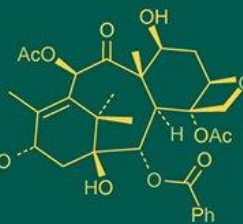
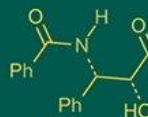


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Influence of phenophase-based irrigation regimes on physical fruit quality attributes of mango (*Mangifera indica* L.) cultivars under ultra high density planting system

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Abstract

The present investigation was carried out during 2022-23 and 2023-24 at the Centre of Excellence for Fruits, Mulugu, Telangana, India, to study the influence of phenophase-based irrigation regimes on physical fruit quality attributes of mango cultivars under Ultra High Density Planting (UHDP) system. The experiment was laid out in a Factorial Randomized Block Design with four mango cultivars viz., Banganpalli, Dashehari, Himayath and Kesar, and four irrigation levels based on crop evapotranspiration (ETc), namely 125%, 100%, 75% and 50% ETc. Significant differences were observed among cultivars and irrigation treatments for fruit weight, fruit firmness, fruit dimensions, fruit volume, specific gravity and pulp weight. Among the cultivars, Himayath recorded superior fruit weight (409.91 g), fruit volume (309.94 cm³), specific gravity (1.32) and pulp weight (309.91 g). Irrigation at 125% ETc recorded higher fruit weight (309.33 g), fruit length (11.76 cm), fruit breadth (8.41 cm) and pulp weight (209.33 g), whereas 100% ETc maintained better fruit firmness. The results revealed that phenophase-based irrigation scheduling significantly affects fruit physical quality and can be effectively utilized to improve fruit quality and water-use efficiency under UHDP systems.

Keywords: Mango, drip irrigation, ETc, UHDP, fruit quality, pulp weight, fruit firmness

Introduction

Mango (*Mangifera indica* L.) is one of the most important fruit crops cultivated in tropical and subtropical regions of the world. In India, mango occupies a prominent position due to its high economic value, consumer preference and export potential. Fruit quality in mango is greatly influenced by irrigation management, particularly during critical stages of fruit development.

Ultra High Density Planting (UHDP) has emerged as an efficient production system for increasing productivity per unit area. However, higher plant density increases competition for water and nutrients, necessitating precise irrigation scheduling. Drip irrigation based on crop evapotranspiration (ETc) offers an effective means of maintaining optimum soil moisture and improving water-use efficiency.

Physical fruit quality attributes such as fruit weight, fruit dimensions, fruit firmness, fruit volume, specific gravity and pulp weight determine market acceptability and processing suitability. These characteristics are significantly affected by moisture availability during fruit growth and development.

Information on the response of mango cultivars to phenophase-based irrigation scheduling under UHDP conditions is limited. Therefore, the present study was undertaken to evaluate the influence of different irrigation regimes on physical fruit quality attributes of Banganpalli, Dashehari, Himayath and Kesar cultivars and to identify suitable irrigation levels for improving fruit quality under Ultra High Density Planting systems.

Materials and Methods

The present investigation was conducted during 2022-23 and 2023-24 at the Centre of Excellence for Fruits, Mulugu, Siddipet District, Telangana, India.

The experiment was laid out in a Factorial Randomized Block Design (FRBD) with three replications.

The first factor consisted of four mango cultivars:

- V₁-Banganpalli
- V₂-Dashehari
- V₃-Himayath
- V₄-Kesar

The second factor consisted of four irrigation levels based on crop evapotranspiration (ET_c):

- I₁-125% ET_c
- I₂-100% ET_c
- I₃-75% ET_c
- I₄-50% ET_c

Irrigation water was applied through a drip irrigation system according to treatment schedules. Uniform cultural practices including fertigation, pruning, weed management and plant protection measures were followed throughout the study period.

At harvest, representative fruits were collected and evaluated for fruit weight, fruit firmness, fruit length, fruit breadth, fruit volume, specific gravity and pulp weight using standard procedures. Data from both years were pooled and subjected to analysis of variance (ANOVA). Treatment means were compared using the Critical Difference (CD) test at 5 percent level of significance.

Results

Fruit Weight

Fruit weight varied significantly among cultivars and irrigation regimes. Himayath recorded the highest pooled fruit weight (409.91 g), followed by Banganpalli (348.70 g), Kesar (248.35 g) and Dashehari (192.88 g). Among irrigation treatments, 125% ET_c recorded the highest fruit weight (309.33 g), while 50% ET_c recorded the lowest fruit weight (286.16 g).

Fruit Firmness

Fruit firmness differed significantly among cultivars and irrigation treatments. Himayath recorded the highest fruit firmness (2.94), whereas Kesar recorded the lowest value (2.51). Irrigation at 100% ET_c recorded the highest fruit firmness (2.80).

Fruit Dimensions

Banganpalli recorded the maximum fruit length (11.46 cm) and fruit breadth (9.06 cm). Irrigation at 125% ET_c resulted in the highest fruit length (11.76 cm) and breadth (8.41 cm). Reduction in irrigation level resulted in a gradual decrease in fruit dimensions.

