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EFFECT OF TYPES OF CUTTINGS AND LEVELS OF INDOLE BUTYRIC ACID (IBA) ON ROOTING AND GROWTH OF MALPIGHIA (*MALPIGHIA COCCIGERA* L.)

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ABSTRACT

A field experiment was conducted at Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand, during *Kharif*-2024 to evaluate the effect of types of cuttings and levels of indole butyric acid (IBA) on rooting and growth of malpighia (*Malpighia coccigera* L.). The experiment was laid out in a Factorial Completely Randomised Design with two types of cuttings (semi-hardwood and hardwood) and four levels of IBA (0, 250, 500 and 750/ mg/l), forming eight treatment combinations replicated three times. Hardwood cuttings showed significantly superior performance, recording the highest number of sprouts and leaves per sprout (at 60, 90 and 120 DAP), number of roots per cutting, length of longest sprout, length of longest root, shoot fresh and dry weight, root fresh and dry weight at 120 DAP. Among IBA levels, 750/ mg/l recorded highest number of sprouts and leaves per sprout (at 60, 90 and 120 DAP), number of roots per cutting, length of longest sprout, length of longest root, shoot fresh and dry weight, root fresh and dry weight at 120 DAP. These findings suggest that propagation using hardwood cuttings treated with 750/ mg/l IBA is most effective for improving rooting and growth in Malpighia (*Malpighia coccigera* L.) under nursery conditions.

***Key words*:** Rotting, Types of cuttings, Growth, Propagation, Malpighia, indole butyric acid (IBA), Topiary, Ornamental crop

Introduction

Malpighia coccigera L., commonly known as Singapore Holly or Dwarf Holly, is an evergreen ornamental shrub valued for its compact growth habit, glossy foliage and attractive pink to white flowers accompanied by bright red berries. Native to Central and South America, it has gained prominence in tropical and subtropical regions, including the coastal belts of India, owing to its drought tolerance, aesthetic appeal and adaptability to diverse climatic and soil conditions (Dey *et al.*, 2018). The species is extensively used in landscaping, bonsai and topiary design due to its dense branching pattern, small leaves and ability to withstand frequent pruning. While seed propagation is constrained by poor germination and low seed viability, vegetative propagation through stem cuttings provides a reliable and efficient alternative for large-scale multiplication (Tripathi *et al.*, 2022; Beyl & Trigiano, 2016).

Therefore, the integration of suitable cutting types with optimal IBA concentrations constitutes a strategic approach to enhancing propagation efficiency, improving plant establishment, and boosting nursery performance in *Malpighia coccigera* L.

Material and Method

The study was conducted during the *Kharif* season of 2024 at the Flower and Ornamental Nursery, College of Horticulture, Anand Agricultural University, Anand, Gujarat, to assess the effect of cutting types and levels of indole-3-butyric acid (IBA) on rooting and growth of *Malpighia coccigera* L. The experiment followed a Factorial Completely Randomised Design (FCRD) with three replications, involving two cutting types (semi-hardwood and hardwood) and four IBA concentrations (0, 250, 500 and 750/ mg/l), forming eight treatment combinations. A total of 480 cuttings were planted in 5/ ×/ 7 inch polybags filled with a 1:1:1 mixture of soil, sand and vermicompost. Cuttings were 10–15/ cm in length and their basal ends were dipped in freshly prepared IBA solutions for 2 minutes before planting. Standard nursery practices were followed, including irrigation and disease management.

Result and Discussion

Effect of types of cuttings on rooting and growth of malpighia

Number of spouts per cutting

The number of sprouts per cutting in malpighia was significantly influenced by cutting type. Hardwood cuttings (C_2) produced more sprouts (4.70, 5.32 and 5.53 at 60, 90 and 120 DAP, respectively) than semi-hardwood cuttings (C_1), which recorded 4.02, 4.78 and 5.15. This may be attributed to the greater physiological maturity, higher carbohydrate reserves, and structural stability of hardwood cuttings, which enhance metabolic activity and bud break. Similar results were reported by Kumaresan *et al.*, (2019) in jasmine, Mehta *et al.*, (2018) in pomegranate and Malakar *et al.*, (2019) in acid lime.

