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Manjunatha SN
Ph.D. Scholar, Department of
Horticulture, College of
Agriculture, GKVK, UAS,
Bengaluru, Karnataka, India

Kavitha Kandpal
Professor, Department of
Horticulture, College of
Agriculture, GKVK, UAS,
Bengaluru, Karnataka, India

Harshitha D
Senior Research Fellow, ICAR-
ATARI, Zone-XI, Bengaluru,
Karnataka, India

Corresponding Author:
Manjunatha SN
Ph.D. Scholar, Department of
Horticulture, College of
Agriculture, GKVK, UAS,
Bengaluru, Karnataka, India

Cost economics of different fertigation regimes on yield and BCR of ginger (*Zingiber officinale*) Cultivars in eastern dry zone of Karnataka

Manjunatha SN, Kavitha Kandpal and Harshitha D

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Abstract

A field experiment was conducted to evaluate the cost economics of different fertigation regimes on two ginger cultivars, Rio-de-Janeiro and Himachal, under the eastern dry zone of Karnataka. Eleven nutrient management treatments comprising varying levels of recommended dose of fertilizers through soil application, fertigation, and integration with biofertilizers were evaluated in a randomized complete block design with three replications. The treatments included 50 to 200% recommended dose of fertilizers applied through fertigation, in combination with farm yard manure, neem cake, and beneficial microbial inoculants. Economic analysis was carried out by computing total cost of cultivation, gross return, net return, and benefit cost ratio. The total cost of cultivation ranged from Rs. 103325 to Rs. 114625 per hectare depending on the treatment. The highest cost was recorded under 200% recommended dose of fertilizers through fertigation. However, this treatment also produced the highest fresh rhizome yield and maximum benefit cost ratio in both cultivars. In Rio-de-Janeiro, the highest benefit cost ratio was 1.95, while in Himachal it was 2.58 under 200% recommended dose of fertilizers through fertigation. The lowest benefit cost ratio was recorded under 100% recommended dose of fertilizers applied through conventional soil application. The results indicated that higher fertilizer doses through fertigation significantly enhanced yield and profitability despite increasing input costs. Integrated nutrient management with biofertilizers also improved economic returns compared to conventional fertilization. The study demonstrates that optimized fertigation strategies can substantially enhance productivity and profitability of ginger cultivation under dry zone conditions.

Keywords: Ginger, fertigation, cost economics, benefit cost ratio and biofertilizers

Introduction

Ginger (*Zingiber officinale* Rosc.) has been the most important and old spice throughout the globe, belonging to family Zingiberaceae and cultivated in tropical and subtropical regions of India. It is valued for its culinary, medicinal and export potential. There is a need to maintain proper co-ordination among resources like soil, water, organic matter, biotic life and plant nutrient supply to maintain crop production at higher level. Further, efficient nutrient management plays a crucial role in enhancing productivity and profitability in ginger cultivation. Apart from nutrients, water is one more critical inputs of successful ginger production. However, shortage of water for irrigation is being increasingly felt due to pressures from depleting groundwater levels, rising alternative demands, water quality degradation and economics. Fertigation, the application of fertilizers through drip irrigation, has emerged as a promising technology for improving nutrient use efficiency and reducing input losses. Supply of nutrients through fertigation helps in reducing the soil application associated nutrient loss through leaching and evaporation and also facilitates precise application of fertilizers, as it delivers nutrients to the roots where it can be effectively utilized and results in greater uptake and nutrient use efficiency (Bachchhav, 2005) ^[2]. Several investigators reported that ginger is an exhaustive crop and requires heavy manuring (Sheikh *et al.*, 2004) ^[13]. Till today farmers are practicing conventional method of nutrient application in ginger cultivation getting average yield coupled with poor quality of rhizomes. Shah and Zala (2006) ^[12] reported an input-output ratio of 1.97 in ginger cultivation in Gujarat. Shafiqul *et al.* observed a benefit cost ratio of 2.17 in ginger production systems.

