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Impact of humic acid and micronutrients on economics of parthenocarpic cucumber under walk in net tunnel

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Abstract

The experiment was conducted during 2025-26 *Rabi* season at Centre of Excellence on Protected Cultivation and Precision Farming, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment consisted of three replications and thirteen treatments of humic acid and micronutrients. The economic feasibility of the crop production was assessed. It was observed that the treatment T₈ [FeSO₄ @ 100 ppm (Foliar spray) + Humic acid @ 0.2% (drenching)] resulted in highest cost of cultivation (3,71,489 Rs. ha⁻¹) while maximum gross income (12,33,000 Rs. ha⁻¹), net income (8,61,748 Rs. ha⁻¹) and B:C ratio (3.32) was recorded in T₁₂ [Boric acid @ 40 ppm (Foliar spray) + Humic acid @ 0.2% (drenching)].

Keywords: Micronutrients, economics, cucumber

1. Introduction

Cucumber (*Cucumis sativus* L., 2n = 14) is also called Khira and is believed to have originated in India. It thrives in tropical and subtropical climates (Thamburaj & Singh, 2005) [9]. It is a high-temperature preferring, frost-sensitive plant that thrives in warm and bright light. Area under cucumber in India is 131.49 '000 ha with production of 1759.07 '000 MT (Anon., 2023 a). [2]. The important cucumber growing states are West Bengal, Uttar Pradesh, Tripura, Telangana, Tamilnadu, Sikkim, Rajasthan, Punjab, Madhya Pradesh, Gujrat, Bihar, Haryana, Karnataka, and Chhattisgarh. In Chhattisgarh cucumber is grown on an area of 0.015 '000 Ha and production is 0.158 '000 MT (Anon., 2023 b) [3]. Major cucumber growing districts are Bijapur, Raigarh and Sukma. Cucumber may be grown all around the year in protected structure with great fruit yields and low disease and insect incidence. The nutrients elements that are required in small quantities are referred to as micro or trace elements. Plant growth and development are significantly influenced by micronutrients. Zinc is an important micronutrient for the activity of some enzymes and for the synthesis of tryptophan, a precursor of indole acetic acid (IAA) which increases the production of photosynthates and biomass accumulation, promoting plant growth and yield (Haleema *et al.*, 2018) [4]. Iron is necessary for maintaining the structure and function of chloroplasts. Additionally, it is required for the synthesis of cytochrome and chlorophyll, which significantly boosts yield and growth (Kazemi, 2013) [5]. Boron helps in more photosynthetic activity hence more production and storage of carbohydrates. It also helps plants to flower and produce fruits hence enhancing their growth and yield (Patidar *et al.*, 2017) [6]. Humic acid application significantly increases N, P, and K uptake in plants, which ultimately influences higher branches, number of flowers, fruits, yield (Sivakumar *et al.*, 2007) [8]. Economics analysis of different nutrient treatments in cucumber is important for identifying cost-effective treatments.

2. Materials and Methods

The present experiment was conducted during 2025 *Rabi* season at Centre of Excellence on Protected Cultivation and Precision Farming, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The geographical condition is extends from latitude 21° 23" to longitude 81° 65" and located at elevations 289.56 meters above sea level.

