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RESEARCH ARTICLE

EFFECT OF GROWTH REGULATORS ON VEGETATIVE PROPAGATION AND GROWTH OF PATCHOULI (*POGOSTEMON CABLIN* (BLANCO) BENTH.) CUTTINGS

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ABSTRACT

The experiment was conducted to find out the vegetative propagation of patchouli (*Pogostemon cablin* (Blanco) Benth.) inside the mist chamber at Allahabad region of Uttar Pradesh, India . Three different sizes of stem cuttings (8, 10, and 12cms) of patchouli were dipped in different concentration of IBA (500, 1000, 1500 ppm) with control condition to check the best fit concentration in respect to its rooting behavior. It was observed that the rooting response of Patchouli varied with size of cuttings, season and concentration of IBA. The maximum plant height (14.93 cm), number of leaves (16.49) and collar diameter (4.92 cm), were recorded in the 12 cm cuttings with 500 ppm. Similarly patchouli cuttings treated with IBA-500 ppm registered equally high root length (6.46cm) and root number (82.36) with good root quality.

INTRODUCTION

India has a long tradition of more than 500 years as a supplier of fragment materials to western civilization in Greece, Rome and Egypt. Today there is a huge demand for oil of plant origin in view of their biosafety and unique aroma properties. Increasing demand for essential oil due to increasing population and standard of living obligates production of more and more essential oil (Saha *et al*., 1992). Aromatic crops are gaining importance as economically more lucrative crops than many traditional agricultural crops in different agro-ecosystems due to their demand for herbal aromatic products. As a result, aromatic crops are replacing traditional food crops in certain area, while they have been cultivated in modified cropping system in other areas. Introduction of highly profitable aromatic crops in the existing cropping system with completely replacing in traditional crops is strategy that has been acquired. The agro climatic conditions for introduction of Patchouli crop in South India are highly conducive apart from other aromatic crops like java citronella, lemongrass, Rosemary, Geranium and Vetiver etc. (Rao *et al.,* 2000). The Patchouli (*Pogostemon cablin* Benth.), (Syn. *P. Patchouli* Pellet.), belongs to the family Lamiaceae is the source of oil.

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Species is native of the Philippines, however it is also grown in Malaysia, Indonesia and Singapore. 0.5 -1.0 meter in height, it is a pubescent herb with erect branches, leaves are ovate to oblong-ovate and take 5-6 months to attain full growth. This crop can thrive for few years. However, the quantity of the oil decreases after 2-3 years age. The cultivation of Patchouli is reported to have started first in Java in 1895 with planting material imported from Singapore, though the identity of the species is uncertain (Seopadyo and Tong, 1968). Commercial cultivation of the Patchouli in India was first attempted by Tata Oil Mills in 1942. After the initial stray attempts to grow the crop, its systematic cultivation started in 1962 by Central Institute of Medicinal and Aromatic Plants (CIMAP) (Kumar *et al.,* 1986). The total annual world production of Patchouli oil is around 800-1000 tonnes. India imports Patchouli oil worth 60 million rupees annually. It is estimated that flavor and fragrance industry in India need about 200 tonnes of Patchouli oil (Puttanna *et al.,* 2005). However, the production of Patchouli oil in India is very negligible (Farooqi and Sreeramu, 2004). Patchouli oil is used in a wide range of toilet soaps, scents, body lotions, pre-shaved and after shave lotions and detergents. Its stong tenacity renders it particularly suitable for heavy perfumes and for imparting a lasting character and strength to lighter perfumes. In a very low concentration (0.002%) the oil is extensively used as a flavour ingredient. Considering the importance of this crop, it is

essential to generate enough planting material by using stem cuttings (jadhav *et al,* 2003). Auxins are playing a tremendous role in increasing rooting and apical bud dominance. Therefore, effect of different concentrations of auxins on rooting of patchouli was investigated

