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Studies on effect of auxin on rooting of stem cuttings of orange jasmine (*Murraya paniculata*)

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ABSTRACT

The present study investigates the effect of various auxin treatments on the rooting and shooting behavior of semi-hardwood stem cuttings of Murraya paniculata (orange jasmine), a valuable ornamental shrub in landscaping and floriculture. Conducted at Kittur Rani Channamma College of Horticulture, Arabhavi, the experiment tested ten treatments comprising different concentrations of indole-3-butyric acid (IBA), naphthaleneacetic acid (NAA), and their combinations. Results indicated that the combination of IBA and NAA at 3000 ppm significantly enhanced propagation success. This treatment led to the earliest shoot (15.33 days) and root (28.33 days) initiation, longest shoot (10.33 cm) and root (7.90 cm) lengths, and the highest shoot number (4.33), root biomass, rooting percentage (85%), and survival rate (80%). These improvements are attributed to the synergistic effect of the auxins in promoting cell division, elongation, and nutrient uptake. The study concludes that the application of IBA+NAA at 3000 ppm is an effective and practical method for mass propagation of Murraya paniculata, facilitating its widespread adoption in ornamental horticulture.

Keywords: *Semi-hardwood cuttings, rooting, auxins, IBA, NAA, rooting percentage and survival percentage.*

Introduction

Landscape and ornamental trees are an important part of human life. They provide shade and beauty around homes, schools, markets and shopping areas, places of work, along streets and highways, in city parks and other areas. They also help conserve energy and the quality of air, water and soil [13]. The utility and importance of shrubs in garden or landscape are universally acknowledged. A garden or landscape without shrubs loses its charm, attraction and beauty. In small gardens where the planting of trees is not possible, some of the selected shrubs find a place. Ornamental shrubs are the backbone of any garden. Introduction and placement of right ornamental shrub at right place enhances the beauty of garden. Shrubs are propagated by seeds and elite lines need to be propagated by cuttings [1].

Trees can have considerable effects on the microclimate of areas with heavy human populations. They absorb heat as they transpire, provide shade that reduces solar radiation, and reflection can reduce or increase wind speed, and can increase fog precipitation and snow deposition [7]. Trees can have a significant beneficial effect on the cost of winter heating and summer cooling of buildings. They break up urban "heat islands" by providing shade. It has been estimated that the shade provided by strategically placed trees near a residential home can reduce air conditioning costs by 30-50 percent, and trees planted as windbreaks around buildings can reduce winter heating energy use by 4-22 percent [5,12].

Vegetative propagation plays a pivotal role in the commercial cultivation and aesthetic enhancement of ornamental plants, offering a means for rapid multiplication and preservation of desirable traits[8]. Among various ornamental species, *Murraya paniculata*, commonly known as orange jasmine or mock orange is native to India, belongs to the Rutaceae family, holds significant value in floriculture and landscaping due to its attractive, glossy foliage, fragrant white blossoms, and suitability for hedging, bonsai, and avenue plantation [3]. This evergreen shrub not only enhances visual appeal but also contributes to air purification and biodiversity in urban green spaces [10]. Despite its horticultural appeal, the propagation of *Murraya paniculata* through seeds is often constrained by poor germination rates, genetic variability, and extended juvenile periods. Therefore, vegetative methods, particularly stem cuttings, are preferred to ensure uniformity and quicker establishment. However, the success of propagation via cuttings is frequently limited by the plant's inherent rooting difficulties, necessitating the use of rooting enhancers.

Auxins, a class of plant growth regulators, play a crucial role in adventitious root formation by stimulating cell differentiation and division at the base of cuttings[15]. The application of synthetic auxins such as indole-3-butyric acid (IBA) and naphthaleneacetic acid (NAA) has shown promising results in enhancing root initiation and development across various plant species[6]. Investigating the influence of different auxins on the rooting response of *Murraya paniculata* cuttings can provide valuable insights into developing effective propagation

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protocols, thereby promoting its wider adoption in ornamental horticulture. This study aims to investigate the effect of different types and concentrations of auxin on the rooting behavior of *Murraya paniculata* stem cuttings, with the goal of optimizing propagation techniques for improved success and uniformity.

