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Effect of different fertigation regimes on the cost economics of Mango cv. Ratna under high density planting system

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Abstract
India is the largest producer of mango in the world; however, the lack of cost economic data limits growers from adopting modern production technologies. To address this gap, the present study evaluated the cost economics of mango cultivation under a high-density planting system with five different fertigation regimes T_1: 125% RDF, T_2: 100% RDF, T_3: 75% RDF, T_4: 50% RDF, and T_5: Control (soil application of nutrients as per KAU Package of Practices). The results revealed that the highest cost of cultivation was recorded in T_1 (125% RDF) (₹11,26,036/ha), while the lowest was observed in T_4 (50% RDF) (₹7,54,407/ha). During the 2023 and 2024 growing seasons, the highest gross returns were obtained from T_2 (100% RDF) (₹24,57,532/ha and ₹39,10,276/ha, respectively), whereas the lowest were recorded in T_4 (50% RDF). However, the maximum net returns were achieved in T_3 (75% RDF) (₹15,73,026/ha in 2023 and ₹30,13,327/ha in 2024), with corresponding highest benefit-cost ratios (B:C) of 2.79 and 4.43, respectively. The study concludes that fertigation with 75% of the recommended dose of fertilizers is the most cost-effective and efficient regime for enhancing productivity and profitability of mango under high-density planting conditions.

Keywords: Mango, fertigation, high density planting, cost economics

Introduction
Mango (*Mangifera indica* L.) belongs to the family Anacardiaceae and is believed to have originated in the Indo-Burma region. It has a chromosome number of 2n = 40. Recognized as the National Fruit of India, mango is valued for its nutritional richness, delightful taste, attractive aroma, and health-promoting properties. Apart from its delicious flavour, it is highly nutritious, rich in beta-carotene (a precursor of vitamin A, 4800 I.U.), and is a good source of vitamin C. India stands as the world's leading producer of mango, with an estimated cultivation area of 2,393.86 thousand hectares, an annual production of 22,662.89 thousand metric tons, and a productivity rate of 9.47 metric tons per hectare (Ministry of Agriculture and Farmers Welfare, Government of India, 2024-25; 1st Advance Estimates). The major mango-producing states in India include Andhra Pradesh, Karnataka, Gujarat, Maharashtra, Tamil Nadu, Chhattisgarh, Bihar, and Uttar Pradesh.
Being the largest mango producer in the world and with a rapidly increasing population, it is essential to adopt advanced production technologies in mango cultivation to meet the per capita demand and enhance productivity. However, before adopting any advanced production technology, a prior assessment of its cost economics is necessary, as it helps farmers and growers make informed decisions to improve productivity. Therefore, the present study outlines the cost economics of different fertigation regimes adopted under a high-density planting system in mango orchards.

Materials and Methods
This research project was conducted at the Mango Orchard of the Department of Fruit Science, College of Agriculture, Vellanikkara, Kerala Agricultural University, Thrissur during 2023 and 2024 growing season.

The experiment was designed with RBD with 5 different treatments with, each replicated four times with three trees per replication. The treatments were formulated based on the recommended dose of fertilizer (RDF) for mango as per the Kerala Agricultural University's Package of Practices, which prescribes 500 g N, 360 g P_2O_5, and 750 g K_2O per plant per year. Fertigation was applied at 7-day intervals during different developmental stages, following the method described by Ravishankar *et al*. (2015) [2]. The details of the treatments are presented below:

T_1	: 125% RDF
T_2	: 100% RDF
T_3	: 75% RDF
T_4	: 50% RDF
T_5	: Control (Soil application of nutrients as per KAU PoP with the conventional method of irrigation)

Cost economics per hectare was calculated based on the field data obtained from the study.

Cost of production (Rs ha^{-1})

The prevailing prices of inputs at the time of the experiment were considered for calculating the cost of mango production. The inputs included the installation of the fertigation unit, water-soluble fertilizers, organic manures, growth regulators, labour wages, plant protection chemicals, and other miscellaneous expenses.

Gross returns (Rs ha^{-1})

Gross returns were calculated based on the fruit yield and prevailing market price of the fruits, and were ultimately expressed in rupees per hectare.

