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Effect of different type of stem cuttings and plant growth regulators on rooting of *Jasminum multiflorum* (Pink Kakada)

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Abstract
Pertaining to the importance of jasmine, *Jasminum multiflorum* (Pink Kakada) can be a potential loose flower crop because of its year round flowering habit and colour full fragrant flowers. Though it naturally propagates through suckers, due to limited number of suckers, there is a need to find a solution for multiplication at commercial scale. Hence, the present experiment was conducted with three different type of cuttings along with different concentrations of growth regulators *viz.*, IBA, NAA and their combinations. The experiment was laid out in Factorial Completely Randomized Design with two factors and three replications. The results revealed that the terminal cuttings treated with IBA 500 ppm + NAA 250 ppm registered maximum survival percentage of rooted cuttings (85.36 %), along with increased length of shoots (15.09 cm), number of roots (19.35), length of roots (22.25 cm) and number of leaves per rooted cutting (39.54 cm), while hardwood cuttings showed least days taken for sprouting (11.18 days) and maximum number of sprouted buds (3.84) per cutting.

Keywords: Jasmine, types of cutting, growth regulator and rooting

Introduction
Jasmine is one of the most important tropical fragrant flowers of family Oleaceae and the genus *Jasminum* contains around 200 species (Dickey, 1969) [1]. Among large number of species presented, only three species (*J. sambac*, *J. grandiflorum* and *J. auriculatum*) have attained importance in commercial cultivation (Green and Miller, 2009) [2]. However, these three species have an off-season flowering period from October to February, while *J. multiflorum* (Pink Kakada) produces flowers throughout the year. This *J. multiflorum* can be used as an alternate crop for commercial *Jasminum* spp. during the off season period. In order to commercialize this species for cultivation, large scale multiplication is required but there are no such studies taken up so far on the propagation aspects. The difficulty existed in sexual reproduction of *J. multiflorum*, left the vegetative propagation as the only way for its multiplication. Among the vegetative propagation methods, stem cutting is the cheapest and easiest method of multiplication especially in case of jasmine.

The rooting ability and success percentage of cuttings depends on many factors such as variety, season, location, age of the mother plant, part of the plants used, nutrient status of the cutting, climatic conditions, aftercare etc. As well, plant growth regulators also play an important role in formation of roots and shoot growth in cuttings. Root commencement with the exogenous application of plant growth regulators occupies a significant role in the field of plant propagation (Mukherjee *et al.*, 1976) [3].

Cuttings treated with plant growth regulators at optimum concentration will induce rooting. Action of growth regulator is based on the concentration of hormone applied which differs with type of species and cuttings etc. Auxin is well known to improve rooting of different types of cuttings. The development of root primordium cells depends on the endogenous Auxins in the cutting and synergic composite such as a diphenol. These substances lead to the synthesis of ribonucleic acid (RNA), which act upon root primordium initiation (Hartmann *et al.*, 2002) [4]. Exogenous Auxins are commonly used to improve rooting efficiency and quality of stem-cuttings. Treatment of cuttings with rooting hormones has been reported to improve rooting in many woody and semi woody species. Hence, the present study has been taken up to standardize the method of propagation through stem cutting along with the treatment of plant growth regulator.