Material and Methods

The experiment was carried out in the mist house of Department of Floriculture and Landscape Architecture, Kittur Rani Channamma College of Horticulture, Arabhavi, during December 2020 to June 2021. The maximum temperature during the experiment was 32.55 ºC and relative humidity of 88.59 percent. The *Murraya paniculata* cuttings of length 12-15 cm with one or two trimmed leaves were left on semi-hardwood cuttings. Slant cut was given at the base of each cutting, near to the node and three to four buds were retained. Cocopeat was used as the rooting media, and it was filled into the root trainers. There were ten treatments of auxin formulations used at different concentrations (Control, IBA at 1000 ppm, 2000 ppm, 3000 ppm, NAA at 1000 ppm, 2000 ppm, 3000 ppm and IBA+NAA at 1000 ppm, 2000 ppm, 3000 ppm); twenty cuttings were used for each treatment which was replicated thrice.

The prepared cuttings were dipped in different concentrations of auxins and their combinations. The basal 1.0-2.0 cm portion of the cuttings was dipped in an auxin formulation for 10 minutes and immediately planted in medium to a depth of 2 cm. After the planting, cuttings were placed in a mist house. The mist house had an arrangement for intermittent misting to 2 minutes every 30 minutes interval between 9 AM and 5 PM. The planted cuttings were allowed to root for 120 days. The cuttings were carefully removed from the trainers and washed in water to remove the soil particles adhering to roots to record the observations pertaining to roots, viz., days taken for root initiation, rooting percentage, length of longest root, fresh and dry weight, and per cent success after 120 days of planting. Various shoot characters observations were also recorded after planting. The data pertaining to root and shoot characters were tabulated. The experiment was laid Factorial Completely Randomized Design (FCRD) with 10 treatments replicated thrice and statistically analysed as per the methods outlined by Panse and Sukhatme (1967) [9]. The appropriate standard error of mean (S.Em. ±) and the critical difference (CD) was calculated at five per cent level of probability. Data has been depicted by suitable figures with the appropriate tables.

Results

Effect of auxins on days taken for shooting and number of shoots per cutting:

The data pertaining to days taken for shooting, number of shoots per cutting, and length of the longest shoot in *Murraya paniculata* cuttings treated with different concentrations of auxins is presented in Table 1. Days taken for shooting, number of shoots per cutting, and length of longest shoot differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in the minimum days taken for shooting (15.33 days), followed by the cuttings treated with IBA+NAA at 2000 ppm (19.00 days). The maximum day taken for shooting was found in control (45.00). The cuttings treated with IBA+NAA at 3000 ppm resulted in a maximum number of shoots (4.33), which is on par with the cuttings treated with IBA + NAA at 2000 ppm (4.0). The minimum shoot length was found in control (2.00). The length of the longest shoot differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in maximum shoot length (10.33 cm), followed by the cuttings treated with IBA+NAA at 2000 ppm (9.73 cm). The minimum shoot length was found in the control (3.40 cm).

Effect of auxins on root initiation and length of roots:

The data pertaining to days taken for rooting, length of roots, fresh and dry weight of roots in *Murraya paniculata* cuttings treated with different concentrations of auxins is presented in Table 2. Days taken for rooting initiation, length of roots, and fresh and dry weight of roots differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in minimum days taken for rooting (28.33 days), followed by the cuttings treated with IBA+NAA at 2000 ppm (34.00 days). The maximum day taken for rooting was found in the control (60.00 days). The Length of the longest root differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in a maximum length of root (7.90 cm), followed by the cuttings treated with IBA+NAA at 2000 ppm (7.40 cm). The minimum length of the root was found in the control (4.60 cm). The Root fresh weight differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in maximum fresh weight (0.81 g), which was on par with the cuttings treated with IBA+NAA at 2000 ppm (0.77 g). The minimum fresh weight was found in the control (0.16 g), and the root dry weight differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in maximum dry weight (0.18 g), followed by the cuttings treated with IBA+NAA at 1000 ppm (0.21 g). The minimum dry weight was found in the control (0.05 g).