Net returns (Rs ha^{-1})

Net returns per hectare were calculated by subtracting the cost of cultivation per hectare from the gross returns per hectare.

Benefit-cost ratio (BCR)

The benefit-cost ratio was calculated using the following formula:

$$BCR = \frac{\text{Gross returns (Rs/ha)}}{\text{Cost of cultivation (Rs/ha)}}$$

Results

The effect of different fertigation regimes was examined and evaluated, and it was found to significantly influence the cost economics of mango under the high-density planting system (Table 1).

The highest cost of cultivation was recorded in T_1 (125% RDF) (₹11,26,036/ha), while the lowest was observed in T_4 (50% RDF) (₹7,54,407/ha) under the high-density planting system.

During the 2023 growing season, the highest gross return was recorded in T_2 (100% RDF) (₹24,57,532/ha), while the lowest was observed in T4 (50% RDF) (₹14,27,857/ha). In the 2024 season, T2 (100% RDF) again registered the highest gross return (₹39,10,276/ha), whereas T4 (50% RDF) recorded the lowest (₹30,81,247/ha).

During the 2023 growing season, the highest net return was recorded in T_3 (75% RDF) with ₹15,73,026 per hectare, while the lowest net return was observed in T_4 (50% RDF) with ₹6,73,450 per hectare. In the 2024 season, the highest net return was again recorded in T_3 (75% RDF) with ₹30,13,327 per hectare, whereas the lowest net return was obtained in T_5 (control) with ₹22,69,514 per hectare.

During the 2023 growing season, the highest B:C ratio (2.79) was recorded in T_3 (75% RDF), while the lowest (1.73) was observed in T_1 (125% RDF). In the 2024 season, T_3 (75% RDF) again recorded the highest B:C ratio (4.43), whereas T_1 (125% RDF) exhibited the lowest (3.21).

Discussion

The highest cost of cultivation in T_1 (125% RDF) reduced profitability despite higher input use, whereas T_3 (75% RDF) optimized nutrient use, balancing moderate investment with high returns. This resulted in maximum net returns and B:C ratios. Lower RDF levels (T_4) and the control (T_5) limited growth and yield, reducing returns, while excessive RDF increased costs without proportional gain. Similar results were reported by Manjunath *et al*. (2023) [3], who found that fertigation with 75% of the recommended dose of inorganic fertilizers in papaya led to higher gross returns (₹7.10 lakh/ha), net returns (₹4.70 lakh/ha), and a benefit-cost ratio of 2.96. Hazarika *et al*. (2016) [4] also reported that application of 75% RDF + 5 t/ha vermicompost (T4) significantly increased yield and B:C ratio in Toria (*Brassica campestris*).

Table 1: Effect of different fertigation regimes on cost economics of mango cv. Ratna under high-density planting system

Treatments	Cost of cultivation (Rs ha^{-1})	Gross return (Rs ha^{-1})		Net return (Rs ha^{-1})		B:C ratio	
		2023	2024	2023	2024	2023	2024
T_1-125% RDF	11,26,036/-	19,45,805/-	36,11,639/-	8,19,769/-	24,85,603/-	1.73	3.21
T_2-100% RDF	10,02,160/-	24,57,532/-	39,10,276/-	14,55,372/-	29,08,116/-	2.45	3.90
T_3-75% RDF	8,78,284/-	24,51,310/-	38,91,611/-	15,73,026/-	30,13,327/-	2.79	4.43
T_4-50% RDF	7,54,407/-	14,27,857/-	30,81,247/-	6,73,450/-	23,26,840/-	1.89	4.08
T_5-Control	9,98,381/-	20,54,683/-	32,67,895/-	10,56,302/-	22,69,514/-	2.06	3.27

Conclusion

The fertigation regime influenced the cost economics of mango under the high-density planting system. Among the treatments, 75% of the recommended dose of fertilizers applied through fertigation resulted in higher productivity and, consequently, a greater benefit-cost ratio in both seasons of the study. Therefore, this fertigation regime can be recommended for mango growers under similar growing conditions.

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