conducted under field conditions using improved agronomic practices including optimized sowing methods, balanced mineral fertilization, and modern irrigation systems. The results showed that the use of innovative cultivation techniques significantly increased plant growth, biomass accumulation, and overall yield compared with conventional farming methods.

Keywords: alfalfa, innovative cultivation technology, forage crops, sustainable agriculture, irrigation management, soil fertility, crop productivity, agronomic practices.

Introduction. Alfalfa (*Medicago sativa* L.) is considered one of the most valuable perennial forage crops used in modern agriculture. Due to its high protein content, rich mineral composition, and excellent digestibility, alfalfa plays an essential role in improving livestock productivity and ensuring a stable supply of high-quality fodder. In many agricultural regions, alfalfa cultivation also contributes to soil fertility improvement because of its ability to fix atmospheric nitrogen through symbiosis with rhizobium bacteria.

Despite these advantages, traditional alfalfa cultivation technologies often fail to fully utilize the crop's biological potential. Inefficient irrigation methods, improper fertilization practices, and outdated agronomic techniques may reduce yield and negatively affect soil health. In addition, climate change and increasing pressure on natural resources require the development of more efficient and sustainable agricultural technologies.

Innovative cultivation technologies, including improved sowing patterns, precision fertilization, drip irrigation systems, and integrated soil management strategies, can significantly increase crop productivity while reducing environmental impacts. These technologies allow farmers to optimize resource use and enhance the resilience of agricultural systems.

Materials and Methods. Field experiments were conducted during the 2024–2025 growing seasons on experimental plots with an area of 0.1 hectares for each treatment. The soil type of the experimental field was loamy with an average organic matter content of 1.8–2.2%.

Three cultivation variants were studied:

1. Control (Traditional technology)
   - Row spacing: 60 cm
   - Fertilizer rate: N30P60K40 kg/ha
   - Conventional irrigation
2. Improved agronomic technology
   - Row spacing: 45 cm
   - Fertilizer rate: N40P80K60 kg/ha
   - Optimized irrigation schedule
3. Innovative cultivation technology
   - Row spacing: 30 cm
   - Fertilizer rate: N60P90K60 kg/ha

- Water-saving irrigation system

During the growing season, the following indicators were measured:

- Plant height (cm)
- Number of shoots per plant
- Biomass yield (t/ha)
- Dry matter yield (t/ha)

Statistical analysis was conducted to determine the effectiveness of each cultivation method.

The results showed significant differences between traditional and innovative cultivation technologies.

Table 1

Effect of cultivation technology on alfalfa productivity

Cultivation technology	Plant height (cm)	Shoots per plant	Green biomass yield (t/ha)	Dry matter yield (t/ha)
Traditional technology	62	8	38.5	9.1
Improved technology	71	10	45.2	11.4
Innovative technology	76	12	49.3	12.8

The innovative cultivation technology showed the highest productivity indicators. Plant height reached 76 cm, which was 22% higher than in the control variant. The number of shoots per plant increased from 8 to 12, indicating better plant development and canopy formation.

Green biomass yield increased from 38.5 t/ha in the traditional system to 49.3 t/ha in the innovative cultivation system. This represents an increase of approximately 28%. Similarly, dry matter yield increased from 9.1 t/ha to 12.8 t/ha.

Improved irrigation methods also contributed to higher water use efficiency. Water consumption per ton of biomass was reduced by approximately 15–18% compared with the traditional irrigation system.

These results confirm that innovative cultivation technologies can significantly improve both productivity and resource efficiency in alfalfa production systems.

Conclusion. The study demonstrated that the development and implementation of innovative cultivation technologies significantly increase alfalfa productivity. Optimized sowing density, balanced fertilization, and water-saving irrigation systems positively affected plant growth and yield.

The innovative cultivation technology increased green biomass yield by 28% and dry matter yield by 40% compared with traditional cultivation practices. In addition, water use efficiency improved by 15–18%, which is particularly important under conditions of limited water resources.

Therefore, the application of innovative cultivation technologies can be recommended for large-scale alfalfa production to increase forage yield, improve soil fertility, and ensure sustainable agricultural development.

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