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Effect of rooting media and IBA (Indole butyric acid) levels on rooting and survival of AIR layering in fig (*Ficus carica* L.) cv. POONA under middle Gujarat agro-climatic conditions

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ABSTRACT : An experiment was carried out at Horticultural Research Farm, Department of Horticulture, B. A. College of Agriculture Anand during *Kharif* season in the year 2012. The treatments comprised the combinations of rooting media *i.e.* soil, organic media (Vermicompost/Poultry manure) and water holding materials (Sphagnum moss/Coco peat) in the ratio of 60:30:10 g along with various IBA levels (1000, 2000 and 3000 mgL^{-1}) and compared with soil alone (control). The experiment was laid out in CRD with three replications. The air layers made with soil + poultry manure + sphagnum moss + 3000 mg L^{-1} IBA showed early root initiation (8.73 days), minimum days required for bulk appearance of roots (20.80), highest number of primary roots *i.e.* 39.20 and 58.87 at 30 and 45 days, maximum secondary roots *i.e.* 155.93 and 250.73 at 30 and 45 days, maximum primary root length *i.e.* 16.53 and 17.48 cm at 30 and 45 days, maximum secondary root length *i.e.* 2.36 and 3.37 cm at 30 and 45 days, maximum fresh weight of shoot biomass *i.e.* 34.10, 35.96 and 43.53 g at 45, 60 and 75 days after planting of fig air layers, maximum fresh weight of root biomass *i.e.* 5.63, 6.63 and 7.73 g at 45, 60 and 75 days after planting of fig air layers, maximum dry weight of shoot biomass *i.e.* 16.49, 24.91 and 30.88 g at 45, 60 and 75 days after planting fig air layers, maximum dry weight of root biomass *i.e.* 1.65, 2.13 and 2.81 g at 45, 60 and 75 days after planting of fig air layers, maximum survival percentage of air layers *i.e.* 90.93, 88.53 and 83.46 and number of new leaves *i.e.* 4.60, 6.53 and 8.86 at 45, 60 and 75 days of air layers in the poly bag after planting, respectively with highest economics (Net CBR 1:3.34).

KEY WORDS : Air layering, Rooting media, Organic media, Water holding materials, IBA, Fig

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Fig (*Ficus carica* L.) is an ancient and important deciduous fruit crop in tropical and subtropical countries and belongs to the family "Moraceae". Its calorific value is 260. Fig is rich source of protein, calcium, iron and dietary fiber (Chadha, 2007). Fig is propagated through sexual and asexual methods. In sexual method, seed is employed only to produce new varieties by hybridization and for root stock purpose. In asexual method, it can be successfully propagated by cuttings, air layering, grafting and budding. Among all the asexual techniques, the cutting is easiest method but rooting in hard wood cuttings is the fundamental problem in the practical application, whereas air layering in fig is the oldest technique in asexual propagation, because air layering is simple and rapid method of fig propagation. It does not require any special techniques as in the case of grafting and budding. The roots are developed from the aerial parts of a plant after the shoots are girdled and enclosed in a moist rooting medium. This method is also known as Chinese layerage or pot layerage or marcottage or circumposition or gottee (Bose, 2003).

RESEARCH METHODS

The experiment was carried out in Completely Randomized Design with three replications at Horticultural

Research Farm, Department of Horticulture, B. A. College of Agriculture, Anand, Gujarat during July 2012. Total 13 treatments comprised the combination of (1) Soil (2) Organic media (Vermicompost and poultry manure) (3) water holding materials (Sphagnum moss and coco-peat) in the ratio of 60:30:10 g along with different IBA levels (1000, 2000 and 3000 mgL^{-1}) and compared with soil alone (control). The experimental unit consisted of twenty five shoots in each treatment.