Effect of auxins on rooting percentage and survival percentage of cuttings:

The data pertaining to the percentage of rooting and survival percentage of rooted cuttings of *Murraya paniculata* cuttings treated with different concentrations of auxins are presented in Figure 1. The percentage of rooting differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in maximum percentage of rooting (85.00%), followed by the cuttings treated with IBA+NAA at 2000 ppm (75.00%). The minimum percentage of rooting was found in the control (25.00%). Survival Percentage of rooted cuttings differed significantly among different auxins and their combinations. The cuttings treated with IBA+NAA at 3000 ppm resulted in maximum survival percentage (80.00%), followed by the cuttings treated with IBA+NAA at 2000 ppm (65.00%). The minimum survival percentage was found in the control (40.00%).

Table 1: Days taken for shooting, number of shoots, and length of shoot as influenced by different auxins in the cuttings of Murraya paniculata

Treatments	Days taken for shooting	Number of shoots	Length of shoot (cm)
T_1 : Control	45.00	2.00	3.40
T_2 :IBA @1000 ppm	43.33	2.67	4.13
T_3 :IBA @ 2000 ppm	39.00	3.00	4.80
T_4: IBA @ 3000 ppm	35.33	3.33	5.40
T_5: NAA @1000 ppm	33.67	3.00	6.40
T_6: NAA @ 2000 ppm	31.33	3.33	7.00
T_7: NAA @ 3000 ppm	28.67	3.33	7.40
T_8: IBA+NAA @1000 ppm	22.00	3.67	9.00
T_9: IBA+NAA @ 2000 ppm	19.00	4.00	9.73
T_{10}: IBA+NAA @ 3000 ppm	15.33	4.33	10.33
S.Em±	**0.70**	**0.87**	**0.11**
C.D @ 5%	**2.08**	**2.58**	**0.34**

DAP: Days after planting

Discussion

Shoot character

Minimum days taken for shooting were observed in the cuttings treated with IBA+NAA at 3000 ppm. The result may be due to the juvenility of cuttings and the synergetic effect of auxins, which helped in rapid and increased cell division. The results agree with the findings of [2] in *Gardenia thunbergia.* Application of IBA+NAA at 3000 ppm to the cuttings of *Murraya paniculata* found significant for the maximum number of shoots, which may be due to the suppression of apical dominance by the growth hormone which increases the number of shoots. The results are in accordance with [2] in *Gardenia thunbergia*. Treating the cuttings of *Murraya paniculata* with IBA + NAA at 3000 ppm resulted in the highest length of shoot, it may be due to the higher concentration of growth hormone increases cell division and better utilization of carbohydrates and nitrogen. The results agree with the findings of [2] in *Gardenia thunbergia.*

Root character

The cuttings treated with IBA+NAA at 3000 ppm resulted in minimum days for rooting, which may be due to translocation of endogenous auxin to the cut ends and exogenous IBA increased the cell division and cell elongation [16]. The results are in accordance with [2] in *Gardenia thunbergia.* The length of the root was significantly higher in the case of cuttings treated with IBA + NAA at 3000 ppm. Increased root length may be due to the early initiation of roots, leading to more consumption of nutrients. The results are similar to [2] in *Gardenia thunbergia*.
The cuttings which were treated with IBA+NAA at 3000 ppm resulted in maximum fresh weight of root, which might be due to high cell density and more uptake of nutrients and water, which adds to its weight [1]. The results are in accordance with [11] in *Cordyline terminalis*. The cuttings which were treated with IBA+NAA at 3000 ppm resulted in maximum dry weight of root, which might be due to high biomass in fresh root. The results are in accordance with [11] in *Cordyline terminalis*

Table 2: Days taken for rooting, length of longest root, Fresh and dry weight roots as influenced by different auxins in the cuttings of Murraya paniculata

Treatments	Days taken for rooting	Length of longest root (cm)	Fresh weight of roots (g)	Dry weight of roots (g)
T_1 : Control	60.00	4.60	0.16	0.05
T_2 :IBA @1000 ppm	58.33	4.73	0.19	0.06
T_3 :IBA @ 2000 ppm	54.00	5.00	0.24	0.07
T_4: IBA @ 3000 ppm	50.33	5.33	0.31	0.09
T_5: NAA @1000 ppm	48.67	6.17	0.35	0.09
T_6: NAA @ 2000 ppm	46.33	6.40	0.25	0.07
T_7: NAA @ 3000 ppm	43.67	6.80	0.42	0.19
T_8: IBA+NAA @1000 ppm	37.00	7.07	0.57	0.21
T_9: IBA+NAA @ 2000 ppm	34.00	7.40	0.77	0.15
T_{10}: IBA+NAA @ 3000 ppm	28.33	7.90	0.81	0.18
S.Em ±	**0.75**	**0.08**	**0.008**	**0.005**
C.D @ 5%	**2.22**	**0.23**	**0.02**	**0.01**

The highest rooting percentage was observed in cuttings treated with IBA + NAA at 3000 ppm. This result might be due to the exogenous application of higher concentrations of growth hormones which increased the rapid cell division which leads to early formation of callus and root growth [16]. The results are like [14] in poinsettia.

