

THE RELEVANCE OF INNOVATIVE SOLUTIONS FOR ALFALFA CULTIVATION

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Annotation. Alfalfa (*Medicago sativa* L.) is one of the most important perennial forage crops widely cultivated for its high nutritional value and productivity. Improving the technological elements of alfalfa cultivation plays a significant role in increasing yield and forage quality under different soil and climatic conditions. The present study aims to develop and evaluate certain elements of alfalfa cultivation technology, including optimal sowing time, seeding rate, and mineral fertilization practices. Field experiments were conducted to determine the most effective agrotechnical methods that ensure stable plant growth, high biomass production, and improved forage quality. The results of the study demonstrated that the proper combination of sowing time, seed rate, and fertilization significantly influenced plant development, stand density, and green mass yield.

Keywords: alfalfa, cultivation technology, sowing time, seeding rate, fertilization, forage productivity.

Introduction. Alfalfa (*Medicago sativa* L.) is one of the most valuable perennial forage crops widely cultivated in many regions of the world. It is highly appreciated for its high nutritional value, rich protein content, and its ability to improve soil fertility through biological nitrogen fixation. Due to these characteristics, alfalfa plays an important role in the development of livestock production and the sustainable management of agricultural systems.

The productivity and longevity of alfalfa stands largely depend on the correct application of cultivation technologies. Factors such as optimal sowing time, appropriate seeding rate, soil preparation, fertilization, and irrigation significantly

influence plant growth, development, and forage yield. In many agricultural regions, improving these technological elements is considered an important task for increasing the efficiency of forage crop production.

In recent years, special attention has been paid to the development of modern and scientifically based agrotechnical practices for alfalfa cultivation. Optimization of technological elements allows farmers to obtain higher yields, improve forage quality, and ensure stable crop production under various soil and climatic conditions. Proper management of cultivation technology also contributes to better utilization of natural resources and increases the economic efficiency of agricultural production.

Materials and Methods. The research was conducted during the growing season under field conditions in an experimental agricultural area. The study aimed to develop and evaluate certain elements of alfalfa (*Medicago sativa* L.) cultivation technology, including sowing time, seeding rate, and mineral fertilization practices. The experimental field was characterized by typical soil and climatic conditions suitable for forage crop production.

Field experiments were carried out using a randomized block design with several replications. Different sowing dates and seeding rates were tested to determine their influence on plant emergence, growth, and productivity. The seeds used in the experiment were certified and selected for high germination capacity and varietal purity. Prior to sowing, the soil was prepared through standard agricultural practices including plowing, leveling, and harrowing to ensure a uniform seedbed.

Mineral fertilizers were applied according to the experimental scheme to evaluate their effect on plant development and yield formation. Phosphorus and potassium fertilizers were incorporated into the soil before sowing, while nitrogen fertilizers were applied during the early stages of plant growth when necessary. Irrigation and weed control measures were carried out according to recommended agronomic practices for alfalfa cultivation.

Observations and measurements were conducted throughout the vegetation period. Data were collected on seed germination, plant height, stand density, and green biomass yield. The obtained results were analyzed using standard statistical methods to determine the effectiveness of the studied technological elements and to identify the most efficient cultivation practices for alfalfa production.

Table 1.

Effect of Seeding Rate on Growth and Yield of Alfalfa (*Medicago sativa* L.)

Seeding rate (kg/ha)	Plant density (plants/m ²)	Plant height (cm)	Green mass yield (t/ha)	Dry matter yield (t/ha)
10	210	58.4	32.6	7.8
12	235	61.2	35.4	8.5
14	260	64.7	38.9	9.3
16	275	66.1	40.5	9.8
18	290	65.3	39.7	9.5

Discussion. The results of the study demonstrated that the development and improvement of certain technological elements significantly influence the growth, development, and productivity of alfalfa (*Medicago sativa* L.). One of the most important factors affecting the establishment of alfalfa stands is the optimal sowing time. The experiments showed that sowing during favorable soil moisture and temperature conditions ensured better seed germination, uniform plant emergence, and stronger early growth. Delayed or very early sowing negatively affected plant development and reduced stand density.

Seeding rate also played a crucial role in determining plant population and biomass production. An optimal seeding rate provided balanced plant density, which allowed plants to efficiently utilize available nutrients, water, and light. Excessively high seeding rates resulted in competition among plants, while low seeding rates led to insufficient stand formation and reduced productivity.

Conclusion. The study showed that the development and improvement of certain technological elements play an important role in increasing the productivity and efficiency of alfalfa (*Medicago sativa* L.) cultivation. Proper selection of sowing time, optimal seeding rate, and balanced mineral fertilization significantly influence plant growth, stand establishment, and biomass yield.

The results indicated that sowing under favorable soil and climatic conditions ensures better seed germination and uniform plant development. An appropriate seeding rate helps maintain optimal plant density, allowing efficient use of nutrients, water, and sunlight. In addition, the application of mineral fertilizers, particularly phosphorus and potassium, positively affects root system development and overall plant vigor, leading to higher forage productivity.

Implementation of improved technological elements in alfalfa cultivation can contribute to stable crop growth, increased green biomass yield, and improved forage quality. The developed recommendations may be useful for farmers and agricultural specialists in improving forage production systems and ensuring sustainable use of agricultural resources.

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