Eight year old, healthy, well manured, uniform and vigorous plants were selected for the study. One year old shoots having pencil thickness were tagged on the selected plants. Etiolation and air layering was done in the present experiment. In etiolation practice the basal portion of the newly emerged shoot was kept under complete darkness by covering them with a black polyethylene cover and the terminal portion was allowed to grow in normal light conditions. After sufficient time (*i.e.* for 15 days) black polyethylene cover was removed and after that removing a ring of bark about 2.5-3 cm long carefully by giving two circular cuts with a sharp knife was done. After seven days IBA paste was applied on ring of base to selected shoots on the same day the selected shoots were wrapped with polyethylene sheet having selected organic media, water holding media and then tied with plastic string and kept for rooting. The period of observation of root characters was 45 days after layering and air layers separated by given three installation cut at an interval of one week, so as to reduce the sock of sudden detachment. After detachment of air layers transplanted in the poly bag (10×15 cm) containing soil, sand and FYM in the ratio of 1:1:1 and establishment percentage was taken at 75 days after planting in poly bags under net house.

RESEARCH FINDINGS AND DISCUSSION

The results revealed that all the treatments significantly induced early root initiation of air layers and improved root parameters (Table 1). Among the treatments, significantly minimum days (8.73) required for root initiation of air layers was in T_{10} (soil + poultry manure + sphagnum moss + 3000 mgL^{-1} IBA) while in control recorded 18.20 days. This treatment also recorded minimum number of days (20.80) for bulk appearance of roots, highest number of primary roots (39.20 and 58.87), secondary roots (155.93 and 250.73), maximum primary root length (16.53 and 17.48 cm) and secondary root length (2.36 and 3.37 cm), respectively at 30 and 45 days of air layering in fig. Whereas the minimum value of these characters were recorded under control. The early root initiation with the use of sphagnum moss might be due to its higher water holding capacity with good aeration. IBA at 3000 mgL^{-1} was significantly superior over rest of the concentrations for early initiation of roots. The response of IBA with increasing concentration might be due to the activity of auxin at cambial may be adequate for initiating root primordial (Bhagat *et al.*, 1999) the minimum number of days for bulk appearance of roots was due to high moisture holding capacity and aeration in sphagnum moss as well as phosphorus supply from poultry manure (Kumar *et al*., 2004).The maximum number of primary and secondary roots might be due to hormonal effect leading to accumulation of internal substances and their downward

Table 1: Effect of rooting media and IBA levels on root characters at 30 and 45 days of layering of fig (*Ficus carica* L.) cv. POONA

Tr. No.	Treatments *	Days required for root initiation	Days required for bulk appearance of roots	Number of primary roots		Number of secondary roots		Maximum length of primary roots (cm)		Maximum length of secondary roots (cm)	
				30 days	45 days	30 days	45 days	30 days	45 days	30 days	45 days
T_1	Control	18.20	29.66	19.73	31.93	72.13	110.60	5.12	7.62	1.25	1.93
T_2	VC+SM+1000 mgL^{-1}IBA	13.67	28.80	27.46	39.20	121.80	213.87	8.53	10.59	1.78	2.33
T_3	VC+SM+2000 mgL^{-1} IBA	12.80	28.46	27.60	43.20	123.66	217.20	9.30	11.47	1.88	2.45
T_4	VC+SM+3000 mgL^{-1} IBA	12.00	26.06	30.13	44.13	130.06	221.07	11.17	12.56	1.94	2.52
T_5	VC+CP+1000 mgL^{-1} IBA	14.13	29.13	23.53	37.53	107.60	173.40	7.63	9.46	1.38	2.06
T_6	VC+CP+2000 mgL^{-1} IBA	13.93	26.33	25.53	42.33	113.20	189.13	8.45	11.50	1.43	2.17
T_7	VC+CP+3000 mgL^{-1} IBA	11.83	25.66	29.13	42.67	119.40	195.27	9.59	11.91	1.62	2.34
T_8	PM+SM+1000 mgL^{-1} IBA	12.13	23.60	32.93	50.40	144.53	234.07	13.50	15.65	2.33	3.04
T_9	PM+SM+2000 mgL^{-1} IBA	10.80	22.80	35.40	54.53	145.93	239.93	14.56	16.45	2.34	3.20
T_{10}	PM+SM+3000 mgL^{-1} IBA	8.73	20.80	39.20	58.87	155.93	250.73	16.53	17.48	2.36	3.37
T_{11}	PM+CP+1000 mgL^{-1} IBA	12.67	27.27	30.86	45.80	127.53	220.40	12.57	14.59	2.11	2.76
T_{12}	PM+CP+2000 mgL^{-1} IBA	12.40	26.00	31.66	47.67	131.80	221.67	13.23	15.59	2.12	2.83
T_{13}	PM+CP+3000 mgL^{-1} IBA	12.20	24.27	32.26	53.80	132.33	225.20	14.97	16.47	2.16	2.95
	S.E. ±	0.78	0.70	1.09	1.44	4.10	6.32	0.72	0.64	0.07	0.07
	C.D. (P=0.05)	2.29	2.04	3.18	4.21	11.93	18.39	2.10	1.87	0.21	0.23
	C.V. %	10.74	4.67	6.39	5.51	5.69	5.25	11.22	8.47	6.81	5.28