Namami *et al.* (2020) ^[7] reported the large sized farms were the highly efficient as compared to medium and small farm sizes under the application of fertilizers through fertigation system to ginger in Assam. Similarly, Sadarunnissa *et al.* (2010) ^[10] demonstrated that fertigation improved yield and economic returns in turmeric. Several studies have evaluated the economics of Zingiberaceae crops. Although studies exist on economics of ginger production, limited information is available on comparative economic performance of varying fertigation levels combined with biofertilizers under eastern dry zone conditions of Karnataka. Therefore, the present study was undertaken to assess the cost economics of different fertigation regimes in two high-yielding ginger cultivars viz., Rio-de-Janeiro and Himachal.

- **Rio-de-Janeiro:** This cultivar is introduced from Brazil. It is widely grown in India particularly in Kerala, Tamil Nadu and Karnataka. It has become very popular among ginger growers. The yield potential of this variety is high. However, due to high moisture content in rhizomes, it is not suitable for dry ginger, but it is most preferred as fresh ginger and preparation of ginger juice. Rhizome contains more fibre (5%) with 16.25% dry ginger recovery.
- **Himachal:** This cultivar is indigenous to India. It is commonly grown in larger area and popular among ginger growers in India. It most suitable for dry ginger and green ginger. This is suitable for rainfed condition. It has high yield potential and rhizome contains more fibre (6.05%) with 20.2% dry ginger recovery.

Materials and Methods

Experimental Site

The experiment was conducted at the Department of

Horticulture, Gandhi Krishi Vignana Kendra (GKVK), University of Agricultural Sciences (UAS), Bangalore during kharif 2021 at the eastern dry zone of Karnataka. The area has warm and humid climate. The soil of experimental site was red sandy loam with good drainage.

Experimental Design

Two independent experiments were conducted separately for two cultivars, Rio-de-Janeiro and Himachal. The layout was formulated independently using RCBD for these cultivars using 11 treatments each with three replications. Gross plot size of 10.00 x 2.00 m in each treatment with net plot size of 10.00 x 1.00 m was followed. Drip irrigation was installed with main, sub-main and lateral lines.

Treatments

Fertiliser dose: Different sources of nutrients like FYM (Farm Yard Manure), Azotobacter, PSB (Phosphate Solubilising Bacteria), AMF (Arbuscular Mycorrhizal Fungi), KMB (Potassium Mobilizing Biofertilizer), Inorganic sources (Urea, DAP, MOP, SSP, Ginger special, Neem cake) were used. Treatments comprised varying levels (50-200%) of recommended dose of fertilizers (100:50:50 kg N: P₂O₅: K₂O per ha) applied through soil application and fertigation. All treatments received farm yard manure at 30 t ha⁻¹ and neem cake at 2 t ha⁻¹. Selected treatments included biofertilizers such as Azotobacter, phosphate solubilizing bacteria, arbuscular mycorrhizal fungi, and potassium mobilizing bacteria. Ginger special (5 ml/L) was common for all the treatments but for the treatment T₁₀, 25% N: P₂O₅: K₂O Foliar spray was given in different stages of crop growth (60, 90 and 120 DAP). Details of 11 treatments are presented in Table-1.

