THE USE OF ORGANIC MULCH FROM LEGUME RESIDUES AND DRIP IRRIGATION SYSTEMS IN THE CULTIVATION OF COTTON IN UZBEKISTAN

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Abstract: *The combined use of organic mulch and drip irrigation in cotton cultivation offers a promising solution for sustainable agriculture in arid regions such as Uzbekistan. This integrated approach not only promotes water conservation and improves soil quality, but also significantly increases cotton yields while reducing environmental impact. As these technologies are adopted, farmers can expect long-term benefits in the form of more efficient resource use, cost savings, and greater crop resilience to climate change. Further research and government support will be crucial for optimizing these methods to suit local conditions and encouraging their widespread adoption in cotton-growing regions.*

Keywords: *soil, arable layer, nitrogen, phosphorus, potassium, mobile forms, exchangeable forms.*

INTRODUCTION

In Uzbekistan's dry areas like the Mirzachul Plain, hot conditions, scarce rainfall, and water scarcity make cotton farming challenging. Traditional farming methods waste water and damage soil quality. New techniques combining organic mulch from legumes and drip irrigation are gaining popularity [1]. The mulch improves soil quality and moisture retention, while drip irrigation delivers water efficiently to plant roots. These combined methods enhance cotton production and resource efficiency in dry climates. This review examines how organic mulching and drip irrigation impact soil, yields, costs, and sustainability in Uzbekistan's dry regions [2].

Relevance of the topic: Cotton farming in Uzbekistan must adapt to climate change, water scarcity, and poor soil. Water-saving methods like organic mulching with legume leftovers and drip irrigation benefit the environment and cotton yields. Limited research exists on these methods' effects in Uzbekistan's dry climate. This review analyzes how organic mulching and drip irrigation impact cotton farming in Uzbekistan's dry regions, examining soil improvement, water conservation, cotton production, and environmental sustainability.

Research objectives: Analyze weather and land conditions in Uzbekistan's dry regions and their impact on cotton cultivation. Examine current cotton farming challenges from water scarcity. Study how plant residue mulch affects soil properties, moisture retention, fertility and erosion control in dry climates. Evaluate drip irrigation's effectiveness for water conservation and cotton yield improvement. Assess combined

effects of mulch and drip irrigation. Consider economic and environmental implications of these practices. Identify knowledge gaps and future research needs.

Climatic conditions: Uzbekistan's semi-arid areas have a continental climate with hot summers and cool winters. Annual rainfall is 200-300 mm in spring and autumn. Climate change has lengthened dry spells, increased temperatures, and extreme weather frequency. Water resources may decline 6% by 2030, affecting agriculture. The soil, mostly sierozems and salt marshes, is prone to salinization with low organic matter. Water scarcity causes soil degradation. Uzbekistan's water comes from the Amu Darya and Syr Darya rivers. Poor irrigation has worsened water shortages and contributed to the Aral Sea's shrinkage. High salinity and irregular water distribution strain resources. The country implements climate adaptation programs.

Agriculture occupies 60% of land, with cotton as a key crop in irrigated steppes. Research (2018-2024) shows semi-arid regions face rising temperatures and water shortages. Cotton occupies 30% of irrigated land, producing 3.5 million tons annually. Uzbekistan, a world leader in cotton cultivation, develops cotton-textile clusters. The industry faces declining soil quality from salinization, while traditional irrigation wastes water. Uzbekistan implements drip irrigation and mulching technologies. Clusters combining cotton growing and production help increase yields while conserving resources. Modern irrigation systems and soil preservation remain necessary. Drip irrigation and mulching offer solutions for water conservation. Cotton cultivation requires integrated approaches for sustainable development.

Mulching in cotton cultivation: In cotton farming, organic mulching is important as an agronomic measure that helps conserve water and increase yield. Studies from 2018 to 2024 have shown the effectiveness of mulch made from legume residues in arid climates. Mulch helps the soil retain moisture by reducing evaporation. This is critical for cotton fields in Uzbekistan, where water is scarce. Legume mulch increases the soil’s moisture reserve by 10-20%, providing plants with water throughout the season and promoting root development. Mulching lowers soil temperature in summer, preventing plants from overheating. Organic mulch improves soil structure and fertility by activating microorganisms [3]. Mulch from soybeans and beans increases cotton yield by 8-15% [4]. Research confirms that organic mulching with legumes is effective in improving the water regime and soil fertility under drought conditions in Uzbekistan. Introducing this practice alongside modern irrigation methods creates opportunities for the development of cotton farming in other countries.