* VC= Vermi compost, SM= Sphagnum moss, PM= Poultry manure, CP= Coco peat

movement as well as more cell division. The maximum length of primary and secondary roots was might be due to higher concentration of IBA stimulated faster growth of roots resulting in maximum length as reported by Tyagi and Patel (2004).

The fresh weight of shoot and root biomass of air layers was significantly influenced by different treatments (Table 2). Among the treatment combinations, T_{10} (soil + poultry manure + sphagnum moss + 3000 mgL^{-1} IBA) showed maximum fresh weight of shoot biomass (34.10, 35.96 and 43.53 g) and fresh weight of root biomass (5.63, 6.63 and 7.63 g), respectively at 45, 60 and 75 days after planting fig air layers. This effect might be due to nutrient supply from poultry manure and more water holding capacity of sphagnum moss increased

Table 2 : Effect of rooting media and IBA levels on fresh and dry weight of shoot and root at 45, 60 and 75 days after planting air layers of fig (*Ficus carica* L.) cv. POONA

Tr. No.	Treatments *	Fresh weight of shoot (g)			Dry weight of shoot (g)			Fresh weight of root (g)			Dry weight of root (g)		
		45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days	45 days	60 days	75 days
T_1	Control	16.49	18.05	23.54	5.78	7.79	8.86	3.28	3.82	4.93	0.50	0.77	1.34
T_2	VC+SM+1000 mgL^{-1}IBA	25.21	26.35	33.88	10.58	15.18	18.12	4.08	5.37	6.34	1.07	1.52	1.98
T_3	VC+SM+2000 mgL^{-1} IBA	26.27	28.32	35.90	11.55	16.37	19.56	4.25	5.39	6.49	1.11	1.74	2.15
T_4	VC+SM+3000 mgL^{-1} IBA	27.18	29.49	37.79	12.33	18.59	21.96	4.45	5.47	6.53	1.23	1.90	2.16
T_5	VC+CP+1000 mgL^{-1} IBA	21.62	24.81	30.91	10.33	14.56	17.23	3.95	5.06	6.04	1.00	1.44	1.86
T_6	VC+CP+2000 mgL^{-1} IBA	23.64	26.71	33.54	11.24	15.51	18.50	4.06	5.19	6.13	1.05	1.52	1.99
T_7	VC+CP+3000 mgL^{-1} IBA	24.28	27.91	33.25	12.39	17.63	21.37	4.13	5.22	6.25	1.16	1.60	2.07
T_8	PM+SM+1000 mgL^{-1} IBA	28.76	30.55	37.64	14.38	20.54	24.89	5.15	5.92	6.31	1.32	1.89	2.21
T_9	PM+SM+2000 mgL^{-1} IBA	31.44	32.39	39.29	15.52	22.79	27.61	5.37	6.03	7.06	1.44	1.93	2.26
T_{10}	PM+SM+3000 mgL^{-1} IBA	34.10	35.96	43.53	16.49	24.91	30.88	5.63	6.63	7.63	1.65	2.13	2.81
T_{11}	PM+CP+1000 mgL^{-1} IBA	27.49	29.99	35.94	12.11	16.58	20.21	4.25	5.47	6.42	1.09	1.63	2.12
T_{12}	PM+CP+2000 mgL^{-1} IBA	29.55	31.75	38.24	13.54	18.58	23.01	4.36	5.30	6.53	1.21	1.81	2.22
T_{13}	PM+CP+3000 mgL^{-1} IBA	31.54	33.57	40.51	14.53	20.61	24.65	4.58	5.68	6.70	1.34	1.92	2.36
	S.E. ±	0.93	0.91	1.76	0.50	0.58	0.81	0.13	0.19	0.20	0.04	0.50	0.07
	C.D. (P=0.05)	2.71	2.64	5.13	1.45	1.69	2.35	0.37	0.55	0.58	0.12	0.14	0.20
	C.V. %	6.04	5.46	8.54	7.03	5.72	6.59	5.10	6.06	5.42	6.38	5.17	5.87