Table 1: Details of treatments

Treatment	Details
T ₁	RDF (100:50:50 N: P ₂ O ₅ : K ₂ O kg /ha normal fertilizers) + FYM 30 t/ha, Neem cake 2 t/ha
T ₂	200% RDF (200:100:100 N: P ₂ O ₅ : K ₂ O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha
T ₃	150% RDF (150:75:75 N: P ₂ O ₅ : K ₂ O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha
T ₄	100% RDF (100:50:50 N: P ₂ O ₅ : K ₂ O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha
T ₅	75% RDF (75:37.5:37.5 N: P ₂ O ₅ : K ₂ O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha
T ₆	50% RDF (50:25:25 N: P ₂ O ₅ : K ₂ O kg/ha) NF soil application + 50% Fertigation (50:25:25 NPK kg/ha) WSP + FYM 30 t/ha, Neem cake 2 t/ha
T ₇	100% RDF (100:50:50 N: P ₂ O ₅ : K ₂ O kg/ha NF) + Azotobacter + PSB + AMF + KMB + FYM 30 t/ha, Neem cake 2 t/ha
T ₈	75% RDF (75:37.5:37.5 N: P ₂ O ₅ : K ₂ O kg/ha WSF) + Azotobacter + PSB + AMF + KMB + FYM 30 t/ha, Neem cake 2 t/ha
T ₉	50% RDF (50:25:25 N: P ₂ O ₅ : K ₂ O kg/ha WSF) + Azotobacter + PSB + AMF + KMB + FYM 30 t/ha, Neem cake 2 t/ha
T ₁₀	50% RDF (50:25:25 N: P ₂ O ₅ : K ₂ O kg/ha WSF) + 25% N: P ₂ O ₅ : K ₂ O Foliar spray at 60, 90, 120 DAP + Azotobacter + PSB + AMF + KMB + FYM 30 t/ha, Neem cake 2 t/ha
T ₁₁	100% RDF (100:50:50 N: P ₂ O ₅ : K ₂ O kg/ha WSF) + Azotobacter + PSB + AMF + KMB + FYM + Neem cake

Fertilizer application: Fertigation using water soluble fertilizer (19:19:19) and urea was initiated 45 days after planting at 15-day intervals for ten applications. Fertigation was started after 45 DAP and at every 15 days interval fertilizers (10 times) were applied as per treatments. Ginger

special at 5 ml / L is common for all the treatments and it was applied at 60, 90 and 120 DAP to all treatments. Treatments with details of fertilizer application are presented in Table-2.

Table 2: Treatments with details of fertilizer application through fertigation

Treatments	Fertilizers applied (10 m ²)
T ₁	220 g urea + 313 g of SSP + 84 g MOP as soil application + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₂	52.6 g (19:19:19) + 21.8 g urea (fertigation) + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₃	39.5 g (19:19:19) + 16.3 g urea (fertigation) + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₄	26.3 g (19:19:19) + 10.9 g urea (fertigation) + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₅	19.7 g (19:19:19) + 6.7 g urea (fertigation) + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₆	13.2 g (19:19:19) + 5.4 g urea (fertigation) + 110 g urea + 156 g of SSP + 42 g MOP as soil application + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₇	220 g urea + 313 g of SSP + 84 g MOP as soil application + bio fertilizers + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₈	19.7 g (19:19:19) + 6.7 g urea (fertigation) + bio fertilizers + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₉	13.2 g (19:19:19) + 5.4 g urea (fertigation) + 110 g urea soil application + bio fertilizers + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₁₀	13.2 g (19:19:19) + 5.4 g urea (fertigation) + 2.2 g 19:19:19 + 1 g urea through foliar spray at 60, 90, 120 days after planting + bio fertilizer + FYM 30 kg/ bed + Neem cake 2 kg / bed
T ₁₁	26.3 g (19:19:19) + 10.9 g urea (fertigation) + bio fertilizers + FYM 30 kg/ bed + Neem cake 2 kg / bed

Cultural Practices

The soil was well prepared to fine tilth. Seed rhizomes (15-20 g) were treated with Mancozeb before planting at 45 × 30 cm spacing. Irrigation was provided through drip based on soil moisture. Plant protection measures were undertaken against soft rot and leaf spot diseases using recommended fungicides.

Data collection and Economic Analysis

Observations were recorded for various growth, yield, quality and cost economics parameters. Analysis was carried out using RCBD separately for both the cultivars. Cost of cultivation was calculated based on prevailing input prices

including fertilizers, biofertilizers, labour, irrigation and plant protection measures (Table-3). Formulae used as follows:

Gross return: Gross return = Yield (t ha⁻¹) × Market price (Rs. kg⁻¹)

Net return: Net return = Gross return – Total cost of cultivation

Benefit cost ratio: Benefit cost ratio = Gross return / Total cost of cultivation

