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Effect of irrigation level and natural inputs on yield and economics of cucumber (*Cucumis sativus* L.) under Chhattisgarh plains

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ABSTRACT

A field experiment was conducted at the Instructional Research Farm, College of Horticulture and Research Station, Sankara, Patan, Durg, Chhattisgarh, during the Rabi season of 2025–26 to assess the effect of irrigation levels and natural inputs on fruit yield per hectare and the benefit–cost ratio (B:C) of cucumber (*Cucumis sativus* L.) cv. Arka Veera. The experiment was laid out in a Split Plot Design with three replications and twelve treatment combinations, comprising three irrigation levels (I_1 : 100%, I_2 : 75% and I_3 : 50%) in the main plots and four natural input treatments (N_0 : control, N_1 : Jeevamrut @ 500 L ha⁻¹, N_2 : Beejamrut @ 250 ml kg⁻¹ seed and N_3 : Ghanjeevamrut @ 1000 kg ha⁻¹) in the sub-plots. Yield per hectare was highest under 100% irrigation (17.93 q ha⁻¹), which was statistically at par with 75% irrigation (16.80 q ha⁻¹), and was lowest under 50% irrigation (14.52 q ha⁻¹). Among natural inputs, Jeevamrut recorded the highest yield (18.55 q ha⁻¹), followed by Ghanjeevamrut (17.53 q ha⁻¹), while the control recorded the lowest (13.79 q ha⁻¹). The combination of 100% irrigation with Jeevamrut (I_{1N_1}) produced the maximum yield (21.17 q ha⁻¹), whereas I_{3N_0} recorded the minimum (12.84 q ha⁻¹). At a selling price of Rs 30 kg⁻¹, I_{1N_1} also recorded the highest gross return (Rs 63,510 ha⁻¹), net return (Rs 33,070 ha⁻¹) and B:C ratio (2.09), followed by I_{2N_1} (1.95) and I_{3N_1} (1.90). Overall, 100% irrigation combined with Jeevamrut was the most productive and profitable combination, while Jeevamrut under reduced irrigation retained a favourable B:C ratio.

Keywords: Cucumber, Irrigation, Yield, B:C ratio, Jeevamrut, Ghanjeevamrut

1. Introduction

Cucumber (*Cucumis sativus* L.) is an important cucurbitaceous vegetable grown for its tender fruits, which are consumed fresh as salad and valued for their high moisture content and refreshing quality. Its shallow root system and rapid vegetative growth make the crop highly responsive to soil moisture, and both deficit and excess irrigation can reduce fruit set, fruit weight and marketable yield (Hari *et al.*, 2017; Li *et al.*, 2024) [1, 2]. Irrigation is also a major component of production cost, and its effect on profitability depends on whether the additional yield offsets the additional expenditure (Nair *et al.*, 2018; Patel *et al.*, 2022) [3, 4]. At the same time, there is growing interest in low-cost, farm-prepared natural inputs such as Jeevamrut, Beejamrut and Ghanjeevamrut, which supply nutrients and beneficial microorganisms at little cost and are reported to improve crop productivity and returns (Kumar *et al.*, 2021; Saharan *et al.*, 2023; Kasundra *et al.*, 2026) [6, 7, 5].

Information on how irrigation level and natural inputs jointly influence the yield and economics of cucumber under the Chhattisgarh plains is limited. The present study therefore evaluated three irrigation levels and four natural input treatments on fruit yield per hectare and benefit–cost ratio of cucumber cv. Arka Veera.

2. Materials and Methods

The experiment was conducted during the *Rabi* season of 2025–26 at CHRS, Sankara, Patan, Durg, Chhattisgarh (21°18' N, 81°55' E; 291 m AMSL). The soil was loamy and slightly acidic (pH 6.44), with EC 0.15 dS m⁻¹, organic carbon 0.68%, and available N, P and K of 213.2, 10.2 and 281.8 kg ha⁻¹, respectively. Cucumber cv. Arka Veera was sown on 25 December 2025 at 60 × 30 cm spacing. The experiment was laid out in a Split Plot Design with three replications and 12 treatment combinations. Main plots consisted of three irrigation levels: I_1 (100%, 16 irrigations), I_2 (75%, 12 irrigations) and I_3 (50%, 8 irrigations) of crop water requirement. Sub-plots comprised N_0 (control), N_1 (Jeevamrut @ 500 L ha⁻¹), N_2 (Beejamrut @ 250 ml kg⁻¹ seed) and N_3 (Ghanjeevamrut @ 1000 kg ha⁻¹). Fruits were harvested at edible maturity and yield was expressed as q ha⁻¹. Economics were calculated using a market price of Rs 30 kg⁻¹, with net return obtained by subtracting cultivation cost from gross return and B:C ratio calculated as gross return/cost

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of cultivation. Data were analysed using ANOVA for Split Plot Design, and treatment means were compared by CD at 5% significance (Gomez *et al.*, 1984) [8].

3. Results and Discussion

Irrigation levels and natural inputs significantly influenced fruit yield per hectare and the economics of cucumber, as presented in Tables 1 to 3.

