



ISSN Print: 2618-060X
 ISSN Online: 2618-0618
 NAAS Rating (2026): 5.20
 IJRA 2026; 9(10): 174-179
www.agronomyjournals.com
 Received: 25-07-2026
 Accepted: 22-09-2026
 Published: 06-10-2026

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Effect of thickness of vine cuttings and plant growth regulators on propagation of ivy gourd (*Coccinia grandis* L.)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i10c.6781>

ABSTRACT

Ivy gourd is a perennial, dioecious crop belonging to the family Cucurbitaceae and commonly known as kundru in hindi. The present investigation was carried out during 2025–26 at the nursery unit of Centre of Excellence on Protected Cultivation and Precision Farming (CoEPCPF), Indira Gandhi Krishi Vishwavidyalaya (IGKV), Raipur, Chhattisgarh, to identify the optimum cutting thickness and plant growth regulator (PGR) combination for economical and efficient vegetative propagation of ivy gourd (*Coccinia grandis* L.). Sixteen treatment combinations comprising four cutting thicknesses (C_1 : 0.60 cm, C_2 : 1.00 cm, C_3 : 1.40 cm and C_4 : 1.80 cm) and four PGR treatments (P_1 : IBA 1000 ppm + NAA 200 ppm, P_2 : IBA 2000 ppm + NAA 400 ppm, P_3 : IBA 3000 ppm + NAA 600 ppm and P_4 : water spray as control) were laid out in a Factorial Completely Randomized Design (FCRD) with three replications.

Thinner cuttings (C_1) sprouted earliest (8.67 days), whereas thicker cuttings (C_4) took longer (12.08 days) but subsequently recorded the highest sprouting (77.58%), rooting (75.17%), survival (73.00%) and success percentage (71.42%), along with the maximum number of roots (11.50), root length (23.45 cm) and root volume (8.87 ml); cutting thickness did not significantly affect root diameter. Among the PGR treatments, IBA 3000 ppm + NAA 600 ppm (P_3) recorded the highest rooting percentage (73.00%), root length, root volume and root diameter, while both auxin combinations were markedly superior to the water-sprayed control (P_4). The interaction of cutting thickness and PGR treatments showed that thicker vine cuttings combined with higher auxin concentrations, particularly C_4P_2 (1.80 cm vine cutting + IBA 2000 ppm + NAA 400 ppm) and C_4P_3 (1.80 cm vine cutting + IBA 3000 ppm + NAA 600 ppm), consistently produced maximum sprouting, rooting and success. The highest success percentage (79.67%) was recorded in C_4P_2 , followed by C_4P_3 (79.00%), whereas the lowest success percentage (49.00%) was observed in C_1P_4 (0.60 cm vine cutting + water spray).

The study reveals that vine cuttings of 1.80 cm thickness treated with IBA 2000 ppm in combination with NAA 400 ppm with $B:C = 3.47$ offer the most reliable and economically viable option for commercial vegetative propagation of ivy gourd. This was followed by C_4P_3 (1.80 cm vine cutting + IBA 3000 ppm + NAA 600 ppm), which recorded a $B:C = 3.42$.

Keywords: Ivy gourd, *Coccinia grandis* L., IBA, NAA, Vine cutting thickness, Vegetative propagation, Rooting, Benefit:cost ratio

Introduction

Ivy gourd (*Coccinia grandis* L.) is a relatively underutilized vegetable crop belonging to the family Cucurbitaceae, widely known by names such as tindora, kundru and scarlet gourd (Patel et al., 2021) [1]. It is a hardy, perennial, dioecious climber, predominantly cross-pollinated, and is cultivated across the southern, eastern and central regions of India, including several districts of Chhattisgarh. The immature fruits, tender shoots and leaves are used as a vegetable and the crop is valued for its therapeutic properties in the management of diabetes and other ailments, being rich in phenols, flavonoids, carotenoids and other bioactive compounds (Saini, 2021) [2].