MATERIALS AND METHODS

Mist chamber experiment was conducted in School of Forestry and Environment, SHIATS-Deemed to be University at Allahabad India during seasons 2009-10 with complete Randomised Design (CRD). The climate of the region was humid with mean weekly minimum temperatures were 20.69^{o}C-20.48^{o}C and mean weekly maximum temperature was 33.88 ^{o}C-32.84 ^{o}C. The mean weekly maximum relative humidity was 76.05% and 77.37%, respectively during seasons 2009-10. The experiment of Patchouli (*Pogostemon cablin* benth.) were taken in strain "jahore" with three different size 8 cm, 10 cm, 12 cm. Each set of size were treated with different concentration of growth regulator IBA on mist chamber. The experiment was laid out with 12 cuttings per treatment. The cuttings were prepared by giving parallel cut. The length of three different size stem cuttings was 8, 10, 12 cm with 2-3 nodes per cuttings and these were dipped in different concentration of growth regulator at 0 ppm, 500 ppm, 1000 ppm and 1500 ppm for one minute and shifted in root trainers filled with good potting mixture. The root trainer planted with cuttings shifted in mist house for initiation of rooting. Thereafter, observation were recorded for different parameters of plant height, number of leaves per cuttings, collar diameter, root length, number of roots per cutting at 15 DAT and 30 DAT have been presented crop seasons 2009-10.

RESULTS AND DISCUSSION

Plant Height (cm)

Results of the present study are given in Table 1 to Table 5 (a, b). For 15 days observation in table mention a and b for 30 days. The different growth parameters of patchouli showed significant differences because of application of different growth regulator (IBA) concentrations as well as different size (8, 10, 12 cm) of stem cuttings. 12 cm size of stem cuttings treated with 500ppm plant height was observed maximum in T_1 (13.43 cm) followed by T_2 (12.84 cm) at 15 DAS. However, minimum plant height was observed in control (10.53 cm). At 30 DAS, maximum plant height was observed in T_1 (14.93 cm) followed by in T_2 (14.50 cm). However, minimum plant height was recorded in control (11.97 cm). Data on stem cuttings revealed that maximum plant height was observed in L_3 at 15 DAS (12.93 cm). However, minimum plant height was recorded in L_1 (11.84 cm). At 30 DAS, maximum plant height was found in L_3 (14.42 cm) whereas, minimum plant height was recorded in L_1 (13.22 cm). The IBA treatment may be complement by activating hydrolyzing enzymes at the rooting site which catalyses the starch degradation and thereby enable availability of sugars for rapidly multiplying cells at the site of root initiation (Prasad *et al.* 1980; Bhattacharjee *et al.* 1991; Venugopal *et al*. 2008).

No. of Leaves

The number of leaves was recorded maximum in T_1 (13.99) followed by T_2 (12.99), whereas, minimum number of leaves per plant was recorded in control (10.63) at 15 DAS. At 30 DAS, number of leaves per plant was observed maximum T_1 (16.49) followed by T_2 (15.94) and minimum was observed in control (12.40) during the crop seasons 2009-10. Among stem cuttings, maximum number of leaves were recorded in L_3 (13.12) and minimum number of leaves were observed in L_1 (11.15) at 15 DAS. At 30 DAS, maximum number of leaves per plant (15.43) was observed in L_3 however, minimum number of leaves was recorded in L_1 (14.15). The interaction was significant between size of stem cuttings and different concentrations of IBA for number of leaves during seasons 2009-10. The treatment combination of T_1L_3 (IBA 500 ppm+12 cm) produced higher number of leaves per cutting at 15 DAS and 30 DAS. The higher number of leaves was due to growth regulators in the soil which increased the activity of lateral meristem and uptake of more nitrogen by plants which were required to intensify vegetative growth Jadhav *et al.* (2003).

Collar diameter (cm)

The collar diameter was maximum in T_1 (4.32 cm) followed by T_2 (4.18 cm). However, minimum collar diameter was recorded in control (3.72 cm) at 15 DAS. At 30 DAS, collar diameter was observed maximum in T_1 (4.92 cm), followed by T_2 (4.56 cm). However, minimum collar diameter (4.04 cm) was observed in control. The stem cuttings showed maximum collar diameter in L_3 (4.10 cm) whereas, minimum diameter was recorded in L_1 (3.94 cm) after 15 DAS. At 30 DAS, maximum collar diameter was observed in L_3 (4.51 cm) and a minimum collar diameter was recorded in L_1 (4.35 cm). A similar interaction was observed between size of stem cuttings and concentration of IBA for collar diameter (Jadhav *et al*., 2003).