3.1 Yield per hectare ($q\ ha^{-1}$)

Irrigation significantly affected yield per hectare (Table 1). The maximum yield ($17.93\ q\ ha^{-1}$) was recorded under I_1 (100% irrigation), statistically at par with I_2 (75%; $16.80\ q\ ha^{-1}$), while I_3 (50%) recorded the minimum ($14.52\ q\ ha^{-1}$). Full irrigation produced about 23.5% higher yield than 50% irrigation, probably due to adequate soil moisture supporting cell expansion, fruit filling and fruit weight (Hari *et al.*, 2017; Santosh *et al.*, 2024) [1, 9]. Reduced yield under water deficit may be associated with restricted cell expansion (Li *et al.*, 2024) [2].

Natural inputs also significantly influenced yield. The highest yield was obtained with N_1 (Jeevamrut; $18.55\ q\ ha^{-1}$), which was at par with N_3 (Ghanjeevamrut; $17.53\ q\ ha^{-1}$), followed by N_2 (Beejamrut; $15.80\ q\ ha^{-1}$), while N_0 recorded the lowest yield ($13.79\ q\ ha^{-1}$). Jeevamrut increased yield by about 34.5% over the control, possibly due to improved nutrient availability and microbial activity in the root zone (Saharan *et al.*, 2023; Bhadu *et al.*, 2023) [7, 10].

Among treatment combinations (Table 2), the maximum yield ($21.17\ q\ ha^{-1}$) was recorded in I_1N_1 , followed by I_1N_3 ($19.35\ q\ ha^{-1}$), while I_3N_0 recorded the minimum ($12.84\ q\ ha^{-1}$). This indicates a complementary effect of adequate irrigation and natural inputs (Santosh *et al.*, 2024; Saharan *et al.*, 2023) [9, 7]. Under full irrigation, Jeevamrut increased yield by about 47%.

3.2 Benefit–cost ratio

The economics of different treatment combinations are presented in Table 3. Cost of cultivation increased with irrigation intensity and natural-input application, ranging from Rs 25,240 ha^{-1} in I_3N_0 to Rs 30,040 ha^{-1} in I_1N_0 among controls. Jeevamrut increased the cost by

only Rs 400 ha^{-1} , whereas Ghanjeevamrut added Rs 2,000 ha^{-1} (Nair *et al.*, 2018; Patel *et al.*, 2022; Kasundra *et al.*, 2026) [3, 4, 5].

Gross and net returns generally followed the yield trend. The maximum gross return (Rs 63,510 ha^{-1}) and net return (Rs 33,070 ha^{-1}) were recorded in I_1N_1 , while the minimum gross return (Rs 38,520 ha^{-1}) occurred in I_3N_0 . The high returns from I_1N_1 resulted from its greater yield with only a small additional cost for Jeevamrut (Kumar *et al.*, 2021; Bhadu *et al.*, 2021) [6, 11].

The highest B:C ratio was recorded in I_1N_1 (2.09), followed by I_2N_1 (1.95) and I_3N_1 (1.90). Jeevamrut produced the highest B:C ratio at each irrigation level. In contrast, I_1N_0 recorded a lower ratio (1.44) than I_2N_0 and I_3N_0 (1.53 each), indicating that the additional cost of full irrigation was not compensated by a proportional yield increase without natural inputs. The relatively high B:C ratios of I_2N_1 and I_3N_1 suggest that Jeevamrut may help maintain profitability under reduced irrigation (Kumar *et al.*, 2024; Malik, 2017; Kumar *et al.*, 2017) [12, 13, 14].

Table 1. Effect of irrigation levels and natural inputs on fruit yield of cucumber.

Treatment	Yield per hectare ($q\ ha^{-1}$)
Irrigation levels	
I_1 – 100% irrigation (16 irrigations)	17.93
I_2 – 75% irrigation (12 irrigations)	16.80
I_3 – 50% irrigation (8 irrigations)	14.52
SEm $\pm$	0.58
CD at 5%	2.33
Natural inputs	
N_0 – Control (no natural input)	13.79
N_1 – Jeevamrut @ 500 L ha^{-1}	18.55
N_2 – Beejamrut @ 250 ml kg^{-1} seed	15.80
N_3 – Ghanjeevamrut @ 1000 kg ha^{-1}	17.53
SEm $\pm$	0.34
CD at 5%	1.03