Propagation of ivy gourd is achieved mainly through stem cuttings rather than seed, since seed propagation is associated with poor viability and a high proportion of non-fruitle male plants (Subbaiah et al., 2018) [3]. Expansion of the area under this crop is currently constrained by the limited availability of quality planting material, and successful establishment of cuttings depends on factors such as cutting thickness, physiological maturity and the use of plant growth regulators (PGRs). Auxins, particularly indole-3-butyric acid (IBA) and 1-naphthaleneacetic acid (NAA), promote cell division and adventitious root initiation at the base of cuttings and are widely used to enhance rooting, survival and establishment in vegetatively propagated horticultural crops (Farman et al., 2019; Bhardwaj et al., 2017) [5, 4].

Although the beneficial effect of IBA and NAA on rooting of ivy gourd cuttings has been documented (Bhardwaj et al., 2017; Jagdale et al., 2023) [4, 6], information on the combined effect of cutting thickness

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and auxin concentration, along with the resultant economics of propagation, remains limited. Keeping this in view, the present investigation was undertaken with the following objectives: (i) to study the effect of PGRs and their combinations on the propagation of ivy gourd; (ii) to study the effect of vine cutting thickness on root and shoot growth; and (iii) to work out the benefit:cost ratio.

Materials and methods

The field experiment was conducted during the *Rabi* season of 2025–26 at the nursery unit of Centre of Excellence on Protected Cultivation and Precision Farming (CoEPCPF), Department of Vegetable Science, College of Agriculture, IGKV, Raipur (C.G.), located at 289.56 m above mean sea level in the central plain agro-climatic zone of Chhattisgarh. Uniform, healthy, disease-free vine cuttings (variety Indira Kundru-35) of 15–30 cm length, bearing 3–5 nodes, were collected and graded into four thickness classes (0.60, 1.00, 1.40 and 1.80 cm diameter) using a digital Vernier caliper. The experiment comprised sixteen treatment combinations of four cutting thicknesses (Factor A) with four PGR treatments (Factor B; Table 1), laid out in a Factorial Completely Randomized Design with three replications and fifty cuttings per treatment.

Stock solutions of IBA (1000, 2000, 3000 ppm) and NAA (200, 400, 600 ppm) were prepared in ethyl alcohol and made up with distilled water. Before planting, cuttings were treated with 0.1% Carbendazim + Mancozeb for two minutes; the basal ends were then dipped in the respective PGR solution for 1–2 minutes and planted in polythene bags (8" × 6") containing a soil:sand:FYM (2:1:1) potting mixture. Control cuttings received only a water spray. Routine irrigation, a humic acid drench (2 ml/l) at 15 days after planting (DAP) and periodic 19:19:19 fertigation were provided as after-care.

Days to sprouting was recorded after planting and observations on sprouting percentage, survival percentage, rooting percentage, success percentage, number of roots, root length, root diameter, root volume, and dry weight of shoot and root were recorded at 90 DAP. These observations were taken from five randomly selected rooted cuttings from each replication.

Statistical analysis

The experimental data were analyzed using the Factorial Completely Randomized Design (FCRD) as described by Panse *et al.* (1985) [7]. The treatment effects were tested using the *F*-test at 5% probability level. Standard Error of Mean (*SEm*[±]) and Critical Difference (CD at 5%) were calculated when the treatment effect was significant. The cost of cultivation, gross return, net return and benefit:cost (B:C) ratio were calculated on a per-hectare nursery basis using a selling price of ₹30 per rooted cutting.

Results and discussion

Days to sprouting

Cutting thickness significantly influenced the number of days taken for sprouting; the thinnest cuttings (*C*₁, 0.60 cm) sprouted earliest (8.67 days), while the thicker cuttings, *C*₂ (1.00 cm) and *C*₄ (1.80 cm), required the longest period (12.08 days each). PGR treatments did not significantly affect days to sprouting, although *P*₂ recorded the numerically earliest average sprouting (10.08 days). The earlier sprouting of thinner cuttings may be attributed to their younger, more physiologically active tissue, in agreement with Padekar *et al.* (2018) [8], who reported earliest sprouting in tip cuttings of kartoli, and with Hartmann *et al.* (1990) [9], who also noted that older, more lignified wood is generally slower to sprout and root in many vegetatively propagated species.

Among the treatment combination the earliest sprouting (7.67 days) was recorded in *C*₁*P*₂ (0.60 cm cutting + IBA 2000 ppm + NAA

400 ppm), whereas the latest sprouting (13.33 days) occurred in *C*₄*P*₄ (1.80 cm cutting + water spray). Earlier sprouting under PGR treatment may be attributed to enhanced mobilization of stored carbohydrates, nitrogen and other growth substances, facilitating early bud activation. Similar findings were reported by Padekar *et al.* (2018) [8] in kartoli (*Momordica dioica*).