Materials and Methods

The present research work was conducted in the Department of Floriculture and Landscaping, Tamil Nadu agricultural university, Coimbatore, during June to September, 2018. The experiment was laid out in Factorial Completely Randomized Design (FCRD) with 3 replications and two factors: types of cutting and Auxins. The first factor comprised of three treatments *viz.*, hardwood cutting (C_1), semi hardwood cutting (C_2) and terminal cutting (C_3) and second factor contains 8 treatments *viz.*, distilled water (T_1), IBA 1000 ppm (T_2), IBA 1500 ppm (T_3), NAA 500 ppm (T_4), NAA 1000 ppm (T_5), IBA 500 ppm + NAA 250 ppm (T_6), IBA 750 ppm + NAA 500 ppm (T_7) and Keradix (commercial rooting powder) (T_8). The stem cuttings were taken from healthy mother plants (2 years old) in the field of Jasmine, TNAU, Coimbatore. Mature terminal cuttings of 10-15 cm with 8 to 10 leaves, past season growth of immature semi hardwood cuttings with 3-4 nodes without leaves and fully mature hardwood cuttings with 3-4 nodes without leaves were taken. A slant cut was given at the basal end and a transverse cut at the top of each cutting. The basal end (2.5- 3.0 cm) of the cuttings was dipped in 0.5% copper oxy-chloride solution for 10 minutes followed by growth regulator solutions. Then, the treated cuttings were planted vertically in polyethylene bags (10 cm diameter x 15 cm height). For keradix treatment, the basal end of the cutting (2.5-3 cm) was dipped in Keradix powder and cuttings were tapped to remove the excess powder. All cuttings were maintained under low cost polytunnel and watered regularly. Relative humidity in the tunnel was maintained at ≥ 85 % and temperature at 30 ± 2^0C. Further observations were recorded on various shoot and root parameters such as days taken for sprouting, number of buds sprouted, number of roots per cutting, root length (cm), shoot length (cm), number of leaves formed on cuttings and survival percentage (%). Data pertaining to various shoot and root parameters were tabulated and statistically analyzed using Factorial Completely Randomized Design (FCRD). The inference was drawn after comparing the calculated F values with the tabulated F values at 5 % (P= 0.05) level of significance.

Results and Discussion

Effect of types of cutting and growth hormones on shoot and root parameters

Days taken for sprouting and number of buds sprouted

In the present study, different type of cuttings showed significant influence on days taken for sprouting and number of sprouts per cutting (Table 1). It was observed that the number of days taken for sprouting was recorded least in hardwood cuttings (11.18 days) (C_1), while terminal cuttings (C_3) recorded maximum of 17.83 days and maximum number of sprouts per cutting (3.84) was higher in hardwood cuttings (C_1) while it was lower (2.48) in terminal cuttings (C_3). In respect of growth regulator treatments and interaction effects, the days taken for sprouting and number of sprouts per cutting found to be non-significant. The least days taken for sprouting and increased number of sprouts in hardwood cutting might be due to stored food materials (carbohydrates) which help to induce early sprouting of buds and also enhance the number of sprouts in cuttings. Similar results have been reported by Chandramouli, 2001 in *Stevia rebaudiana* (stevia) [5], Gupta *et al.*, 2002 in *Bougainvillea glabra* (bougainvillea) [6], Singh *et al.*, 2013 in *Cestrum nocturnum* (night jasmine) [7] and Singh, 2013 in *Thuja compacta* (Thuja) [8].

Table 1: Effect of different type of cuttings and growth regulator on shoot parameters of *Jasminum multiflorum* (Pink Kakada)

Parameters		Days taken for sprouting				Number of buds sprouted			
Growth regulator \ Cutting		C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	Control	12.23	14.52	17.54	15.10	3.26	3.02	1.84	2.71
T_2	IBA – 1000 ppm	11.26	13.65	17.21	14.04	3.90	3.32	2.07	3.10
T_3	IBA – 1500 ppm	10.50	13.04	16.32	13.62	3.95	3.24	2.00	3.06
T_4	NAA - 500 ppm	11.21	14.25	16.24	14.57	3.97	3.75	2.75	3.49
T_5	NAA - 1000 ppm	11.12	14.00	16.97	14.80	3.58	3.50	2.75	3.28
T_6	IBA - 500 ppm + NAA - 250 ppm	10.56	13.54	16.64	13.68	4.22	3.91	3.15	3.76
T_7	IBA - 750 ppm + NAA - 500 ppm	10.52	13.20	16.86	13.58	4.30	4.05	3.20	3.85
T_8	Keradix	11.85	14.24	17.45	14.85	3.51	3.70	2.07	3.09
Mean		11.18	13.82	17.83		3.84	3.56	2.48	
		S.Ed		CD		S.Ed		CD	
Cutting (C)		0.26		0.54		0.06		0.13	
Growth regulator (T)		NS		NS		NS		NS	
Interaction (C x T)		NS		NS		NS		NS	