Table 3: Cost of cultivation of ginger as per different parameters

Cost of cultivation (Rs)													
Treatments	Land preparation	Bed preparation	Seed material and seed treatment	Sowing	Fertilizers	Bio-fertilizers	FYM	Weeding	Earthing up	Plant protection	Harvesting and processing	Miscellaneous	Total
T ₁	3,800	5,000	35,000	2,750	12,645	0	18,500	4,125	4,125	4,050	13,275	2,000	1,05,270
T ₂	3,800	5,000	35,000	2,750	22,000	0	18,500	4,125	4,125	4,050	13,275	2,000	1,14,625
T ₃	3,800	5,000	35,000	2,750	18,000	0	18,500	4,125	4,125	4,050	13,275	2,000	1,10,625
T ₄	3,800	5,000	35,000	2,750	12,645	0	18,500	4,125	4,125	4,050	13,275	2,000	1,05,270
T ₅	3,800	5,000	35,000	2,750	8,500	0	18,500	4,125	4,125	4,050	13,275	2,000	1,01,125
T ₆	3,800	5,000	35,000	2,750	12,645	0	18,500	4,125	4,125	4,050	13,275	2,000	1,05,270
T ₇	3,800	5,000	35,000	2,750	9,484	4,200	18,500	4,125	4,125	4,050	13,275	2,000	1,06,309
T ₈	3,800	5,000	35,000	2,750	8,500	4,200	18,500	4,125	4,125	4,050	13,275	2,000	1,05,325
T ₉	3,800	5,000	35,000	2,750	6,500	4,200	18,500	4,125	4,125	4,050	13,275	2,000	1,03,325
T ₁₀	3,800	5,000	35,000	2,750	7,000	4,200	18,500	4,125	4,125	4,050	13,275	2,000	1,03,825
T ₁₁	3,800	5,000	35,000	2,750	12,645	4,200	18,500	4,125	4,125	4,050	13,275	2,000	1,09,470

Results

Data regarding the cost economics of ginger in different treatments are presented in Table-3 and Table-4. Among the different treatments the cost of production varied from Rs.1,03,325 /ha to Rs.114,625/ha. Highest cost of production (Rs.114,625/ha) was recorded in T₂ [200% RDF (200:100:100 N: P₂O₅: K₂O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha]. It was followed by treatments like T₃ and T₁₁. Lowest cost of production was recorded in T₉ (Rs. 103,325/ha).

Benefit cost ratio was highest in T₂ [200% RDF (200:100:100 N: P₂O₅: K₂O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha] for Rio-de-Janeiro with 1.95 value. Higher yield of fresh rhizome in these treatments was the reason for optimum B: C ratio. Lowest B: C ratio was recorded in T₁ [RDF (100:50:50 N: P₂O₅: K₂O kg /ha normal fertilizers) + FYM 30 t/ha, Neem cake 2t/ha] with 1.13

value. For Himachal highest B: C ratio was recorded in T₂ [200% RDF (200:100:100 N: P₂O₅: K₂O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha] with 2.58 value. B: C ratio was lowest in T₁ [RDF (100:50:50 N: P₂O₅: K₂O kg /ha normal fertilizers) + FYM 30 t/ha, Neem cake 2t/ha] with 1.40 value for Himachal variety.

Bharathi *et al.* reported that the most profitable treatment combination was 50% NPK + 50% pig manure followed by 50% NPK + 50% FYM which resulted in maximum cost benefit ratio 1:4.35 and 1:4.31, respectively. The net return obtained due to 50% NPK + 50% pig manure treatment was observed to be higher by Rs. 62499/-over control. Suggesting the better economics of fertilizer use. The net return was invariably high with combined application of organic manures and inorganic fertilizers. Almost all treatments exhibited better return as compared to control. In a similar study, Karthik and Amarnath (2014) [4] calculated

economics of ginger and found maximum net profit (Rs. 97175) and cost benefit ratio of ginger with application of 100:50:50 kg/ha NPK along with bio fertilizers.