Sprouting percentage

Sprouting percentage was significantly influenced by both factors and their interaction (Table 2). Cutting thickness *C*₄ (1.80 cm vine cutting thickness) recorded the highest sprouting (77.58%) and *P*₃ (IBA 3000 ppm + NAA 600 ppm) the highest among PGR treatments (76.42%), while the interaction *C*₄*P*₃ (86.00%) and *C*₄*P*₂ (1.80 cm cutting + IBA 2000 ppm + NAA 400 ppm) (85.00%) were the best combinations, against the lowest in *C*₁*P*₄ (0.60 cm cutting thickness with water spray) (57.00%). The higher sprouting of thicker, auxin-treated cuttings may be ascribed to their greater reserves of carbohydrates and nutrients together with the stimulatory effect of auxin on cell division and bud break, corroborating the findings of Bhardwaj *et al.* (2017) [4] and Jayaganesh *et al.* (2025) [10] in ivy gourd and of Ayesha *et al.* (2018) [11] in dragon fruit.

Survival percentage

The data presented in Table 2 indicating that PGR combination and vine cuttings thickness significantly influenced survival percentage. Among the PGR treatments, *P*₃ (IBA 3000 ppm + NAA 600 ppm) recorded the highest survival (70.25%), followed by *P*₂ (67.92%) and *P*₁ (63.75%), while *P*₄ (water spray) recorded the lowest (54.83%). The interaction between cutting thickness and PGR significantly influenced survival, with *C*₄*P*₂ (1.80 cm cutting + IBA 2000 ppm + NAA 400 ppm) recording the highest survival (80.67%), followed by *C*₄*P*₃ (80.00%) and *C*₃*P*₃ (78.00%), whereas *C*₁*P*₄ (0.60 cm cutting + water spray) recorded the lowest (51.33%). The superior survival of thicker cuttings under PGR treatment may be attributed to greater carbohydrate reserves and enhanced root development, resulting in improved water and nutrient uptake. Similar responses have been reported in phalsa (Ghosh *et al.*, 2017; Ratnamala *et al.*, 2014; Devi *et al.*, 2016) [13, 14, 12].

Success percentage

Success percentage reflecting the proportion of cuttings that sprouted, rooted and survived as healthy established plants, was highest in *C*₄*P*₂ (79.67%), closely followed by *C*₄*P*₃ (79.00%), and lowest in *C*₁*P*₄ (49.00%) (Table 2). This cumulative pattern, mirroring the trend recorded for sprouting, rooting and survival, is consistent with observations in little gourd by Modi *et al.* (2019) [15] and in kartoli by Padekar *et al.* (2018) [8], and confirms the report of Bhardwaj *et al.* (2017) [4] that optimum IBA concentration enhances the overall establishment of ivy gourd cuttings by improving rooting efficiency and reducing desiccation at the cutting base.

Table 1. Treatment details of the experiment

Factor A: Thickness of vine cutting	Factor B: Plant growth regulator (PGR)
<i>C</i> ₁ – 0.60 cm	<i>P</i> ₁ – IBA 1000 ppm + NAA 200 ppm
<i>C</i> ₂ – 1.00 cm	<i>P</i> ₂ – IBA 2000 ppm + NAA 400 ppm
<i>C</i> ₃ – 1.40 cm	<i>P</i> ₃ – IBA 3000 ppm + NAA 600 ppm
<i>C</i> ₄ – 1.80 cm	<i>P</i> ₄ – Water spray (control)

(continued on next page)

Table 2. Interaction effect of vine cutting thickness (C) and PGR treatment (P) on days to sprouting, sprouting, survival and success percentage of ivy gourd cuttings