Number of leaves per sprout

Hardwood cuttings (C_2) of malpighia exhibited a significantly higher number of leaves per sprout (12.92, 27.17 and 43.62 at 60, 90 and 120 DAP, respectively) compared to semi-hardwood cuttings (C_1), which recorded 6.98, 16.17 and 31.32 at the corresponding intervals. The increased leaf production in hardwood cuttings may be attributed to their greater maturity, thickness, and higher carbohydrate reserves, which support early sprouting and vigorous shoot elongation. These results are in agreement with Singh and Attri (2000) in West Indian cherry and Raut *et al.*, (2015) in pomegranate.

Number of roots per cutting

As presented in the Table, cutting type had a significant influence on root development in malpighia. Hardwood cuttings (C_2) produced a significantly higher number of roots per cutting (38.10) compared to semi-hardwood cuttings (C_1), which recorded 24.47 roots. This enhanced rooting response in hardwood cuttings may be attributed to their higher physiological maturity and greater carbohydrate reserves, including starch and soluble sugars, which provide essential energy and substrates for adventitious root initiation and development. These results are in conformity with the findings of Singh and Attri (2000) in west indian cherry (*Malpighia galbra* L.), Mahmood (2012) in Eranthemum and Kumaresan *et al.*, (2019) in jasmine.

Length of longest sprout (cm)

Hardwood cuttings (C2) recorded a significantly greater sprout length (26.42/ cm) compared to semi-hardwood cuttings (C1), which showed 20.90/ cm. This enhanced elongation may be attributed to the higher physiological maturity, greater carbohydrate reserves, and improved hormonal balance in hardwood cuttings, providing sustained energy for shoot growth. Their lignified structure and better rooting efficiency also improve water and nutrient uptake, further supporting sprout development (Hartmann *et al.*, 2011). These results are in agreement with findings by Rifnas *et al.*, (2021) in acalypha, Yeshiwas *et al.*, (2015) in rose, Savaliya *et al.*, (2021) in hibiscus, and Kumaresan *et al.*, (2019) in jasmine.

Length of longest root (cm)

The data revealed a significant influence of cutting type on the length of the longest root in malpighia. Hardwood cuttings (C_2) produced the longest roots (9.47/ cm), significantly exceeding the root length observed in semi-hardwood cuttings (C_1), which measured 7.94/ cm. This may be attributed to the greater physiological maturity and higher carbohydrate reserves in hardwood cuttings, which provide sustained energy for root elongation. Their fully lignified structure and higher levels of endogenous auxins further support both root initiation and extension (Hartmann *et al.*, 2011). These findings are consistent with those reported by Singh and Attri (2000) and Patil *et al.*, (2016) in West Indian cherry and Mahmood (2012) in Eranthemum.

Fresh weight of shoot (g)

The type of cutting had a significant influence on

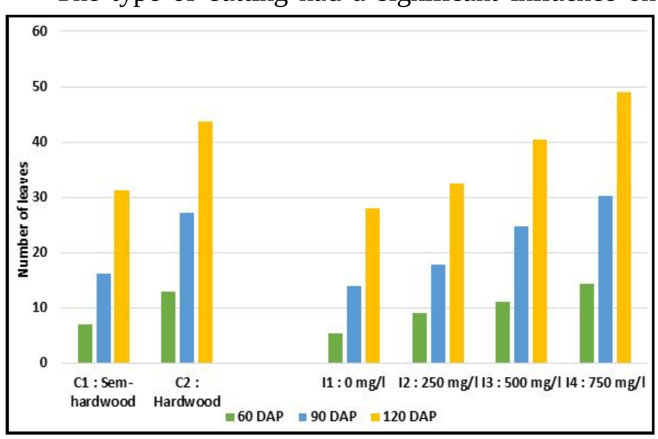

Fig. 1: Effect of types of cuttings and levels of indole butyric acid (IBA) on number of leaves of malpighia.