Number of roots per cutting

An increased number of roots per cutting found in terminal cuttings (14.77) (C_3), while hardwood cutting showed a minimum of 3.74 (C_1). Among the Auxin treatments, IBA 500 ppm + NAA 250 ppm treated cuttings resulted in maximum number of roots (12.87) (T_6). Interaction effect of types of cutting and plant growth regulators showed significant effect, where maximum number of roots per cutting (19.35) observed in the terminal cuttings treated with IBA 500 ppm + NAA 250 ppm (C_3T_6). However, there is no root formation in hardwood cuttings (0.00) treated with NAA 500 ppm (C_1T_4) and1000 ppm (C_1T_5) and also in control (C_1T_1) (Fig. 1). The failure of rooting in hardwood cuttings may be due to the development of more number of vegetative shoots at initial stages, which might have caused reduced callus formation and root initiation. The number of roots in NAA treated cuttings was lesser than the IBA-treated cuttings which might be due to the reason behind that the indole compounds produce more number of fibrous roots in cuttings than the naphthalene compounds. Weisman *et al.*, 1988[9] reported that IBA is the most extensively used growth regulator to stimulate root initiation in cuttings because of its high ability to promote rooting, weak toxicity and great stability in comparison to NAA. The application of IBA may have indirect influence by enhancing the speed of translocation and movement of sugar to the base of the cuttings and consequently stimulate rooting (Haissig, 1974) [10]. This is in accordance with the findings reported by Singh *et al.*, 2013 in *Cestrum nocturnum* (night jasmine) [7], Zeinab and Hossein, 2014 in *Hibiscus rosa-sinensis* (hibiscus) [11], Singh and Singh, 2011 in *Bougainvillea glabra* (bougainvillea) [12] and Singh *et al.*, 2014 in *Duranta repens* (duranta) [13].

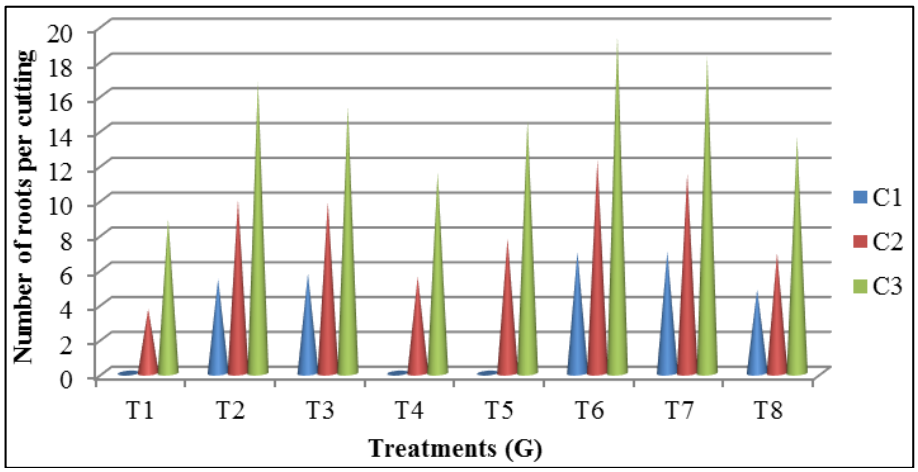


Fig 1: Effect of different type of cuttings and growth regulator on number of roots per cutting of *Jasminum multiflorum* (Pink Kakada)

Root length (cm)

In general, the increased number of roots per cutting resulted in reduced average length of roots. In this experiment, the maximum root length (16.29 cm) was recorded in terminal cuttings (C_3) and that of minimum in hardwood cuttings (4.63 cm) (C_1). In growth regulator treatments, the maximum root length (14.45) observed in IBA 500 ppm + NAA 250 ppm (T_6) treated cuttings, while minimum root length (6.26 cm) in control (T_1). Significant differences observed between types of cutting and IBA, NAA and their combinations. The maximum root length (22.25 cm) was observed in terminal cuttings treated with IBA 500 ppm + NAA 250 ppm (C_3T_6) followed by 17.36 cm in terminal cuttings treated with IBA 1000 ppm (C_3T_2) (Table 2). The increased root length might be due to early production of callus, differentiation of cells, greater cell elongation and differentiation of vascular tissue, which in turn Favoured the root growth. Shenoy, 1992 [14] in *Rosa damascena* reported that the increase in root length over control may be due to the enhanced hydrolysis of carbohydrates, metabolites accumulation and cell division induced by Auxin. These results were in line with the findings of Patil *et al.*, 1998 in *Jasminum sambac* (Jasmine) [15], Swamy *et al.*, 2002 in *Grewia optiva* (Bihul) and *Robinia pseudoacacia* (black locust) [16], Singh *et al*., 2010 in *Bougainvillea glabra* (bougainvillea) [17], Grewal *et al.*, 2005 in *Dendranthema grandiflora* cv. Snowball[18], Singh *et al.*, 2013 in *Cestrum nocturnum* (night jasmine) [7] and Sharma, 2014 in *Tagetes erecta* (marigold) [19].