Root length (cm)

The stem cuttings treated with different concentrations of IBA observed with significantly higher root length. At 15 DAS and 30 DAS, root length was recorded maximum in T_1 (2.38 cm) followed by T_2 (2.00 cm) however, minimum root length was observed in T_0 (1.33 cm) at 15 DAS. The average root length was observed maximum in T_1 (6.46 cm), followed by T_2 (4.86 cm) whereas, minimum in T_0 (3.79 cm) at 30 DAS during both the year of study. The maximum root length was recorded in L_3 (2.01 cm) whereas, minimum root length was recorded in L_1 (1.72 cm). At 15 DAS, stem cuttings showed maximum root length in L_3 (5.24 cm) however, minimum was observed in L_1 (4.69 cm) at 30 DAS. A significant interaction was observed between lengths of stem cuttings and different concentrations of IBA for root length during year 2009-10. Higher root length was recorded in T_1L_3 (IBA 500 ppm+12 cm) at 15 DAS and 30 DAS. Increased root length was may be due to increased plant height, number of green leaves which may help in production of photosynthates and further supply to the roots in patchouli (Venugopal *et al.* 2008).

Number of roots per plant

The data showed that average number of roots per plant was maximum in T_1 (37.88) followed by in T_2 (26.40) however, minimum number of roots per plant was observed in control (17.69) at 15 DAS. The average number of roots per plant was

Table 1. (a, b) Effect of concentration of IBA on different length of stem cutting and their interaction on plant height (cm) of Patchouli under Nursery condition after 15 and 30 days after sowing (DAS)

(a) 15 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	8.87	13.27	12.73	12.50	11.84
L2 (10 cm)	10.30	13.33	12.83	12.60	12.27
L3 (12 cm)	12.43	13.70	12.93	12.67	12.93
Mean (T)	10.53	13.43	12.83	12.59	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.05	0.10	
Treatment of IBA		S	0.06	0.12	
Interaction (LXT)		S	0.10	0.20	

(b) 30 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	9.87	14.70	14.40	13.90	13.22
L2 (10 cm)	12.63	14.77	14.47	13.97	13.96
L3 (12 cm)	13.40	15.33	14.63	14.33	14.42
Mean (T)	11.97	14.93	14.50	14.07	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.02	0.04	
Treatment of IBA		S	0.02	0.04	
Interaction (LXT)		S	0.04	0.08	

Table 2. (a, b) Effect of concentration of IBA on different length of stem cutting and their interaction on number of leaves per plant of Patchouli under Nursery condition after 15 and 30 days after sowing (DAS)

(a) 15 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	8.70	13.83	12.83	9.23	11.15
L2 (10 cm)	10.73	13.87	13.07	12.52	12.52
L3 (12 cm)	12.57	14.27	13.07	13.12	13.12
Mean (T)	10.67	13.99	12.99	11.40	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.02	0.03	
Treatment of IBA		S	0.02	0.04	
Interaction (LXT)		S	0.03	0.07	

(b) 30 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	11.83	1613	15.90	12.73	14.15
L2 (10 cm)	12.63	16.17	15.97	14.17	14.73
L3 (12 cm)	12.73	17.17	15.97	15.83	15.43
Mean (T)	12.40	16.49	15.94	14.24	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.02	0.04	
Treatment of IBA		S	0.02	0.05	
Interaction (LXT)		S	0.04	0.08	

Table 3. (a, b) Effect of concentration of IBA on different length of stem cutting and their interaction on collar diameter (cm) of Patchouli under Nursery condition after 15 and 30 days after sowing (DAS)