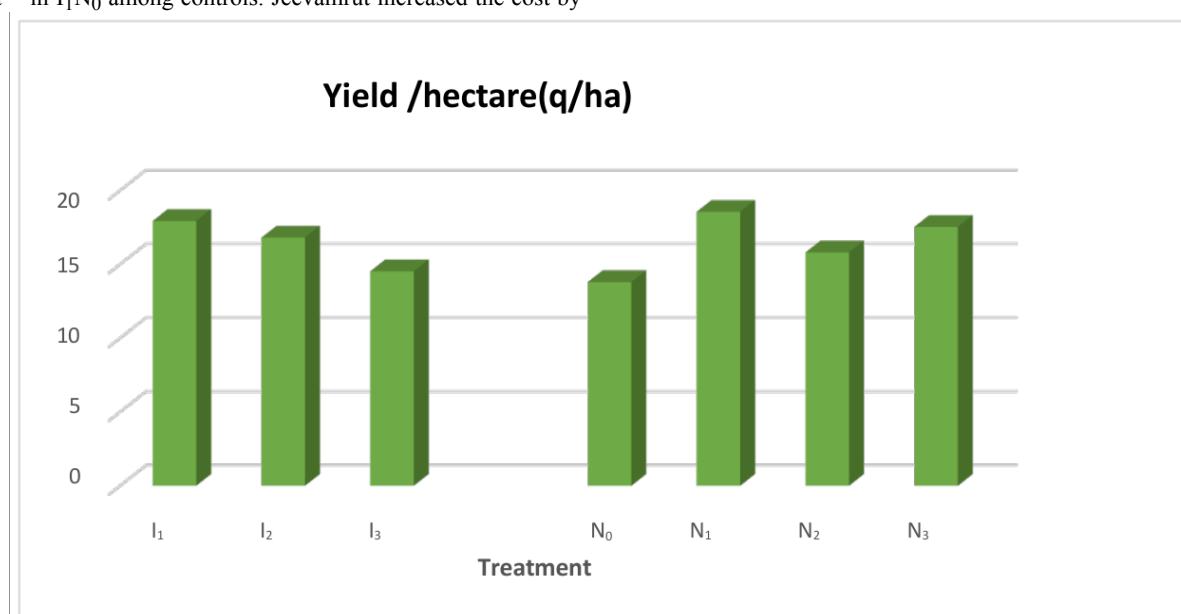


Figure 1. Effect of irrigation and natural inputs on yield of cucumber in $q\ ha^{-1}$

Table 2. Interaction effect of irrigation levels and natural inputs on yield per hectare (q ha^{-1}) of cucumber.

Treatment	I1	I2	I3	Total	Mean
N ₀	14.40	14.13	12.84	42.05	13.79
N ₁	21.17	18.19	16.28	55.64	18.55
N ₂	16.79	17.13	13.47	47.39	15.80
N ₃	19.35	17.73	15.50	52.58	17.53
Total	71.71	67.18	58.09	S.E.(m) $\pm$	0.593
Mean	17.93	16.80	14.52	CD (5 %)	1.778

Table 3. Cost, yield and economic returns of cucumber as influenced by irrigation levels and natural inputs.

Notation	Treatment details	Cost of cultivation (Rs ha^{-1})	Yield (q ha^{-1})	Gross return (Rs ha^{-1})	Net return (Rs ha^{-1})	B:C ratio
I ₁ N ₀	100% irrigation (control)	30,040	14.40	43,200	13,160	1.44
I ₁ N ₁	100% irrigation + Jeevamrut	30,440	21.17	63,510	33,070	2.09
I ₁ N ₂	100% irrigation + Beejamrut	30,250	16.79	50,370	20,120	1.67
I ₁ N ₃	100% irrigation + Ghanjeevamrut	32,040	19.35	58,050	26,010	1.81
I ₂ N ₀	75% irrigation (control)	27,640	14.13	42,390	14,750	1.53
I ₂ N ₁	75% irrigation + Jeevamrut	28,040	18.19	54,570	26,530	1.95
I ₂ N ₂	75% irrigation + Beejamrut	27,850	17.13	51,390	23,540	1.85
I ₂ N ₃	75% irrigation + Ghanjeevamrut	29,640	17.73	53,190	23,550	1.79
I ₃ N ₀	50% irrigation (control)	25,240	12.84	38,520	13,280	1.53
I ₃ N ₁	50% irrigation + Jeevamrut	25,640	16.28	48,840	23,200	1.90
I ₃ N ₂	50% irrigation + Beejamrut	25,450	13.47	40,410	14,960	1.59
I ₃ N ₃	50% irrigation + Ghanjeevamrut	27,240	15.50	46,500	19,260	1.71

4. Conclusion

Both irrigation level and natural inputs significantly influenced the yield per hectare and the benefit–cost ratio of cucumber cv. Arka Veera. Full irrigation (100%) gave the highest yield, though it was statistically at par with 75% irrigation, and Jeevamrut was the best natural input, followed by Ghanjeevamrut. The combination of 100% irrigation with Jeevamrut (I₁N₁) recorded the maximum yield (21.17 q ha^{-1}), gross return (Rs 63,510 ha^{-1}), net return (Rs 33,070 ha^{-1}) and B:C ratio (2.09). Jeevamrut under 75% and 50% irrigation also maintained high B:C ratios of 1.95 and 1.90, respectively. Full irrigation with Jeevamrut is therefore recommended for cucumbers in the Chhattisgarh plains, while Jeevamrut with 75% irrigation is a sound option where water is limited.

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6. Competing interests

The authors have no conflict of interest to declare regarding this manuscript

Selling price of cucumber: Rs 30 kg^{-1} . B:C ratio = $\frac{\text{gross return}}{\text{cost of cultivation}}$.

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