Table 2: Effect of different type of cuttings and growth regulator on shoot and root parameters of *Jasminum multiflorum* (Pink Kakada)

Parameters		Root length (cm)				Shoot length (cm)				Number of leaves on cutting			
Cutting / Growth regulator		C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean	C_1	C_2	C_3	Mean
T_1	Control	0.00	5.54	13.23	6.26	0.00	4.74	5.57	3.44	0.00	13.25	15.67	9.64
T_2	IBA – 1000 ppm	6.45	9.85	17.36	11.22	4.25	6.83	10.99	7.36	16.89	25.38	31.52	24.60
T_3	IBA – 1500 ppm	7.53	10.61	17.21	11.78	6.29	7.46	12.10	8.62	18.05	26.78	33.84	26.22
T_4	NAA - 500 ppm	0.00	9.74	14.32	8.02	0.00	6.93	9.28	5.40	0.00	17.85	23.02	13.62
T_5	NAA - 1000 ppm	0.00	9.83	14.24	8.02	0.00	7.70	8.68	5.46	0.00	20.67	23.51	14.73
T_6	IBA - 500 ppm + NAA - 250 ppm	8.43	12.68	22.25	14.45	7.76	10.69	15.09	11.18	19.35	28.94	39.54	29.28
T_7	IBA - 750 ppm + NAA - 500 ppm	9.34	16.97	16.38	14.23	8.13	10.17	14.63	10.98	21.84	27.68	36.24	28.59
T_8	Keradix	5.34	6.84	15.34	9.17	4.15	5.76	8.49	6.13	13.46	14.65	22.41	16.84
Mean		4.63	10.25	16.29		3.28	7.53	10.60		11.19	21.9	28.21	
		SEd		CD		SEd		CD		SEd		CD	
Cutting (C)		0.214		0.430		0.141		0.283		0.390		0.785	
Growth regulator (T)		0.349		0.703		0.230		0.463		0.638		1.282	
Interaction (C x T)		0.606		1.218		0.399		0.802		1.105		2.220	

Shoot length (cm)

The maximum shoot length (10.60 cm) was recorded in terminal cuttings (C_3) and that of minimum (3.28 cm) (C_1) was recorded in hardwood cuttings, while the cuttings treated with IBA, NAA and their combinations showed significant differences that ranges between 3.44 cm to 11.18 cm. Interaction effect of cuttings and Auxin treatments recorded increased shoot length compared to control and it was found that terminal cuttings treated with IBA 500 ppm + NAA 250 ppm showed maximum shoot length of 15.09 cm (C_3T_6) followed by IBA 750 ppm + NAA 500 (14.63 cm) (C_3T_7) (Table 2). The increased shoot length of terminal cuttings may be due to the active root growth and more number of roots per cutting, which in turn increased the uptake of water and nutrients. In IBA and NAA treated cuttings, Auxin enhanced the cell division, cell elongation and production of protein synthesis which might have resulted in enhanced healthy vegetative growth. Similar findings were observed by Girisha *et al.*, 2012 in *Bellis perennis* (daisy) [20] and Singh and Negi, 2014 in *Tecoma stans* (yellow bells) [21].