The soil of the experimental field is clay-loam and having soil pH (7.2), electrical conductivity (2.0 dS m⁻¹), organic carbon (0.472%), available nitrogen (154.78 kg ha⁻¹), available phosphorus (52.08 kg ha⁻¹) and available potassium (416.86 kg ha⁻¹). The experiment was laid out in Randomized block design (RBD) with three replications and thirteen treatments consists of T₁: ZnSO₄ @ 20 ppm (FS) + Humic acid @ 0.1% (D), T₂: ZnSO₄ @ 20 ppm (FS) + Humic acid @ 0.2% (D), T₃: ZnSO₄ @ 40 ppm (FS) + Humic acid @ 0.1% (D), T₄: ZnSO₄ @ 40 ppm (FS) + Humic acid @ 0.2% (D), T₅: FeSO₄ @ 50 ppm (FS) + Humic acid @ 0.1% (D), T₆: FeSO₄ @ 50 ppm (FS) + Humic acid @ 0.2% (D), T₇: FeSO₄ @ 100 ppm (FS) + Humic acid @ 0.1% (D), T₈: FeSO₄ @ 100 ppm (FS) + Humic acid @ 0.2% (D), T₉: Boric acid @ 20 ppm (FS) + Humic acid @ 0.1% (D), T₁₀: Boric acid @ 20 ppm (FS) + Humic acid @ 0.2% (D), T₁₁: Boric acid @ 40 ppm (FS) + Humic acid @ 0.1% (D), T₁₂: Boric acid @ 40 ppm (FS) + Humic acid @ 0.2% (D), T₁₃: Control (only water spray). Humic acid was applied through drenching at 20, 40 and 60 days after sowing, whereas micronutrients were applied as foliar sprays at 25, 45 and 65 days after sowing. The economics of different treatments were calculated based on the cost of cultivation, gross return, net return and Benefit: Cost (B:C) ratio.

2.1 Economics of Cultivation

The input and output costs were determined treatment-wise based on current market prices, and various economic measures, such as the net profit and Benefit: Cost ratio, were calculated.

Cost of Cultivation

Each treatment's cultivation costs were determined individually, accounting for all cultural customs used in cucumber production. The cost of cultivation varied slightly among the treatments due to differences in the application dose of humic acid and micronutrients.

Gross return

Gross return is the total monetary value of produce obtained from a unit area during a cropping season, calculated by multiplying the yield with the prevailing market prices, without deducting the cost of cultivation.

Net return

The net return for each treatment was calculated individually by using the following formula.

$$\text{Net return} = \text{Gross return} - \text{Total cost of cultivation}$$

Benefit Cost ratio

The economics of cucumber production under a walk-in net tunnel were calculated using the prevailing prices of inputs and produce. The income per rupee spent (B:C ratio) was estimated in order to determine the feasibility of the treatments.

$$\text{B:C ratio} = \frac{\text{Gross return (Rs. ha}^{-1}\text{)}}{\text{Cost of cultivation (Rs. ha}^{-1}\text{)}}$$

3. Results and Discussion

The economic analysis of different treatments is presented in Table 1. Significant variations were observed among the treatments with respect to gross return, net return, and Benefit: Cost (B:C) ratio. Among all the treatments, T₁₂ recorded the highest gross return (12,33,000 Rs. ha⁻¹), net return (8,61,748 Rs. ha⁻¹), and B:C ratio (3.32), which was primarily attributed to its higher marketable fruit yield. The enhanced economic returns may be due to the positive influence of humic acid and micronutrients on plant growth, yield, and fruit quality, leading to increased productivity and better market value. In contrast, T₁₃ recorded the lowest gross return (9,09,000 Rs. ha⁻¹), net return (5,49,319 Rs. ha⁻¹), and B:C ratio (2.53), which could be attributed to its comparatively lower yield despite having a similar cost of cultivation. The higher profitability achieved under the superior treatment indicates that the additional investment in micronutrient application was effectively compensated by the increased yield and economic returns. These findings are in agreement with those of Sidhu *et al.* (2020) [7], who reported a higher net return (6,28,660.38 Rs. ha⁻¹) and B:C ratio (3.58) with the combined application of [Zinc 30 ppm + Boron 40 ppm] in cucumber. Similar results were also reported by Akshata *et al.* (2023) [1], who observed that the combined application of salicylic acid and micronutrients significantly enhanced crop productivity and economic returns.