Treatment	Days to sprouting	Sprouting (%)	Survival (%)	Success (%)
T ₁ (C ₁ P ₁)	9.67	62.33	57.00	55.33
T ₂ (C ₂ P ₁)	13.00	64.00	57.67	56.33
T ₃ (C ₃ P ₁)	11.00	72.67	68.00	67.00
T ₄ (C ₄ P ₁)	12.00	76.33	72.33	70.33
T ₅ (C ₁ P ₂)	7.67	60.00	56.00	54.00
T ₆ (C ₂ P ₂)	11.67	62.00	58.00	56.33
T ₇ (C ₃ P ₂)	10.00	82.67	77.00	75.67
T ₈ (C ₄ P ₂)	11.00	85.00	80.67	79.67
T ₉ (C ₁ P ₃)	8.00	67.67	61.00	60.33
T ₁₀ (C ₂ P ₃)	11.00	68.33	62.00	60.67
T ₁₁ (C ₃ P ₃)	11.33	83.67	78.00	76.00
T ₁₂ (C ₄ P ₃)	12.00	86.00	80.00	79.00
T ₁₃ (C ₁ P ₄)	9.33	57.00	51.33	49.00
T ₁₄ (C ₂ P ₄)	12.67	60.33	53.00	51.67
T ₁₅ (C ₃ P ₄)	12.33	61.67	56.00	54.00
T ₁₆ (C ₄ P ₄)	13.33	63.00	59.00	56.67
SEm±	0.64	1.67	1.58	1.48
CD (5%)	NS	4.81	4.56	4.26
CV (%)	10.98	4.16	4.27	4.09

C₁ = 0.60 cm, C₂ = 1.00 cm, C₃ = 1.40 cm, C₄ = 1.80 cm thickness of vine cutting; P₁ = IBA 1000 ppm + NAA 200 ppm, P₂ = IBA 2000 ppm + NAA 400 ppm, P₃ = IBA 3000 ppm + NAA 600 ppm, P₄ = water spray (control). NS = non-significant.

Table 3. Effect of vine cutting thickness (C) and PGR (P) on days to sprouting, sprouting %, survival % and success % of Ivy gourd cuttings.

Factor	Days to sprouting	Sprouting (%)	Survival (%)	Success (%)
Vine cutting thickness (C)				
C ₁ (0.60 cm)	8.67	61.75	56.33	54.67
C ₂ (1.00 cm)	12.08	63.67	57.67	56.25
C ₃ (1.40 cm)	11.17	75.17	69.75	68.17
C ₄ (1.80 cm)	12.08	77.58	73.00	71.42
SEm (±)	0.32	0.83	0.79	0.74
CD (p = 0.05)	0.92	2.40	2.28	2.13
Plant growth regulator (P)				
P ₁ (IBA 1000 + NAA 200 ppm)	11.42	68.83	63.75	62.25
P ₂ (IBA 2000 + NAA 400 ppm)	10.08	72.42	67.92	66.42
P ₃ (IBA 3000 + NAA 600 ppm)	10.58	76.42	70.25	69.00
P ₄ (water spray, control)	11.92	60.50	54.83	52.83
SEm (±)	0.32	0.83	0.79	0.74
CD (p = 0.05)	NS	2.40	2.28	2.13

C = vine cutting thickness (C₁ = 0.60, C₂ = 1.00, C₃ = 1.40, C₄ = 1.80 cm diameter); P = plant growth regulator (P₁ = IBA 1000 ppm + NAA 200 ppm, P₂ = IBA 2000 ppm + NAA 400 ppm, P₃ = IBA 3000 ppm + NAA 600 ppm, P₄ = water spray). SEm(±) = standard error of mean; CD = critical difference; NS = non-significant.

Shoot and root growth parameters

Number of roots, root length, root volume, shoot dry weight and root dry weight increased significantly with cutting thickness, while number of roots, root length, root volume and shoot dry weight were also significantly higher under auxin treatment than in the water-sprayed control (P₄). Root diameter and root:shoot ratio were not significantly influenced by either factor (Table 5). The maximum shoot dry weight (12.29 g), root dry weight (2.98 g), number of roots (11.50), root length (23.45 cm) and root volume (8.87 ml) were recorded with C₄. Among PGR treatments, P₃ (IBA 3000 ppm + NAA 600 ppm) recorded the highest root length (23.02 cm), root diameter (1.74 mm), root volume (8.07 ml) and shoot dry weight (11.85 g), while P₂ (IBA 2000 ppm + NAA 400 ppm) recorded the highest root dry weight (2.39 g).