Survival percentage

Survival percentage was high in cuttings treated with IBA + NAA at 3000 ppm. This is because of a greater number of primary and secondary roots, with long roots might help in surviving after transplantation. Cerveny *et al*. (2006) observed good root growth and survival percentage in the cuttings of *Murraya paniculata,* which were treated with IBA + NAA at 1500 ppm [4].

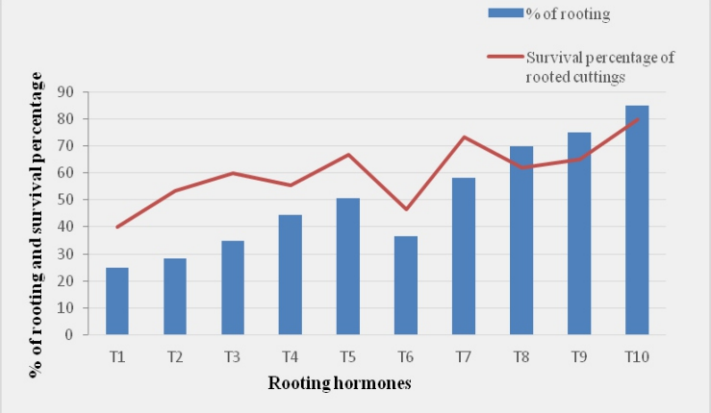

Fig. 1: *Percentage of rooting and survival percentage of cuttings as influenced by auxins in Murraya paniculata. WhereT_1 to T_{10} different concentrations of auxin (T_1: Control, T_2: IBA @1000 ppm, T_3: IBA @ 2000 ppm, T_4: IBA @ 3000 ppm, T_5: NAA @1000 ppm, T_6: NAA @ 2000 ppm, T_7: NAA @ 3000 ppm, T_8: IBA+NAA @1000 ppm, T_9: IBA+NAA @ 2000 ppm, T_{10}: IBA+NAA @ 3000 ppm).*

Conclusion

The present study demonstrated that the application of auxins, particularly the combination of indole-3-butyric acid (IBA) and naphthaleneacetic acid (NAA) at 3000 ppm, significantly enhanced rooting and shooting parameters in semi-hardwood stem cuttings of *Murraya paniculata*. Among all the treatments, IBA+NAA @ 3000 ppm resulted in the earliest shoot (15.33 days) and root (28.33 days) initiation, longest shoots (10.33 cm), longest roots (7.90 cm), and the highest rooting (85.00%) and survival (80.00%) percentages. This synergistic effect of IBA and NAA facilitated better cell division, differentiation, and nutrient uptake, contributing to improved root biomass and shoot development. These findings suggest that the use of IBA+NAA at 3000 ppm can be effectively recommended for the vegetative propagation of orange jasmine, enabling uniform, rapid, and large-scale multiplication of planting material for floriculture and landscaping purposes.

Future scope

- Further studies can explore intermediate concentrations of IBA and NAA (e.g., between 2000 ppm and 3000 ppm) to identify the most cost-effective and efficient dosage for commercial propagation.
- Research could assess the impact of environmental variables (e.g., temperature, humidity, light intensity) on the efficacy of auxin treatments to refine propagation protocols for different climatic zones.
- Studies on physiological mechanisms (e.g., hormone transport, gene expression) underlying the observed synergistic effects of IBA and NAA could deepen understanding of rooting processes.
- Exploring other vegetative propagation methods (e.g., air layering, grafting, tissue culture) for *Murraya paniculata* could complement cutting-based approaches, especially for elite or recalcitrant genotypes.
- Developing user-friendly auxin application kits or pre-treated cuttings could facilitate wider implementation among small-scale growers.

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