Table 1: Impact of humic acid and micronutrients application on economics of cucumber (1 hectare)

Treatments	Yield (q ha ⁻¹)	Cost of cultivation (Rs. ha ⁻¹)	Gross return (Rs. ha ⁻¹)	Net return (Rs. ha ⁻¹)	B:C ratio
T ₁	702	3,67,746	10,53,000	6,85,254	2.86
T ₂	712	3,71,178	10,68,000	6,96,822	2.88
T ₃	730	3,67,820	10,95,000	7,27,180	2.98
T ₄	737	3,71,252	11,05,500	7,34,248	2.98
T ₅	664	3,67,865	9,96,000	6,28,135	2.71
T ₆	677	3,71,297	10,15,500	6,44,203	2.74
T ₇	693	3,68,057	10,39,500	6,71,443	2.82
T ₈	698	3,71,489	10,47,000	6,75,511	2.82
T ₉	732	3,67,747	10,98,000	7,30,253	2.99
T ₁₀	752	3,71,179	11,28,000	7,56,821	3.04
T ₁₁	782	3,67,820	11,73,000	8,05,180	3.19
T ₁₂	822	3,71,252	12,33,000	8,61,748	3.32
T ₁₃	606	3,59,681	9,09,000	5,49,319	2.53

Selling price-15 Rs. kg⁻¹

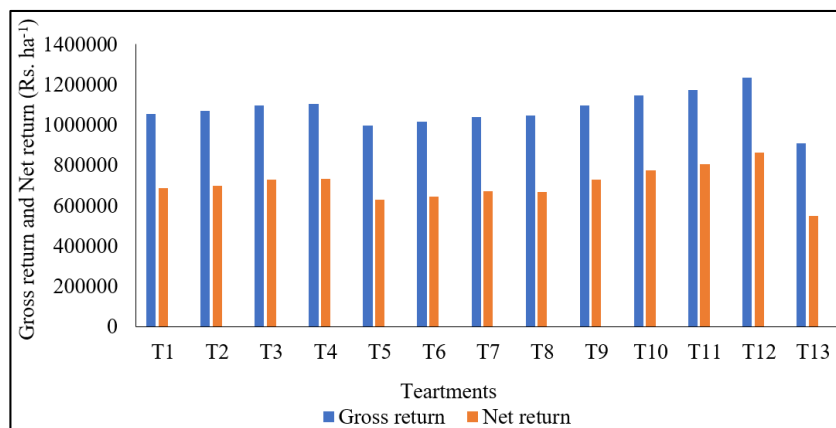


Fig 1: Impact of humic acid and micronutrients on Gross return and Net return (Rs. ha⁻¹)

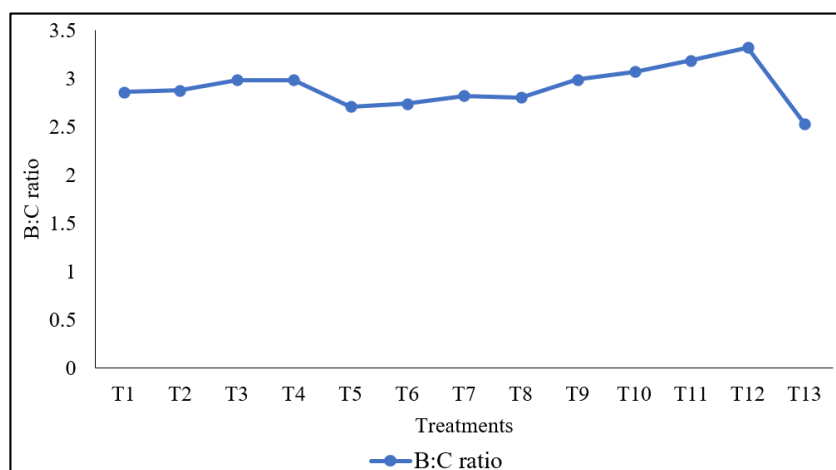


Fig 2: Impact of humic acid and micronutrients on B:C ratio

Conclusion

The result of Economic analysis conclude that the most profitable treatment was T₁₂ [Boric acid @ 40 ppm (Foliar spray) + Humic acid 0.2% (Drenching)], resulting in the greatest gross return, net return, and Benefit: Cost ratio. Therefore, this treatment may be recommended for commercial cultivation to generate more economic profits.

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