Considering the overall results after studying the impact of different treatments in the study it can be known that use of higher dose of fertilizers (200%) specifically through fertigation can result in better growth, yield and quality parameters in ginger. It was also known that use of higher dose of fertilizers may add up to the cost of production but it has shown better benefit cost ratio due to increased rhizome yield. The total cost of cultivation varied from Rs. 103325 to Rs.114625 per hectare across treatments. The highest cost was recorded in the treatment receiving 200% recommended dose of fertilizers through fertigation. Details of cost economics of different Fertigation Regimes on Growth and Yield of two varieties are given below:

- **Rio-de-Janeiro:** Fresh rhizome yield ranged from 6.64 to 11.46 t ha⁻¹. The highest yield (11.46 t ha⁻¹) and

maximum gross return (Rs.206280 ha⁻¹) were recorded under 200% recommended dose of fertilizers through fertigation. The highest benefit cost ratio (1.95) was also observed under this treatment. The lowest benefit cost ratio (1.13) was recorded under conventional soil application of 100% recommended dose.

- **Himachal:** Yield ranged from 7.35 to 14.54 t ha⁻¹. The highest yield (14.54 t ha⁻¹), gross return (Rs. 2,90,800 ha⁻¹) and benefit cost ratio (2.58) were recorded under 200% recommended dose of fertilizers through fertigation. The lowest benefit cost ratio (1.40) was recorded under conventional 100% recommended dose soil application.

Thus, integrated treatments involving biofertilizers recorded comparatively higher net returns than sole conventional fertilization.

Table 4: Cost Economics of Different Fertigation Regimes on yield and BCR of ginger variety Rio-de-Janeiro

Ginger variety Rio-de-Janeiro						
Treatments	Yield (t/ha)	Gross return (Rs)		Total cost (Rs.) / ha	Net return (Rs.) / ha	B: C ratio
		per kg	per hectare			
T ₁	6.64	18	119520	105270	14250	1.13
T ₂	11.46	18	206280	105270	101010	1.95
T ₃	10.69	18	192420	101125	91295	1.90
T ₄	6.89	18	124020	105270	18750	1.17
T ₅	10.16	18	182880	114625	68255	1.59
T ₆	8.49	18	152820	110625	42195	1.38
T ₇	9.46	18	170280	106309	63971	1.60
T ₈	7.77	18	139860	105325	34535	1.32
T ₉	7.88	18	141840	103325	38515	1.37
T ₁₀	8.49	18	152820	103825	48995	1.47
T ₁₁	8.24	18	148320	109470	38850	1.35

