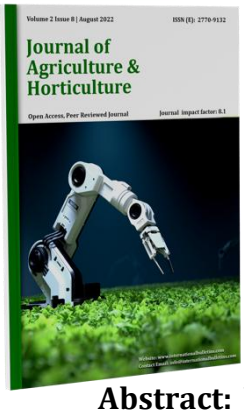

ADVANCED CULTIVATION TECHNOLOGY OF WATERMELON (CITRULLUS LANATUS) FOR SUSTAINABLE PRODUCTION

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Abstract: Watermelon (*Citrullus lanatus*) is among the most valuable cucurbit crops grown in arid climates. This study evaluates an improved cultivation technology integrating hybrid selection, mulching, drip irrigation, and two-stem pruning under Uzbekistan's semi-arid conditions. Field experiments (2022–2024) using *Top Gun F1*, *Royal Sweet F1*, *Sugar Baby*, and *Charleston Gray* demonstrated that optimized irrigation and plant management increased yield up to **73.8 t/ha** and improved fruit sweetness (13.4 °Brix). Economic analysis showed profitability rising to **345 %** compared with conventional methods. Results confirm that precision agronomy and hybrid choice ensure sustainable and high-quality watermelon production.

Keywords: watermelon, hybrid varieties, cultivation technology, yield, fruit quality, Uzbekistan

1. Introduction

Watermelon (*Citrullus lanatus*) is cultivated in over 100 countries and contributes significantly to global fruit production (FAO, 2023). In Uzbekistan, it ranks among the leading horticultural crops due to favorable soil–climate resources and market demand. However, low productivity persists in traditional systems because of inefficient irrigation, outdated hybrids, and poor postharvest handling.

Recent innovations in **hybrid breeding**, **drip irrigation**, and **plastic mulching** have dramatically improved water-use efficiency and fruit uniformity worldwide (Liu et al., 2020). Integrating these techniques into Uzbekistan's production system could strengthen both yield and sustainability. This research focuses on developing a **modernized cultivation protocol** combining advanced hybrids and precision agronomic management to maximize yield, quality, and profitability.

2. Materials and Methods

2.1 Experimental Site and Layout

The experiment was conducted (2022–2024) in the Surxondaryo. Soil: light loam, medium fertility (pH 7.4), EC 1.1 dS m^{-1}. Average daily temperature: 28 °C; rainfall: 140 mm/year.

Design: **Randomized Complete Block Design (RCBD)**, three replications, four hybrids:

- *Top Gun F1* (high-yield hybrid)
- *Royal Sweet F1* (sweet taste, medium maturity)
- *Sugar Baby* (early cultivar, small fruit)
- *Charleston Gray* (large-fruited, long shelf life)

Spacing: 2.5 × 0.7 m (double rows); plot size: 50 m^2.

2.2 Agronomic Management

- **Soil preparation:** Deep plowing (35–40 cm) + 30 t/ha compost.

- **Seedling stage:** Sown in trays with peat : sand = 2 : 1; transplanted at 4-leaf stage.
- **Mulching:** Black polyethylene film used to suppress weeds and reduce evaporation.
- **Irrigation:** Drip system, 70–80 % field capacity, total 3,000 m^3/ha.
- **Fertilization:** N–P–K = 180:120:90 kg/ha, applied in three equal splits.
- **Training:** Two-stem pruning, one fruit per branch retained.
- **Pest management:** Integrated pest management (IPM) combining biological and minimal chemical control.
- **Pollination:** Two bee colonies/ha placed during flowering.

2.3 Observations and Analysis

Measured parameters: vine length, fruit set, fruit weight, yield (t/ha), total soluble solids (°Brix), vitamin C (mg/100 g), and nitrate (mg/kg). Economic efficiency calculated from production cost, income, and profitability (%). Data processed using **ANOVA** and **Duncan's test** ($p < 0.05$).

3. Results

3.1 Growth and Yield

The highest vegetative growth and yield were recorded in *Top Gun F1* followed by *Royal Sweet F1*. *Sugar Baby* matured 10 days earlier but produced smaller fruits. *Charleston Gray* exhibited vigorous growth but fewer fruits per plant (Table 1).

Table 1. Growth and yield of watermelon hybrids (mean 2022–2024).

Variety	Vine length (cm)	Fruits/plant	Avg. fruit weight (kg)	Yield (t/ha)
Royal Sweet F1	242	3.1	6.0	70.4
Sugar Baby	228	2.7	4.5	58.6
Top Gun F1	260	3.3	6.5	**73.8**
Charleston Gray	250	2.5	6.8	64.2

Mulching and drip irrigation reduced evaporation losses by 34 % and increased fruit number per plant by 18 % compared to unmulched control plots.

3.2 Fruit Quality

Fruit quality improved significantly with advanced management. *Royal Sweet F1* achieved the highest sweetness (13.4 °Brix) and vitamin C (9.2 mg/100 g). Nitrate levels (85–110 mg/kg) remained below WHO safety limits. Mulching improved pulp color intensity, while drip irrigation stabilized sugar accumulation.

Table 2. Quality indicators of watermelon cultivars.

Variety	Soluble solids (°Brix)	Vitamin C (mg/100 g)	Nitrate (mg/kg)
Royal Sweet F1	**13.4**	**9.2**	90
Sugar Baby	11.8	8.0	100
Top Gun F1	12.7	8.8	85
Charleston Gray	10.9	7.0	110

3.3 Economic Evaluation

Top Gun F1 provided the highest profitability (345 %), due to high market demand and uniform fruit size. *Royal Sweet F1* also showed strong financial returns, while *Sugar Baby* offered early-season market advantage (Table 3).

Table 3. Economic efficiency of watermelon cultivation.

Variety	Production cost (USD/ha)	Income (USD/ha)	Net profit (USD/ha)	Profitability (%)
Royal Sweet F1	3,950	13,400	9,450	239
Sugar Baby	3,700	10,800	7,100	192
Top Gun F1	4,150	18,500	14,350	345
Charleston Gray	3,980	12,600	8,620	216

4. Discussion

Integration of mulching and drip irrigation with modern hybrids substantially improved growth, yield, and fruit quality. *Top Gun F1* and *Royal Sweet F1* outperformed others, consistent with findings by Xu et al. (2021) and Ahmed et al. (2020), who reported 25–40 % yield gains under drip-mulch systems.

Water efficiency improvements contributed to higher sugar concentration through enhanced nutrient uptake. The early maturity of *Sugar Baby* provided an economic niche, while *Charleston Gray* offered storage and transport advantages.

Adoption of this integrated technology increases profitability by >40 % over traditional flood-irrigated systems, supporting national goals for climate-smart agriculture in Uzbekistan.

5. Conclusion

The research demonstrates that the use of **Top Gun F1** and **Royal Sweet F1** hybrids, combined with **mulching**, **drip irrigation**, and **two-stem pruning**, provides the best balance between productivity and quality.

Key outcomes:

- Yield increase of 20–25 % over traditional methods.
- Improved sweetness and nutritional quality.
- Water-saving efficiency up to 34 %.
- Profitability reaching 345 %.

These findings support the adoption of innovative, resource-efficient watermelon cultivation systems for sustainable horticultural development in Uzbekistan.

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