Table 1: Effect of types of cuttings and levels of indole butyric acid (IBA) in rooting and growth of malpighia.

Treatments	NSC			NLS			NRC	LLS	LLR	FWS	DWS	FWR	DWR
	60 DAP	90 DAP	120 DAP	60 DAP	90 DAP	120 DAP	120 DAP	120 DAP	120 DAP	120 DAP	120 DAP	120 DAP	120 DAP
Types of cuttings (C)													
C_1-Semi-hardwood	4.02	4.78	5.15	6.98	16.17	31.32	24.47	20.90	7.94	6.926	1.653	1.132	0.422
C_2- Hardwood	4.70	5.32	5.53	12.92	27.17	43.62	38.10	26.42	9.47	11.325	3.305	2.113	0.660
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
S.E (m) ±	0.08	0.08	0.09	0.22	0.55	0.88	0.46	0.39	0.16	0.160	0.044	0.029	0.008
C.D at 5%	0.24	0.26	0.29	0.66	1.65	2.65	1.38	1.18	0.49	0.480	0.133	0.087	0.025
Levels of indole butyric acid (I)													
I_{1-} 1000 PPM	3.50	4.07	4.23	5.40	13.83	27.90	20.63	20.83	7.03	7.418	2.059	1.509	0.502
I_{2-} 2000 PPM	3.93	4.83	5.07	9.10	17.87	32.47	27.37	22.45	8.26	8.846	2.432	1.596	0.532
I_{3-} 3000 PPM	4.67	5.33	5.70	10.97	24.77	40.47	35.10	24.82	8.98	9.503	2.568	1.640	0.547
I_{4-} 4000 PPM	5.33	5.97	6.37	14.33	30.20	49.03	45.05	26.53	10.55	10.736	2.858	1.766	0.583
F test	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
SE (m) ±	0.11	0.12	0.13	0.31	0.78	1.25	0.65	0.55	0.23	0.226	0.062	0.041	0.012
CD at 5 %	0.35	0.37	0.40	0.93	2.34	3.75	1.95	1.66	0.69	0.680	0.188	0.124	0.035
Interaction C × I													
F test	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.

NSC: Number of sprouts per cutting; **NLS:** Number of leaves per sprout; **NRC:** Number of roots per cutting; **LLS:** Length oflongest sprout (cm); **LLR:** Length of longest root (cm); **FWS:** Fresh weight of shoot (g); **DWS:** Dry weight ofshoot(g); **FWR:** Fresh weight of root (g); **DSR:** Dry weight of root (g)

shoot dry weight in malpighia. Hardwood cuttings (C_2) recorded the highest dry weight (3.305/ g), significantly surpassing semi-hardwood cuttings (C_1) (1.653/ g) at 120 DAP. This enhanced performance may be attributed to greater structural maturity, higher carbohydrate reserves and improved physiological efficiency. These attributes promote stronger root systems and more effective nutrient translocation, resulting in higher biomass accumulation. The results are consistent with those reported by Malakar *et al.*, (2019) in acid lime and Mahmood (2012) in eranthemum.

Dry weight of shoot (g)

As shown in the Table, cutting type had a significant effect on shoot dry weight in malpighia. Hardwood cuttings (C2) recorded the highest dry weight (3.305/ g), significantly exceeding that of semi-hardwood cuttings (C1), which produced 1.653/ g at 120 DAP. This increase may be attributed to the greater structural maturity, higher carbohydrate reserves, and physiological stability of hardwood cuttings, which promote stronger root systems and more efficient nutrient uptake. Reduced transpiration and better internal resource utilisation also contribute to higher dry matter accumulation. These findings align with those of Malakar *et al.*, (2019) in acid lime and Mahmood (2012) in eranthemum.

