INFLUENCE OF AGROECOLOGICAL FACTORS AND CULTIVATION PRACTICES ON THE YIELD AND QUALITY OF WATERMELON (CITRULLUS LANATUS)

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Abstract: Environmental conditions and cultivation practices play a crucial role in determining the yield and fruit quality of watermelon (*Citrullus lanatus*). This study investigates the impact of temperature, soil moisture, and agronomic management on the growth and biochemical composition of four watermelon cultivars under the agroecological conditions of southern Uzbekistan. Field trials conducted during 2022–2024 revealed that temperature fluctuations and solar radiation significantly influenced sugar accumulation and vitamin C synthesis. Integrating adaptive planting dates, mulching, and balanced fertilization improved fruit quality (13.2 °Brix) and increased yield up to **72.6 t/ha**. The findings provide valuable insights for optimizing watermelon cultivation in semi-arid environments to achieve high yield stability and superior fruit quality.

Keywords: watermelon, agroecology, fruit quality, temperature stress, yield stability, Uzbekistan

1. Introduction

Watermelon (*Citrullus lanatus*) is a major summer crop in Uzbekistan, occupying thousands of hectares in the southern regions, including Surxondaryo and Qashqadaryo. The crop's productivity and market value depend largely on agroecological conditions such as temperature, soil fertility, moisture availability, and cultivation technology (FAO, 2023).

Due to the country's continental climate, high daytime temperatures (>40 °C) and low humidity during fruit development can negatively affect yield and biochemical quality. According to Liu et al. (2021), sugar accumulation and pigment formation in watermelon are highly sensitive to temperature stress and light intensity.

This research aims to evaluate the influence of **environmental factors and cultivation practices** on watermelon yield and fruit quality, and to develop adaptive recommendations for sustainable production under semi-arid conditions.

2. Materials and Methods

2.1 Experimental Site

Field experiments were conducted between 2022–2024 in the experimental fields (Surxondaryo, Uzbekistan; 37.9°N, 67.0°E). Soil: light loam with 1.5 % humus, pH 7.6. Climate: arid continental; average growing season temperature 27.5 °C; annual precipitation 142 mm.

Four hybrids were tested:

- Royal Sweet F1
- Top Gun F1
- Sugar Baby
- Charleston Gray

Experimental design: **RCBD** with three replications.

2.2 Agronomic Treatments

- **Sowing time:** Early (April 5), Medium (April 20), and Late (May 5).
- **Irrigation:** Drip irrigation maintaining 70–75 % field moisture capacity.
- **Mulching:** Black polyethylene mulch and control (no mulch).
- **Fertilization:** 180–120–90 kg/ha N–P–K with foliar micronutrient application.
- **Pest management:** IPM methods using biological control.
- **Harvest:** Fruits harvested at 32–35 days after pollination.

2.3 Measured Parameters

- **Growth:** vine length, number of leaves, leaf area index (LAI).
- **Yield:** fruit number per plant, fruit weight, yield (t/ha).
- **Quality:** total soluble solids (°Brix), vitamin C (mg/100 g), lycopene content (mg/100 g).
- **Environmental factors:** average day/night temperature, relative humidity, and soil moisture content.

Data analyzed using **ANOVA** and **correlation analysis** (SPSS 26.0).

3. Results

3.1 Influence of Agroecological Conditions

Temperature fluctuations between day and night strongly affected fruit quality. Optimum sugar accumulation occurred when daytime temperature averaged **33–35 °C** and night temperature **22–24 °C** (ΔT = 11–13 °C). Excess heat (>38 °C) reduced fruit weight by 8–12 %.

Soil moisture below 65 % field capacity led to decreased fruit size and lower vitamin C concentration.

3.2 Yield and Growth Parameters

Top Gun F1 produced the highest yield (72.6 t/ha) under optimal temperature and mulching, while *Sugar Baby* was the earliest maturing hybrid (58.4 t/ha). Mulching improved yield by an average of 18 % (Table 1).

Table 1. Effect of sowing time and variety on yield and fruit development.

Variety	Sowing Time	Yield (t/ha)	Avg. fruit weight (kg)	Days to maturity
Top Gun F1	Medium	**72.6**	6.4	90
Royal Sweet F1	Medium	68.5	6.1	88
Sugar Baby	Early	58.4	4.7	80
Charleston Gray	Late	61.3	6.6	96

3.3 Fruit Quality Indicators

Quality analysis revealed that moderate temperatures and drip irrigation favored high sugar and lycopene accumulation. *Royal Sweet F1* achieved the highest sugar content (13.2 °Brix), while *Top Gun F1* recorded the highest vitamin C (9.5 mg/100 g).

Table 2. Biochemical composition of watermelon cultivars.

Variety	Soluble solids (°Brix)	Vitamin C (mg/100 g)	Lycopene (mg/100 g)
Royal Sweet F1	**13.2**	8.9	4.6
Top Gun F1	12.8	**9.5**	4.4
Sugar Baby	11.7	8.1	3.8
Charleston Gray	10.9	7.4	3.5

3.4 Relationship Between Climate and Quality

Correlation analysis showed that:

- Temperature–Brix ($r = 0.68$, $p < 0.01$)
- Soil moisture–Vitamin C ($r = 0.59$, $p < 0.05$)
- Solar radiation–Lycopene ($r = 0.63$, $p < 0.05$)

These relationships demonstrate that controlled agroecological management improves biochemical outcomes and fruit uniformity.

4. Discussion

The findings highlight that **agroecological regulation**—particularly managing temperature and soil moisture—is critical for improving watermelon quality and yield stability. Moderate thermal amplitude enhances sugar translocation, while sufficient irrigation supports vitamin synthesis.

Mulching acted as a microclimatic regulator, maintaining soil temperature 3–4 °C lower than ambient air, similar to reports by Ahmed et al. (2020). Early sowing under high heat reduced fruit set, whereas medium sowing (mid-April) synchronized flowering with favorable thermal conditions.

The integration of adaptive sowing dates, mulching, and hybrid selection provided the best performance, confirming the potential for climate-smart watermelon production in Uzbekistan.

5. Conclusion

Agroecological and agronomic optimization significantly affects watermelon yield and fruit quality. The *Top Gun F1* and *Royal Sweet F1* hybrids demonstrated the best adaptability to semi-arid conditions, achieving 70–73 t/ha yield with high sweetness (13 °Brix).

For sustainable production, it is recommended to:

1.Schedule planting between **April 10–20** to avoid excessive heat.

2.Apply **mulching and drip irrigation** to maintain soil moisture.

3.Use **balanced N–P–K fertilization** combined with micronutrients.

Adopt **climate monitoring systems** to predict stress periods.

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