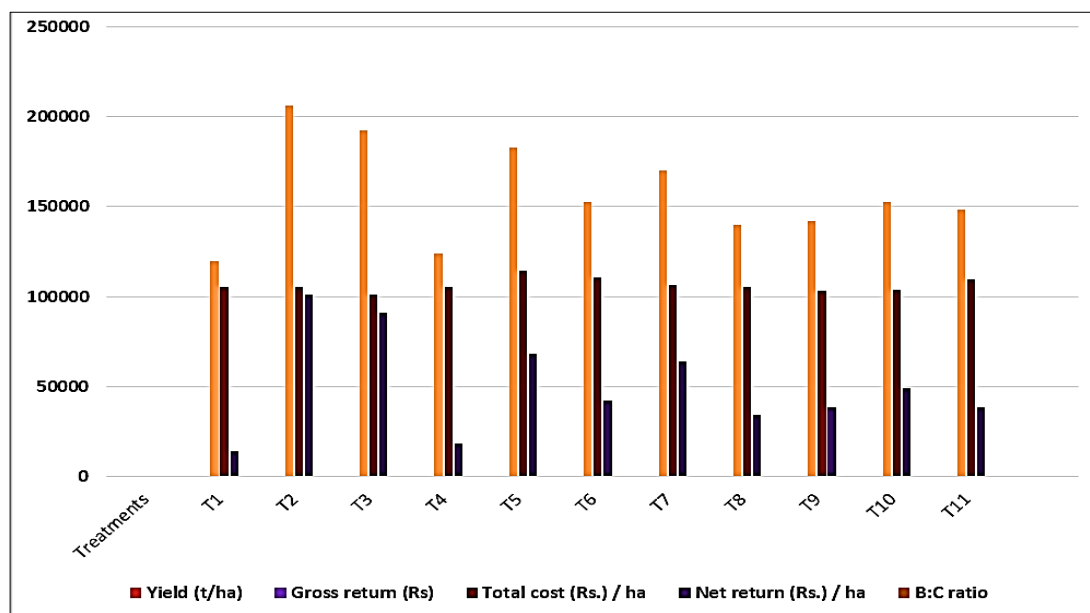
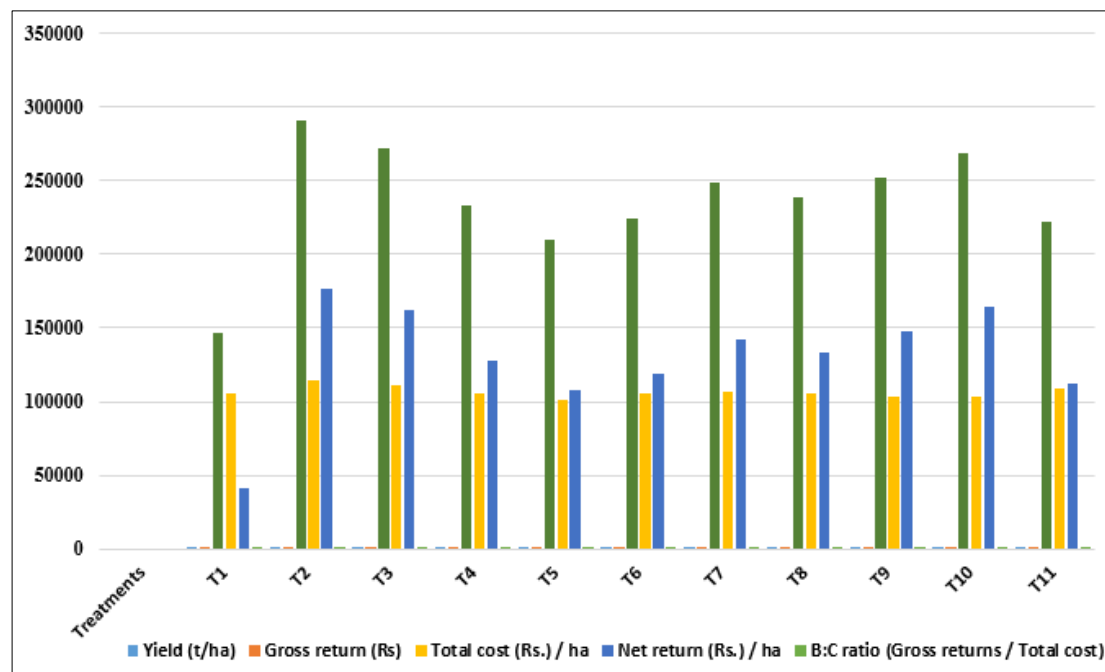


Fig 1: Ginger variety Rio-de-Janeiro.

Table 5: Cost Economics of Different Fertigation Regimes on yield and BCR of ginger variety Himachal

Ginger variety Himachal						
Treatments	Yield (t/ha)	Gross return (Rs)		Total cost (Rs.) / ha	Net return (Rs.) / ha	B: C ratio (Gross returns / Total cost)
		per kg	per hectare			
T ₁	7.35	20	147000	105270	41730	1.40
T ₂	14.54	20	290800	114625	176175	2.58
T ₃	13.62	20	272400	110625	161775	2.46
T ₄	11.64	20	232800	105270	127530	2.21
T ₅	10.47	20	209400	101125	108275	2.08
T ₆	11.20	20	224000	105270	118730	2.13
T ₇	12.41	20	248200	106309	141891	2.33
T ₈	11.95	20	239000	105325	133675	2.27
T ₉	12.58	20	251600	103325	148275	2.43
T ₁₀	13.42	20	268400	103825	164575	2.54
T ₁₁	11.09	20	221800	109470	112330	2.03