Fresh weight of root (g)

The type of cutting significantly influenced root fresh weight in malpighia. At 120 DAP, hardwood cuttings (C_2) showed the highest weight (2.113/ g), considerably more than semi-hardwood cuttings (C_1) (1.132/ g). This difference is likely due to the higher maturity, carbohydrate reserves, and structural integrity of hardwood cuttings, which enhance root initiation and growth. Improved moisture retention and reduced transpiration further support biomass accumulation. Similar trends were reported by Malakar *et al.*, (2019) in acid lime and Rifnas *et al.*, (2021) in acalypha.

Dry weight of root (g)

The type of cutting had a significant impact on root dry weight in malpighia at 120 DAP. Hardwood cuttings (C_2) recorded the highest dry root weight (0.660/ g), significantly exceeding that of semi-hardwood cuttings (C_1), which produced 0.422/ g. This advantage may stem from the greater carbohydrate reserves, structural maturity and lower water loss in hardwood cuttings, all of which favour root biomass accumulation. In contrast, the limited reserves and higher desiccation risk in semi-hardwood cuttings may restrict root development. Similar observations were reported by Rifnas *et al.,* (2021) in acalypha.

Effect of levels of indole butyric acid (IBA) on rooting and growth of malpighia

Number of sprouts per cutting

The number of sprouts per cutting in malpighia was significantly influenced by IBA concentrations. The highest number of sprouts (5.33, 5.97 and 6.37) was recorded in treatment I_4 (750/ mg/l IBA) at 60, 90 and 120 DAP, respectively, while the control (I_1) exhibited the lowest values (3.50, 4.07 and 4.23). The improved sprouting with IBA application may be attributed to enhanced cell division and elongation in meristematic tissues, along with better nutrient mobilisation and hormonal regulation. Similar findings were reported by Mehta *et al.,* (2018) in pomegranate.

Number of leaves per sprout

Among the IBA treatments, 750/ mg/l (I_4) resulted in the highest number of leaves per sprout (14.33, 30.20 and 49.03 at 60, 90 and 120 DAP, respectively), while the control (I_1) recorded the lowest (5.40, 13.83 and 27.90). The enhanced leaf production under I_4 may be attributed to elevated endogenous auxin levels promoting cell division, elongation, and meristem activity. Auxins such as IBA are known to stimulate vegetative growth by improving nutrient uptake and reserve mobilisation (Hartmann *et al.,* 2011). These findings align with Al-Zebari *et al.,* (2015) in citron and Kumaresan *et al.,* (2019) in jasmine.

Number of roots per cutting

IBA levels significantly affected the number of roots per cutting in malpighia. The highest root count (45.05) was observed with 750/ mg/l IBA (I_4), while the control (I_1) recorded the lowest (20.63). The enhanced rooting under I_4 may be attributed to the role of IBA in promoting cell division, differentiation, and root primordia development. At optimal concentration, IBA enhances auxin accumulation at the basal end, activates rooting enzymes like peroxidase and IAA-oxidase, and supports carbohydrate mobilisation to the rooting zone. These results are supported by Gontijo *et al*., (2003), Bharmal *et al.,* (2005), Sultana *et al.,* (2006), Singh and Negi (2014), and Sahariya *et al.,* (2013).

Length of longest sprout (cm)

The length of the longest sprout per cutting in malpighia was significantly influenced by IBA concentrations. The highest sprout length (26.53/ cm) was recorded with 750/ mg/l IBA (I_4), while the shortest (20.83/ cm) was observed in the control (I_1). The enhancement may be attributed to IBA's role in stimulating cell division, elongation, and vascular differentiation key for shoot development. Optimal levels also boost rooting and nutrient uptake, supporting sprout elongation. Additionally, IBA may induce gibberellin and cytokinin synthesis, unlike the control, were limited root and hormonal activity restricted sprout growth. These results align with findings by Sahariya *et al.,* (2013), Akhtar *et al.,* (2015), Netam *et al.,* (2018) and Alam (2018).