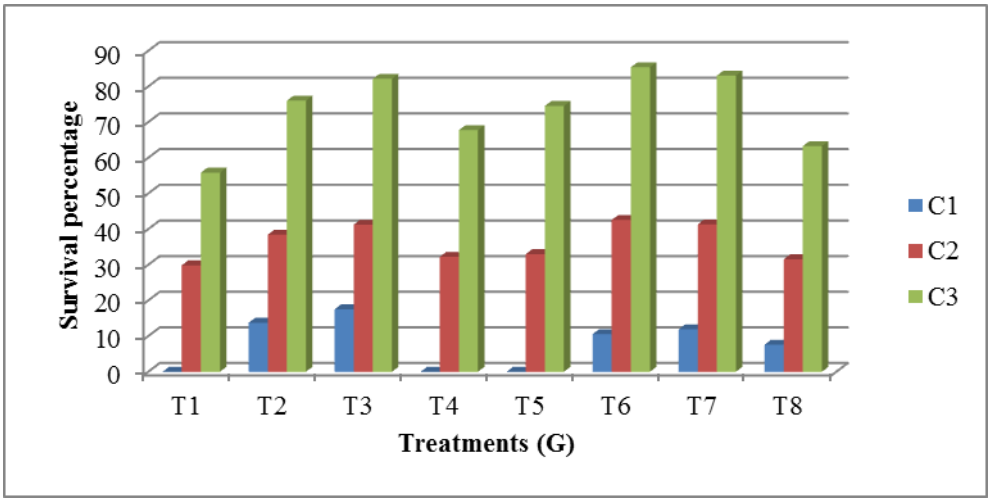
Number of leaves per cutting

There was a significant difference noticed in number of leaves per cutting, among different type of cuttings. The maximum number of leaves observed in terminal cutting (28.21) (C_3) and minimum was in hardwood cutting (11.19) (C_1). Interaction effect showed increased number of leaves (39.54) in terminal cuttings treated with IBA 500 ppm + NAA 250 ppm (C_3T_6) and followed by 36.24 leaves in IBA 500 ppm + NAA 250 treated terminal cuttings (C_3T_7), whereas no leaves

were observed in any hardwood cutting when treated with NAA at 500 ppm (C_1T_4) and 1000 ppm (C_1T_5) and also in control (C_1T_1) (Table 2). The increased number of leaves in terminal cuttings might be due to increased plant height and number of shoots. Evans, 1976[22] reported that exogenous applied auxin increases the number of leaves per cutting due to callus cell separation, cell expansion and protein synthesis which resulted in enhanced root growth, enhanced shoot growth and there by number of leaves increased. In case of hardwood cuttings, the shoots that are produced were dried slowly day by day due to the reason of failure of callus formation and root initiation. Similar findings were observed by Hirapara *et al.*, 2005 in *Jasminum arborescence* (jasmine)[23] and Singh *et al*., 2010 in *Bougainvillea glabra* (bougainvillea) [17].

Survival percentage

In case of survival percentage, there were significant differences observed among the different cuttings (Fig. 2). The terminal cuttings showed maximum survival percentage of 73.49 % (C_3) and minimum was found in hardwood cuttings (7.65 %) (C_1). Among plant growth regulator treatments, IBA 500 ppm + NAA 250 ppm showed maximum survival percentage (14.45 %) (T_4) while it was showed minimum in control (6.26 %) (T_1). Interaction effect between types of cutting and growth regulators indicated that the terminal cuttings treated with IBA 500 ppm + NAA 250 ppm recorded an increased survival percentage (85.36 %) (C_3T_6) followed by 83.03 % in IBA 750 ppm + NAA 500 ppm treated terminal cuttings (C_3T_7), whereas 100 % mortality observed in hardwood cuttings treated with NAA at 500 ppm (C_1T_4) and 1000 ppm (C_1T_5) and also in control (C_1T_1). The increased survival percentage in terminal cuttings may be due to the active development of root and shoot parameters which were poor in hardwood cuttings. Similar results were observed by Pooja (2010) in *Lonicera japonica* (Japanese honey suckle) [24] and Shenoy (1992) in *Rosa damascena* (damask rose) [25].



T1: Control
T2: IBA – 1000 ppm
T3: IBA – 1500 ppm
T4: NAA - 500 ppm
T5: NAA - 1000 ppm
T6: IBA - 500 ppm + NAA - 250 ppm
T7: IBA - 750 ppm + NAA - 500 ppm
T8: Keradix

C1: Hard wood cutting
C2: Semi hard wood cutting
C3: Terminal cutting

Fig 2: Effect of different type of cuttings and growth regulator on survival percentage of *Jasminum multiflorum* (Pink Kakada)

Conclusion

The present study can be concluded with that the terminal cuttings showed increased percentage of survival by showing good root and shoot growth compared to that of hardwood and semi hardwood cuttings. Among different concentration of IBA, NAA and their combinations, 500 ppm of IBA + 250 ppm of NAA combination was found to be most effective for improving rooting in terminal cuttings of *Jasminum multiflorum* (Pink Kakada) as it has enhanced faster multiplication of this species within a short period.

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