The superior root and shoot growth of thicker cuttings may be attributed to their greater carbohydrate and nutrient reserves and more developed vascular tissue, which support adventitious root initiation and shoot development, in agreement with Ahmadi *et al.* (2021) [16] in pomegranate. The enhancing effect of IBA and NAA on root number, length and biomass corroborates the reports of Ghosh *et al.* (2017) [13] and Ratnamala *et al.* (2014) [14] in phalsa, Muttaleb *et al.*, (2017) [17] in *Piper betle* and Devi *et al.* (2016) [12] in phalsa, who attributed the response to auxin-mediated cell division and mobilization of stored carbohydrates and nitrogen towards developing root and shoot primordia. Similar synergistic improvement in root volume with combined IBA + NAA application was reported by Pradhan *et al.* (2024) [18] in dragon fruit, and the higher root:shoot ratio recorded under lower auxin concentration (P₁) parallels the trend noted by Patil *et al.*

(2017) [19] in *Gmelina arborea*, where cutting characteristics influenced the balance of root and shoot biomass.

In the interaction effect, vine cutting thickness and PGR application significantly influenced root length and shoot dry weight while its effects on root number, root diameter, root volume, root dry weight, and root:shoot ratio remained statistically non-significant, suggesting that the two factors largely acted independently across most rooting parameters. Numerically, the treatment combination C₄P₂ consistently produced the most favourable results, recording the highest root number (12.35), root length (24.77 cm, significantly superior to most combinations and at par with C₄P₃ at 24.40 cm and C₄P₁ at 23.51 cm), root volume (9.33 ml), and root dry weight (3.57 g), while C₄P₃ recorded the highest root diameter (2.04 mm); in contrast, C₁P₄ consistently gave the lowest values across all parameters, including root number (7.64), root length (17.43 cm), root diameter (0.51 mm), root volume (4.94 ml), and root dry weight (1.18 g). This superior performance of thicker cuttings under PGR treatment can be attributed to their greater stored food reserves, which was combined with auxin-mediated adventitious root initiation, enhanced overall root development and biomass accumulation, while the balance between root and shoot growth also appeared to be governed largely by the independent action of cutting thickness and PGR rather than their interaction. These findings align with earlier reports of improved rooting

traits through cutting characteristics and auxin application, including enhanced root number in ivy gourd (Jayaganesh *et al.*, 2025) [10] and little gourd (Patoliya *et al.*, 2025) [20], improved root length in little gourd (Modi *et al.*, 2019) [15], independent effects of cutting maturity and IBA level on root diameter in *Piper betle* (Muttaleb *et al.*, 2017) [17], enhanced root volume through IBA + NAA application in dragon fruit without a marked interaction (Pradhan *et al.*, 2024) [18], non-significant cutting-diameter × IBA interaction for root dry weight despite higher biomass in thicker cuttings of pomegranate (Ahmadi *et al.*, 2021) [16], and comparable independent or auxin-driven effects on root:shoot ratio reported in *Gmelina arborea* (Patil *et al.*, 2017) [19].

Rooting percentage increased significantly with cutting thickness, from 59.00% in C₁ (0.60 cm) to 75.17% in C₄ (1.80 cm) (Table 5), and with PGR concentration, from 57.50% in the control (P₄) to 73.00% in P₃; (IBA 3000 ppm + NAA 600 ppm). The interactions C₄P₃ (1.80 cm cutting thickness + IBA 3000 ppm + NAA 600 ppm) (83.00%) and C₄P₂ (1.80 cm cutting thickness + IBA 2000 ppm + NAA 400 ppm) (82.67%) were statistically superior to all other combinations. Similar improvement in rooting with increasing cutting thickness has been reported in grapevine rootstocks by Doğan *et al.* (2016) [21] who also found that the interaction of cutting thickness and auxin concentration significantly influenced rooting success.

Table 4. Interaction effect of vine cutting thickness (C) and PGR (P) on shoot and root growth parameters of Ivy gourd cuttings.