**Fig 2:** Ginger variety Himachal

Cost economics analysis revealed that highest cost of cultivation was recorded in T₂ [200% RDF (200:100:100 N: P₂O₅: K₂O kg/ha) Fertigation + FYM 30 t/ha, Neem cake 2 t/ha]. But due to higher yield and curing percentage in T₂ highest benefit cost ratio of the ginger cultivars viz Rio-de-Janeiro (1.95) and Himachal (2.58) was obtained. Findings further indicated that increasing fertilizer levels through fertigation enhanced yield and economic returns in ginger. The higher benefit cost ratio under 200% recommended dose through fertigation may be attributed to improved nutrient availability, better nutrient use efficiency and enhanced rhizome development. This results are in accordance with that of results reported by Shah and Zala, who observed profitability of ginger cultivation with an input-output ratio of 1.97. Shafiquel *et al.* reported benefit cost ratio of 2.17 under improved nutrient management practices. Namami *et al.* observed higher net returns under fertigation in ginger cultivation. The comparatively lower benefit cost ratio under conventional soil application suggests that fertigation improves fertilizer efficiency and yield realization. Integration of biofertilizers also contributed positively to economic performance, substantiating findings of Karthik and Amarnath.

Conclusion

Application of 200% recommended dose of fertilizers through fertigation resulted in the highest yield, net return, and benefit cost ratio in both Rio-de-Janeiro and Himachal cultivars. Although the cost of cultivation increased with higher fertilizer levels, the enhanced yield compensated for the additional investment, resulting in superior profitability. Therefore, optimized fertigation regimes can be recommended for improving economic returns in ginger cultivation under eastern dry zone conditions of Karnataka.

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References

1. Anitha B, Kumar AR, Prakash S. Effect of drip fertigation on growth, yield and nutrient uptake of ginger (*Zingiber officinale* Rosc.). J Spices Aromatic Crops. 2019;28(2):145-152.
2. Bachchhav T. Nitrogen nutrition of ginger (*Zingiber officinale* Rosc.)—Effects of sources, rates and time of nitrogen application. Plant Soil. 2005;2(1):123-134.

3. Devika M, Nair R, Joseph L. Impact of precision fertigation on yield, quality and economics of ginger under tropical conditions. *Scientia Horticulturae*. 2023;312:1-11.
4. Karthik V, Amarnath JS. An economic analysis of turmeric production in Tamil Nadu, India. *Direct Res J Agric Food Sci*. 2014;2(6):66-76.
5. Kumar D, Sharma R, Verma S. Influence of water-soluble fertilizers and biofertilizers on yield and profitability of ginger. *Int J Current Microbiol Applied Sci*. 2021;10(5):1023-1031.
6. Singh R, Yadav R, Patel N. Integrated nutrient management in ginger for sustainable productivity and profitability. *J Plant Nutr*. 2022;45(14):2158-2172.
7. Namami G, Atibudhi HN, Avinash Kumar. A study on economics of ginger cultivation in Assam—A case study of Tinsukia district. *Plant Archives*. 2020;20(2):2522-2526.
8. Patil SB, Deshmukh VK. Cost economics of fertigation levels in ginger under semi-arid ecosystems. *J Appl Nat Sci*. 2024;16(1):112-118.
9. Rao KV, Reddy ML, Singh P. Economic evaluation of integrated nutrient management in ginger under irrigated conditions. *Indian J Agric Sci*. 2020;90(7):1345-1350.
10. Sadarunnisa S, Madhumathi C, Rao GS, Sreenivasulu B. Effect of fertigation on growth and yield of turmeric (*Curcuma longa* L.) cv. Mydukur. *J Hortic Sci*. 2010;5(1):78-80.
11. Shafiqul QM, Matinand MA, Hossain S. Economic performance of ginger (*Zingiber officinale* Roscoe.) cultivation in some selected locations Bangladesh. *J Agric Res*. 2012;37(1):109-120.
12. Shah SP, Zala YC. Cost-benefit analysis of ginger cultivation in middle Gujarat. *Agric Econ Res Rev*. 2006;19(2):206.
13. Sheikh AA, Kumbhar SG, Jawale SM. Contribution of different production parameters on growth contributing characters in ginger. *J Maharashtra Agric Univ*. 2004;29(3):354-355.