(a) 15 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	3.57	4.22	4.10	3.87	3.94
L2 (10 cm)	3.77	4.30	4.20	3.90	4.04
L3 (12 cm)	3.83	4.43	4.23	3.90	4.10
Mean (T)	3.72	4.32	4.18	3.89	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.01	0.01	
Treatment of IBA		S	0.01	0.01	
Interaction (LXT)		S	0.01	0.02	

(b) 30 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	3.93	4.82	4.50	4.13	4.35
L2 (10 cm)	4.10	4.83	4.53	4.17	4.41
L3 (12 cm)	4.10	5.10	4.63	4.20	4.51
Mean (T)	4.04	4.92	4.56	4.17	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.01	0.01	
Treatment of IBA		S	0.01	0.01	
Interaction (LXT)		S	0.01	0.02	

Table 4. (a, b) Effect of concentration of IBA on different length of stem cutting and their interaction on root length (cm) of Patchouli under Nursery condition after 15 and 30 days after sowing (DAS)

(a) 15 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	1.20	2.23	1.87	1.57	1.72
L2 (10 cm)	1.27	2.30	2.03	1.60	1.80
L3 (12 cm)	1.53	2.60	2.10	1.80	2.01
Mean (T)	1.33	2.38	2.00	1.66	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.00	0.01	
Treatment of IBA		S	0.00	0.01	
Interaction (LXT)		S	0.01	0.01	

(b) 30 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	3.23	6.17	4.77	4.60	4.69
L2 (10 cm)	3.70	6.37	4.80	4.60	4.87
L3 (12 cm)	4.43	6.83	5.00	4.70	5.24
Mean (T)	3.79	6.46	4.86	4.63	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.01	0.01	
		S	0.01	0.02	
Treatment of IBA		S	0.01	0.03	
Interaction (LXT)					

Table 5. (a, b) Effect of concentration of IBA on different length of stem cutting and their interaction on number of roots per plant of Patchouli under Nursery condition after 15 and 30 days after sowing (DAS)

(a) 15 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	16.60	37.23	26.23	25.40	26.37
L2 (10 cm)	16.73	37.60	26.47	25.83	26.66
L3 (12 cm)	19.73	38.80	26.50	26.10	27.78
Mean (T)	17.69	37.88	26.40	25.78	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.04	0.08	
Treatment of IBA		S	0.04	0.09	
Interaction (LXT)		S	0.07	0.15	

(b) 30 days after sowing (DAS)

Length of Stem cutting (L)	Concentration of IBA (T)				Mean (L)
	T0 (0ppm)	T1 (500ppm)	T2 (1000ppm)	T3 (1500ppm)	
L1 (8 cm)	43.80	80.77	66.67	56.57	61.95
L2 (10 cm)	47.10	81.43	66.70	57.30	63.13
L3 (12 cm)	51.23	84.87	67.73	57.67	65.38
Mean (T)	47.38	82.36	67.03	57.18	
	F- test	S.Ed.(±)	C.D at 5 %		
Stem cuttings		S	0.09	0.18	
Treatment of IBA		S	0.10	0.20	
Interaction (LXT)		S	0.17	0.35	

maximum in T_1 (82.36) followed by T_2 (67.03), whereas, minimum number of roots per plant was observed in control (47.38) at 30 DAS during 2009-10. Among stem cuttings, maximum number of roots per plant was recorded in L_3 (27.78), whereas, minimum number of roots was observed in L_1 (26.37) at 15 DAS. However, maximum number of roots per plant was recorded in L_3 (65.38). At 30 DAS, minimum number of roots per plant was observed in L_1 (62.95) during the study year. Moreover, the control sample of rooting medium supported low development of root and shoots than the auxin treated samples in the entire experiments. This could perhaps because soil resistant to root penetration is dependent on amongst other factots on water content, structure and strength of soil as well as bulk densities though these were not measured in the rooting media (Amri et al. 2009). Meanwhile Number of roots at decrease concentration of IBA is attributed to more root length per cuttings and vegetative growth of per cuttings by utilizing applied IBA at low concentration in patchouli (Selvarajan and Madhava Rao 1981; Bhattacharjee *et al.* 1992). All the treatments showed non- significant interactions among them.

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