Treatment	No. of roots	Root length (cm)	Root volume (ml)	Root diameter (mm)	Shoot dry weight(g)	Root dry weight (g)	Root:shoot ratio	Rooting (%)
T ₁ (C ₁ P ₁)	8.68	20.19	5.34	0.76	6.73	1.57	0.24	59.67
T ₂ (C ₂ P ₁)	8.97	22.52	7.46	1.03	6.63	1.62	0.25	60.33
T ₃ (C ₃ P ₁)	9.85	22.20	7.33	1.11	7.08	2.06	0.29	70.33
T ₄ (C ₄ P ₁)	11.95	23.51	8.85	1.87	8.54	3.13	0.37	75.00
T ₅ (C ₁ P ₂)	9.85	21.70	6.02	0.88	8.33	1.81	0.22	57.67
T ₆ (C ₂ P ₂)	9.63	19.48	6.92	1.15	9.14	1.88	0.21	60.33
T ₇ (C ₃ P ₂)	10.38	20.74	6.11	1.62	11.44	2.28	0.20	80.00
T ₈ (C ₄ P ₂)	12.35	24.77	9.33	1.95	16.95	3.57	0.21	82.67
T ₉ (C ₁ P ₃)	8.26	21.72	7.00	1.36	11.01	1.73	0.16	63.67
T ₁₀ (C ₂ P ₃)	10.00	23.54	7.87	1.65	10.37	2.16	0.21	65.00
T ₁₁ (C ₃ P ₃)	10.92	22.44	8.15	1.92	10.59	2.05	0.24	80.33
T ₁₂ (C ₄ P ₃)	11.80	24.40	9.25	2.04	15.45	3.23	0.21	83.00
T ₁₃ (C ₁ P ₄)	7.64	17.43	4.94	0.51	4.85	1.18	0.24	55.00
T ₁₄ (C ₂ P ₄)	7.94	17.87	5.96	0.83	5.74	1.42	0.25	56.33
T ₁₅ (C ₃ P ₄)	8.62	18.94	7.07	1.40	6.70	1.58	0.24	58.67
T ₁₆ (C ₄ P ₄)	9.88	21.13	8.06	1.61	8.21	2.00	0.25	60.00
SEm (±)	0.31	0.67	0.31	0.31	0.52	0.10	0.01	1.69
CD	NS	1.93	NS	NS	1.50	NS	NS	4.89
(p = 0.05)								
CV (%)	5.63	5.42	7.58	11.89	9.77	8.44	12.60	4.40

C = vine cutting thickness (C₁ = 0.60, C₂ = 1.00, C₃ = 1.40, C₄ = 1.80 cm diameter); P = plant growth regulator (P₁ = IBA 1000 ppm + NAA 200 ppm, P₂ = IBA 2000 ppm + NAA 400 ppm, P₃ = IBA 3000 ppm + NAA 600 ppm, P₄ = water spray). SEm = standard error of mean; CD = critical difference; CV = coefficient of variation; NS = non-significant.

Table 5. Effect of vine cutting thickness (C) and PGR treatment (P) on shoot and root growth parameters of ivy gourd cuttings (90 DAP)

Treatment	No. of roots	Root length (cm)	Root diameter (mm)	Root volume (ml)	Shoot dry wt. (g)	Root dry wt. (g)	Root: shoot ratio	Rooting (%)
C ₁	8.61	20.26	0.88	5.83	7.73	1.57	0.21	59.00
C ₂	9.14	20.85	1.17	7.05	7.97	1.77	0.23	60.50
C ₃	9.94	21.08	1.51	7.17	8.95	1.99	0.24	72.33
C ₄	11.50	23.45	1.87	8.87	12.29	2.98	0.26	75.17
P ₁	9.86	22.11	1.19	7.25	7.25	2.10	0.29	66.33
P ₂	10.55	21.67	1.40	7.09	11.46	2.39	0.21	70.17

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Treatment	No. of roots	Root length (cm)	Root diameter (mm)	Root volume (ml)	Shoot dry wt. (g)	Root dry wt. (g)	Root: shoot ratio	Rooting (%)
P3	10.24	23.02	1.74	8.07	11.85	2.29	0.20	73.00
P4	8.52	18.84	1.09	6.51	6.37	1.54	0.24	57.50
SEm (±) for C	0.15	0.33	0.15	0.15	0.26	0.50	0.008	0.84
SEm (±) for P	0.15	0.33	0.15	0.15	0.26	0.50	0.008	0.84
CD (5%) for C	0.45	0.96	NS	0.45	0.75	0.14	NS	2.44
CD (5%) for P	0.45	0.96	NS	0.45	0.75	NS	NS	2.44

NS = non-significant. Values are treatment means; C1–C4 and P1–P4 as defined in Table 2.