* VC= Vermi compost, SM= Sphagnum moss, PM= Poultry manure, CP= Coco peat

Table 3 : Effect of rooting media and IBA levels on relative growth rate, number of new leaves and survival percentage at 45, 60 and 75 days after planting air layers of fig (*Ficus carica* L.) cv. POONA

Tr. No.	Treatments *	Relative growth rate (g/day)		Number of new leaves			Survival percentage		
		45 - 60 Days	60 - 75 Days	45 Days	60 Days	75 Days	45 Days	60 Days	75 Days
T_1	Control	0.0208	0.0116	2.20	3.46	5.20	57.60	45.86	37.33
T_2	VC+SM+1000 mgL^{-1}IBA	0.0242	0.0124	3.33	5.30	7.13	71.46	67.73	63.73
T_3	VC+SM+2000 mgL^{-1} IBA	0.0238	0.0121	3.53	5.60	7.33	73.06	70.66	66.66
T_4	VC+SM+3000 mgL^{-1} IBA	0.0264	0.0120	3.86	5.73	7.60	78.66	72.80	69.86
T_5	VC+CP+1000 mgL^{-1} IBA	0.0230	0.0118	2.93	4.60	6.60	67.73	62.93	58.93
T_6	VC+CP+2000 mgL^{-1} IBA	0.0218	0.0123	3.66	5.06	7.13	70.13	66.40	62.93
T_7	VC+CP+3000 mgL^{-1} IBA	0.0234	0.0130	3.86	5.40	7.40	73.33	66.93	64.26
T_8	PM+SM+1000 mgL^{-1} IBA	0.0239	0.0125	4.00	5.53	8.20	81.33	75.46	71.46
T_9	PM+SM+2000 mgL^{-1} IBA	0.0251	0.0126	4.13	6.00	8.53	85.06	79.46	75.46
T_{10}	PM+SM+3000 mgL^{-1} IBA	0.0266	0.0147	4.60	6.53	8.86	90.93	88.53	83.46
T_{11}	PM+CP+1000 mgL^{-1} IBA	0.0214	0.0136	3.66	5.13	7.40	75.46	71.20	68.26
T_{12}	PM+CP+2000 mgL^{-1} IBA	0.0216	0.0142	4.06	5.40	7.60	80.26	74.13	70.66
T_{13}	PM+CP+3000 mgL^{-1} IBA	0.0233	0.0120	4.26	5.80	7.93	82.93	76.80	71.80
	S.Em. ±	0.002	0.002	0.14	0.15	0.18	3.10	3.42	2.84
	C.D. at 5 %	NS	NS	0.40	0.45	0.53	9.01	9.94	8.27
	C.V. %	16.97	31.99	6.59	5.10	4.27	7.07	8.38	7.40

* VC= Vermi compost, SM= Sphagnum moss, PM= Poultry manure, CP= Coco peat

Table 4 : Economics of different treatments for preparing the air layers of fig in poly bags (on the basis of 1000 air layers)