Organic mulching involves covering soil with organic materials to conserve moisture and protect plants. Legume residues are beneficial for mulching as they capture nitrogen through root bacteria, retain moisture, and protect against overheating [5]. Research shows mulching with legumes increases organic matter, improves soil structure, and adds nitrogen, reducing fertilizer needs. In Uzbekistan's arid regions, soybean and bean mulching increases soil moisture by 15–25% while reducing erosion. Microbes become more active under mulch, accelerating nutrient processing.

The use of legume residues for mulching is a simple way to improve soil, especially in cotton farming in semi-arid regions. Mulching retains moisture, increases fertility, and protects the land. Studies show that combining organic mulching with drip irrigation leads to better results: soils are less prone to wind erosion and are more resilient to drought. This makes the technology promising for agriculture in water-scarce conditions.

Drip irrigation in cotton farming: Drip irrigation effectively saves water in Uzbekistan's cotton farming by delivering water directly to plant roots, reducing consumption by 30-50% compared to traditional methods. The system uses tubes with drippers, filters, and fertilizer devices. It increases cotton yield by 15-25%, reduces soil salinization risk, and enables efficient fertilization. The government provides subsidies up to 8 million soms per hectare for installation. In the Fergana region, the system succeeds on saline lands, while Tashkent region reports 60% water savings. Drip irrigation thus enables water conservation and higher yields while supporting agroecosystem health.

Drip irrigation delivers water to plant roots, reducing evaporation losses. In cotton farming, it reduces water use by 30-50% compared to traditional methods in Uzbekistan's semi-arid regions. The system maintains soil moisture, increasing yields by 15-40% and improving nutrient distribution. With a 3-5 year payback period, drip irrigation boosts farmer income while promoting sustainable agriculture and water conservation.

The combined use of organic mulch from legume residues and drip irrigation in cotton cultivation (for arid regions): Research (2018–2024) shows: the combined use of organic legume mulch and drip irrigation helps grow cotton in arid regions. How does it work? 1. Legume mulch: - Reduces soil water evaporation. - Lowers soil temperature during heat. - Enriches the soil with nutrients as it decomposes. - Protects against wind erosion. 2. Drip irrigation: - Delivers water directly to the roots. - Prevents waterlogging of the soil. Experiments in arid regions (Uzbekistan, India, China) have shown: - Cotton yield increased by 20–35%. - Water savings of 30–40%. - The method is effective even on saline soils. Impact on soil: - Mulch increases humus content and microorganism activity. - Protects against erosion. - Drip irrigation preserves soil structure. Economic benefits: - Reduced costs for water and fertilizers. - Less manual labor. - Payback within 2 years. The technology is being implemented in Uzbekistan, China (up to 50% water savings), India, and the Middle East. Main challenges: shortage of organic material, risk of fungal diseases in humid climates, and high initial costs.

Evaluation of the results of combined use of organic mulching and drip irrigation systems: Research shows that using legume-based organic mulch and drip irrigation in cotton cultivation boosts production in semi-arid areas. These methods enhance water balance, retain soil moisture, and increase yield. Organic mulch reduces evaporation by shielding soil from sun and wind, while drip irrigation efficiently waters roots [6]. Legume mulch enriches soil with organic matter and nitrogen, and drip irrigation ensures even moisture distribution. Studies report a 15–25% yield increase and 30–40%

water savings, reducing costs [7]. Mulching also curbs soil erosion, and drip irrigation cuts greenhouse gas emissions, supporting sustainable agriculture.

The combination of legume mulch and drip irrigation — This is a real opportunity for farmers in arid regions to achieve stable cotton yields while saving water and fertilizers. The key is to adapt the methods to local conditions. Organic mulch made from legumes retains moisture, protects the soil from overheating, and makes drip irrigation more effective [8]. These measures increase cotton yields and the resilience of agroecosystems. Using mulch together with drip irrigation allows for water savings of 30–50%, reduces spending on fertilizers and fuel, and boosts yields. Although installing the system requires investment, the combination of drip irrigation and mulch proves its worth.

Mulch made from plant residues, especially legumes, protects the soil from erosion by wind and water, retains moisture, and shields it from heat and heavy rain. Drip irrigation delivers water directly to plant roots, which is crucial for arid regions. As legumes decompose, they enrich the soil with organic matter, improving soil structure and water retention. They fix nitrogen from the air, reducing the need for chemical fertilizers. Drip irrigation accelerates the decomposition of plant residues. This system helps reduce greenhouse gas emissions by keeping more carbon in the soil. Saving water and fertilizers also lowers overall energy consumption.

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