Economics of propagation

The cost of cultivation varied only narrowly among treatments (₹22,367–22,890/ha), the small difference being due to the cost of PGR used, whereas gross and net returns varied widely, being governed mainly by the sprouting, survival and success percentage achieved (Table 6). The maximum gross return (₹78,873.30/ha), net return (₹56,148.87/ha) and benefit:cost ratio (3.47) were recorded in C₄P₂ (1.80 cm cutting thickness + IBA 2000 ppm + NAA 400 ppm)

closely followed by C₄P₃ (1.80 cm cutting thickness + IBA 3000 ppm + NAA 600 ppm) (₹78,210.00/ha gross return; ₹55,319.57/ha net return; B:C 3.42), while the lowest gross return (₹48,510.00/ha), net return (₹26,142.57/ha) and B:C ratio (2.17) were recorded in C₁P₄ (0.60 cm cutting thickness + water spray).

The findings suggested that treatments enhancing rooting, survival and successful establishment substantially improve the economic efficiency of nursery propagation even without a proportionate increase in production cost.

Table 6. Economics of propagation of ivy gourd

Treatment	Cost of cultivation (₹/ha)	Gross return (₹/ha)	Net return (₹/ha)	B:C ratio
T ₁ (C ₁ P ₁)	22,558.43	54,776.70	32,218.27	2.43
T ₂ (C ₂ P ₁)	22,558.43	55,766.70	33,208.27	2.47
T ₃ (C ₃ P ₁)	22,558.43	66,330.00	43,771.57	2.94
T ₄ (C ₄ P ₁)	22,558.43	69,626.70	47,068.27	3.09
T ₅ (C ₁ P ₂)	22,724.43	53,460.00	30,735.57	2.35
T ₆ (C ₂ P ₂)	22,724.43	55,766.70	33,042.27	2.45
T ₇ (C ₃ P ₂)	22,724.43	74,913.30	52,188.87	3.30
T ₈ (C ₄ P ₂)	22,724.43	78,873.30	56,148.87	3.47
T ₉ (C ₁ P ₃)	22,890.43	59,726.70	36,836.27	2.61
T ₁₀ (C ₂ P ₃)	22,890.43	60,063.30	37,172.87	2.62
T ₁₁ (C ₃ P ₃)	22,890.43	75,240.00	52,349.57	3.29
T ₁₂ (C ₄ P ₃)	22,890.43	78,210.00	55,319.57	3.42
T ₁₃ (C ₁ P ₄)	22,367.43	48,510.00	26,142.57	2.17
T ₁₄ (C ₂ P ₄)	22,367.43	51,153.30	28,785.87	2.29
T ₁₅ (C ₃ P ₄)	22,367.43	53,460.00	31,092.57	2.39
T ₁₆ (C ₄ P ₄)	22,367.43	56,103.30	33,735.87	2.51

Conclusion

Thickness of vine cuttings and the concentration of plant growth regulators (IBA and NAA) both play a decisive role in determining the success of vegetative propagation of ivy gourd. Thicker vine cuttings (1.80 cm), owing to their greater reserve food materials and more developed vascular tissue, provide a more favourable base for sprouting, vegetative growth and root development than thinner cuttings, while treatment with IBA and NAA particularly at 2000 ppm + 400 ppm and 3000 ppm + 600 ppm, markedly improves sprouting, rooting and survival over untreated cuttings. This improvement translates directly into higher economic returns, the treatment combination of 1.80 cm thick cuttings treated with IBA 2000 ppm + NAA 400 ppm recording the highest net return and benefit:cost ratio. This combination may therefore be recommended as the most suitable and economically remunerative method for commercial propagation of ivy gourd under the agro-climatic conditions of Chhattisgarh.

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How to cite this article: Gayen R, Sahu S, Shankar D, Hathle R. Effect of thickness of vine cuttings and plant growth regulators on propagation of ivy gourd (*Coccinia grandis* L.). *International Journal of Research in Agronomy*. 2026;9(10):174-179. doi: <https://www.doi.org/10.33545/2618060X.2026.v9.i10c.6781>