Tr. No.	Treatments	Survival of air layers	Gross income (Rs.)	Total cost # (Rs.)	Net return (Rs.)	Net CBR
T_1	Control	373	9325	4454	4871	1:2.09
T_2	VC+SM+4000 mgL^{-1}IBA	637	15925	6284	9641	1:2.53
T_3	VC+SM+5000 mgL^{-1} IBA	667	16675	6304	10371	1:2.64
T_4	VC+SM+6000 mgL^{-1} IBA	699	17475	6324	11151	1:2.76
T_5	VC+CP+4000 mgL^{-1} IBA	589	14725	5484	9241	1:2.88
T_6	VC+CP+5000 mgL^{-1} IBA	624	15600	5504	10096	1:2.83
T_7	VC+CP+6000 mgL^{-1} IBA	643	16075	5524	10551	1:2.91
T_8	PM+SM+4000 mgL^{-1} IBA	715	17875	6209	11666	1:2.87
T_9	PM+SM+5000 mgL^{-1} IBA	755	18875	6229	12646	1:3.03
T_{10}	PM+SM+6000 mgL^{-1} IBA	835	20875	6249	14626	1:3.34
T_{11}	PM+CP+4000 mgL^{-1} IBA	683	17075	5409	11666	1:3.15
T_{12}	PM+CP+5000 mgL^{-1} IBA	707	17675	5429	12246	1:3.25
T_{13}	PM+CP+6000 mgL^{-1} IBA	718	17950	5449	12501	1:3.29

*VC=Vermi compost, SM=Sphagnum moss, PM=Poultry manure, CP=Coco peat
Total cost includes the cost of treatments, plastic bags and labour cost.

the fresh weight of shoots of fig air layers. The highest fresh weight of root biomass might be due to more number of primary and secondary roots. These results are in conformity with Rymbai and Reddy (2010).

The dry weight of shoot and root biomass of air layers was significantly influenced by different treatments (Table 2). Among the treatments combinations, T_{10} (soil + poultry manure + sphagnum moss + 3000 mgL^{-1} IBA) showed maximum dry weight of shoot biomass (16.49, 24.91 and 30.88 g) and dry weight of root biomass (1.65, 2.13 and 2.81 g), respectively at 45, 60 and 75 days after planting fig air layers. This effect might be due to more number of new leaves as well as fresh weight of shoots of air layers ultimately showed highest dry weight of shoots in treatment T_{10}. The highest dry weight of root biomass might be due to higher number of primary and secondary roots, as well as highest fresh weight of root biomass in treatment T_{10} ultimately showed maximum dry weight of root biomass. These results are in conformity with Rymbai and Reddy (2010).

The establishment of rooted air layers was significantly influenced by different treatments (Table 3). Among the treatment combinations, T_{10} (soil + poultry manure + sphagnum moss + 3000 mgL^{-1} IBA) showed higher relative growth rate (0.0266 and 0.0147 g/day), maximum number of new leaves (4.60, 6.53 and 8.86) and survival percentage (90.93, 88.53 and 83.46), respectively at 45, 60 and 75 days after planting air layers in poly bags.

The higher relative growth rate of air layers in treatment T_{10} might due to higher nutrient content in poultry manure, higher water holding capacity of sphagnum moss and higher level of IBA (3000 mg^{-1}). These results are conformity with those reported by Sharangi and Kumar (2011). The maximum number of leaves might be due to the availability of more mineral nutrients and water due to efficient absorption by vigorous root system. In case of maximum survival percentage of air layers might be due to better water holding capacity of sphagnum moss as well as more number of primary and secondary roots, better root length, number of leaves, *etc.* This combination have better absorption of nutrients and moisture from the growing media as well as created more favourable environment for root and shoot growth resulting in higher survival percentage of air layering in fig. The results are quite comparable with the results of Divekar (1984) who reported that the sphagnum moss was the best rooting medium for air layering in karonda. These results are also confirmed by Singh *et al.* (2007) who reported that poultry manure was best rooting medium in air layering. The results in respect to IBA and sphagnum moss also in conformity with finding of Rymbai and Reddy (2010) in guava air layering.

The economics of air layers was worked out on the basis of 1000 layers considering the cost of different organic media, water holding material, IBA as well as labour cost (Table 4). The total cost and net CBR for making 1000 air layers were ranged from Rs. 4454 to Rs. 6324 with net CBR value between 1:1.2.09 to 1:3.34. The highest net CBR (1:3.34) was recorded in treatment T_{10} followed by T_{13} (1:3.29) and T_{12} (3.25). While, least net CBR (1:2.09) was observed in treatment T_1 (control).

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