Length of longest root (cm)

The length of the longest root in malpighia was significantly enhanced by IBA application, with the highest value (10.55/ cm) observed at 750/ mg/l (I_4), compared to the shortest (7.03/ cm) in the control (I_1) at 120 DAP. This may be attributed to IBA's role in promoting cell division, elongation, and enzyme activity essential for root development. Improved vascular differentiation and nutrient absorption under optimal IBA levels likely supported greater root elongation. Similar results were reported by Gontijo *et al.,* (2003), Akhtar *et al.,* (2015), and Yeshiwas *et al.,* (2015).

Fresh weight of shoot (g)

Indole butyric acid (IBA) significantly influenced the fresh shoot weight in malpighia. The highest value (10.736/ g) was recorded with 750/ mg/l IBA (I_4), while the lowest (7.418/ g) occurred in the control (I_1). This improvement may be due to IBA's role in enhancing root development, which in turn supports better water and nutrient uptake, leading to increased shoot growth and turgidity. Additionally, IBA promotes the translocation of carbohydrates and hormones to the shoot apex, enhancing leaf expansion and biomass accumulation. Similar results were reported by Yeshiwas *et al.,* (2015) and Alam (2018).

Dry weight of shoot (g)

The dry shoot weight of malpighia was significantly influenced by IBA concentrations, with the highest value (2.858/ g) observed under 750/ mg/l IBA (I_4) and the lowest (2.059/ g) in the control (I_1) at 120 DAP. This increase may be attributed to the stimulatory effect of IBA on root development, which enhances water and nutrient uptake, thereby supporting greater shoot biomass accumulation. Additionally, IBA facilitates photosynthate translocation and activates enzymes involved in cell wall formation, contributing to increased dry matter. These findings are consistent with those of Akhtar *et al.,* (2015), Yeshiwas *et al.,* (2015), and Alam (2018).

Fresh weight of root (g)

The fresh root weight of malpighia was significantly influenced by IBA concentrations, with the highest value (1.766/ g) observed under 750/ mg/l IBA (I_4), while the lowest (1.509/ g) was recorded in the control (I_1) at 120 DAP. The increased root biomass under I_4 may be attributed to the promotive effect of IBA on root initiation and elongation, which enhances cell division, differentiation, and meristematic activity at the basal end of cuttings. IBA also stimulates enzyme activities such as peroxidases and polyphenol oxidases, facilitating root emergence and structural development (Hartmann *et al.*, 2011). These results align with the findings of Singh *et al.*, (2013), Singh and Negi (2014) and Akhtar *et al.*, (2015).

Dry weight of root (g)

The dry root weight of malpighia was significantly influenced by varying IBA concentrations, with the highest value (0.583/ g) observed under I_4 (750/ mg/l IBA) and the lowest (0.502/ g) recorded in the control (I_1) at 120 DAP. This enhancement may be attributed to the role of IBA in stimulating cell division, elongation, and differentiation in root meristematic tissues, promoting early and vigorous adventitious root formation. At the optimal concentration, IBA activates root-inducing enzymes like peroxidase and polyphenol oxidase and upregulates auxin-responsive genes that regulate root initiation and secondary thickening. Improved root development consequently enhances nutrient and water absorption, leading to higher dry matter accumulation. These findings are consistent with those of Gontijo *et al.*, (2003), Sahariya *et al.*, (2013), Singh *et al.*, (2013), Singh and Negi (2014), Gangani *et al.*, (2023), Akhtar *et al.*, (2015), Yeshiwas *et al.*, (2015) and Nasri *et al.*, (2015).

Conclusion

The results of this study clearly establish that both the type of cutting and levels of indole butyric acid (IBA) significantly influence the rooting and vegetative growth of malpighia. Hardwood cuttings exhibited superior rooting potential, shoot development and biomass accumulation compared to semi-hardwood cuttings. Among the IBA levels, 750/ mg/l proved most effective in enhancing all growth and root-related parameters. Although the interaction effect between cutting type and IBA concentration was statistically non-significant, the combination of hardwood cuttings with 750/ mg/l IBA (2-minute quick dip) consistently delivered the best outcomes across all observed traits. Therefore, this combination can be recommended as an efficient propagation method for malpighia under nursery conditions, ensuring improved rooting success, plant vigour and survivability for large-scale production.

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