Fruit Volume

Fruit volume was significantly influenced by cultivar and irrigation regime. Himayath recorded the highest fruit volume (309.94 cm³), while irrigation at 75% ET_c recorded the highest pooled fruit volume.

Specific Gravity

Specific gravity was highest in Himayath (1.32), indicating better dry matter accumulation and fruit quality.

Pulp Weight

Himayath recorded the highest pulp weight (309.91 g), while Dashehari recorded the lowest pulp weight (92.88 g). Among irrigation treatments, 125% ET_c recorded the highest pulp weight (209.33 g).

Discussion

The present investigation clearly demonstrated that irrigation scheduling significantly influences physical fruit quality parameters of mango under UHDP conditions. The increase in fruit weight under higher irrigation levels may be attributed to enhanced cell expansion and assimilate translocation resulting from adequate moisture availability. Similar observations were reported by Panigrahi *et al.* (2010) [7] and Haldankar *et al.* (2017) [3].

The superior performance of Himayath with respect to fruit weight, fruit volume and pulp recovery may be due to its genetic potential for larger fruit size and efficient assimilate partitioning. Genotypic variation in fruit growth characteristics among mango cultivars has been widely documented.

Fruit firmness was maintained under optimum irrigation levels, particularly at 100% ET_c. Balanced moisture availability helps maintain cellular integrity and favourable physiological conditions within fruit tissues. Excessive or inadequate moisture may adversely affect texture and post-harvest quality.

Improvement in fruit dimensions under higher irrigation treatments indicates the importance of adequate water supply during fruit enlargement. Similar findings have been reported in mango and other perennial fruit crops where drip irrigation significantly improved fruit size and quality.

Higher pulp weight observed under 125% ET_c indicates enhanced mesocarp development and improved pulp recovery. Since pulp recovery is a major determinant of processing quality and consumer preference, proper irrigation scheduling can contribute significantly to increased economic returns.

Overall, the results suggest that phenophase-based irrigation scheduling is an effective strategy for improving physical fruit quality while optimizing water-use efficiency in UHDP mango orchards.

Table 1: Interaction Effect of Irrigation Regimes and Mango Varieties on Fruit Physical Attributes (Pooled Mean Data)

Treatment	Fruit Weight (g)	Fruit Firmness	Fruit Length (cm)	Fruit Breadth (cm)	Fruit Volume (cm ³)	Specific Gravity	Pulp Weight (g)
V ₁ I ₁	352.25	2.83	12.38	9.86	293.28	1.21	252.25
V ₁ I ₂	353.61	2.75	12.01	9.52	295.90	1.20	253.61
V ₁ I ₃	352.54	2.62	11.53	8.67	304.40	1.16	252.54
V ₁ I ₄	336.65	2.80	9.91	8.18	303.90	1.11	236.65
V ₂ I ₁	196.90	2.91	11.70	6.71	298.76	0.66	96.90
V ₂ I ₂	205.44	2.93	11.34	6.15	307.32	0.67	105.44
V ₂ I ₃	200.64	2.85	10.72	5.84	313.48	0.64	100.64
V ₂ I ₄	168.57	2.80	10.29	5.40	308.14	0.55	68.57
V ₃ I ₁	406.38	2.91	12.67	9.76	300.93	1.35	306.38
V ₃ I ₂	429.68	2.93	11.75	8.79	312.86	1.37	329.68
V ₃ I ₃	415.71	2.91	10.87	8.45	318.78	1.30	315.71
V ₃ I ₄	387.86	3.01	10.04	8.17	307.19	1.26	287.86
V ₄ I ₁	239.44	2.37	10.31	7.31	305.29	0.79	139.44
V ₄ I ₂	248.62	2.60	9.88	6.85	306.61	0.81	148.62
V ₄ I ₃	253.77	2.55	9.64	6.52	293.83	0.87	153.77
V ₄ I ₄	251.56	2.52	9.38	6.21	301.05	0.84	151.56
CD (P = 0.05)	7.627	0.193	0.317	0.196	11.11	0.073	16.59
SE(m)±	2.700	0.068	0.113	0.070	3.935	0.026	5.89
CV (%)	2.205	6.04	2.53	2.23	3.17	6.41	7.22

Notes

- V₁ = Banganpalli, V₂ = Dashehari, V₃ = Himayath, V₄ = Kesar
- I₁ = 125% ETc, I₂ = 100% ETc, I₃ = 75% ETc, I₄ = 50% ETc

Conclusion

Phenophase-based irrigation scheduling significantly influenced physical fruit quality attributes of mango under Ultra High Density Planting systems. Irrigation at 125% ETc improved fruit weight, fruit dimensions and pulp recovery, while 100% ETc maintained superior fruit firmness. Among the cultivars evaluated, Himayath exhibited superior fruit weight, fruit volume, specific gravity and pulp weight. The study indicates that optimized irrigation scheduling can enhance fruit quality and improve water-use efficiency in mango cultivation under UHDP conditions.

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