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EFFECT OF ROOTING MEDIA AND ROOTING HORMONE ON SHOOT GROWTH IN BER (*ZIZIPHUS MAURITIANA* LAMK) CV. APPLE BER

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ABSTRACT

The present investigation was carried out during the period from October, 2018 to March, 2019. The experiment was conducted in FCRDby varying media, hormone concentration and duration of treatment in replications.The maximum number of shoots (4.66) were recorded in the combination of coco peat, IBA @ 1000 ppmtreatment for 5 min (three $M_1C_1A_2$) followed by $M_3C_2A_2$ (4.08). In second-order interactions, maximum length of shoot (40.22 cm) was recorded in the combination of coco peat, IBA @ 1000 ppmtreatment for 5 min ($M_1C_1A_2$), followed by $M_3C_2A_2$ (39.25 cm), maximum number of leaves per cutting (31.00) were recorded in coco peat media, IBA @ 1000 ppm treatmentfor 5 min ($M_1C_1A_2$) followed by $M_3C_2A_2$ (28.33). So it is observed that a combination of coco peat, IBA @ 1000 ppm treatment for 5 min have shown maximum growth in all three aspects.

Key words : Apple ber, Number of shoots, Absolute growth rate, IBA.

Introduction

India is bestowed with a varied agro-climate, which is highly favorable for growing a large number of horticultural crops. It has a large range of varieties of fruits in its basket and accounts for 10% of the world's total fruit production with an area of 6480 thousand hectares and production of 92,846 MT (Anonymous, 2017). In Indian arid regions having high temperatures, low and variable precipitations are spread over about 31.7 million hectares limiting the scope for high horticultural productivity.The two most important auxins *i.e.*, IBA and NAA have been used widely either singly or in combination for inducing rooting in cuttings of various crop species (Thimann, 1935). Hence, to find out the survival percentage of apple ber cuttings, the cuttings will be treated with different IBA combinations and will be planted in different rooting media mixtures.

Materials and Methods

The present investigation was carried out from October, 2018 to March, 2019 in a mist house at Kadiyadda, West Godavari District, Andhra Pradesh. The experimental site falls under 'Agro-climatic zone-10 of east coastal plain and hills' (Krishna-Godavari Zone) with an average rainfall of 900 mm and is located at an altitude of 34 m above mean sea level. Kadiyadda village is geographically situated at 16°83' North latitude and 81°5' East longitude. The zone experiences a hot and humid summer with a mild winter climate.

A slant cut was given at the basal end of the terminal cuttings and basal parts (1-2 cm depth) were dipped in IBA solutions (at 1000, 1500 and 2000 ppm) for 5 min, thenair dried for 5 min. For another treatment of IBA, the cuttings were dipped in the IBA powder formulations (at 1000, 1500 and 2000 ppm) and then excess powder on the cuttingsis removed by tapping. The treated cuttings were planted in protrays containing respective rooting media *i.e.* coco peat, vermiculite and sawdustup to one node depth. The terminal open ends of cuttings were smeared with blitox paste. The portrays were kept in a mist chamber and maintained in a congenial atmosphere for rooting.

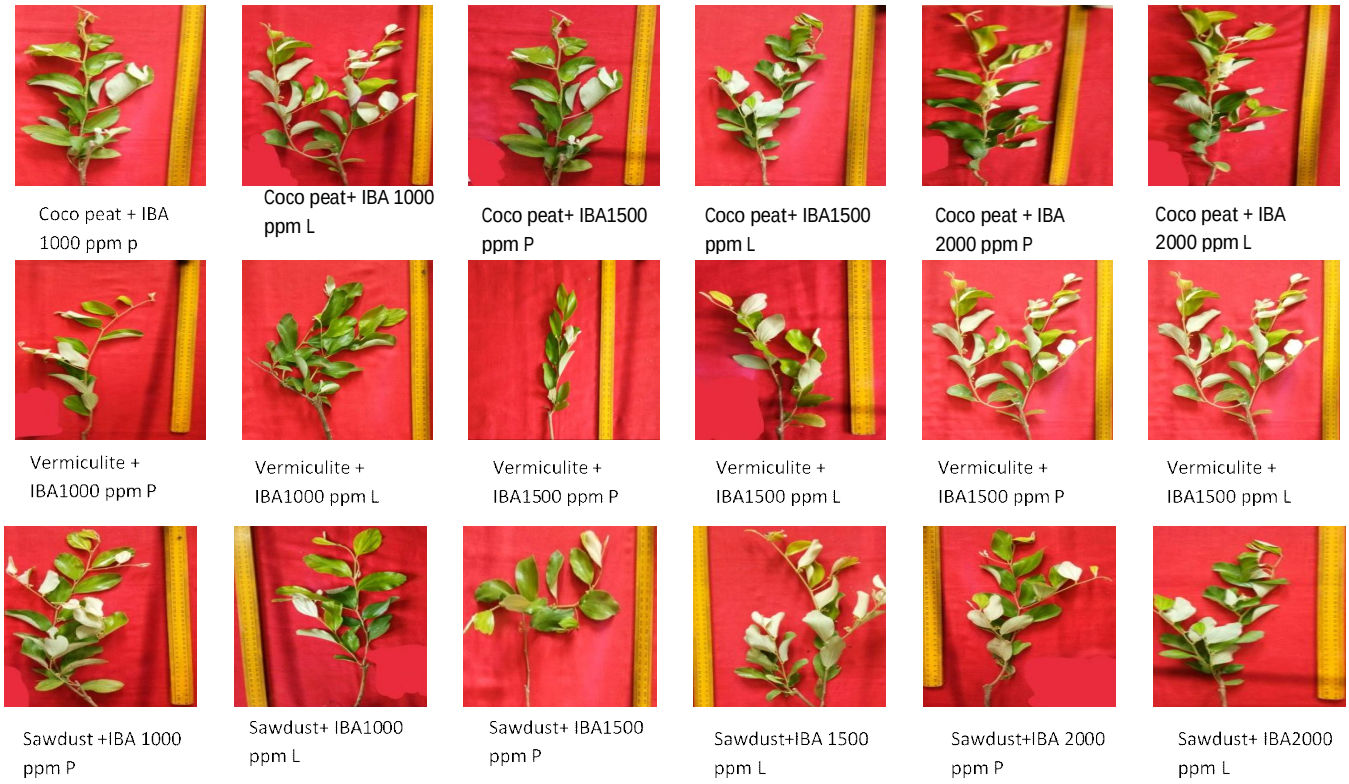

Plate 1 : Effect of rooting media,IBA concentration and method of application on shooting of terminal cutting in ber cv. Apple ber at 120 DAP.

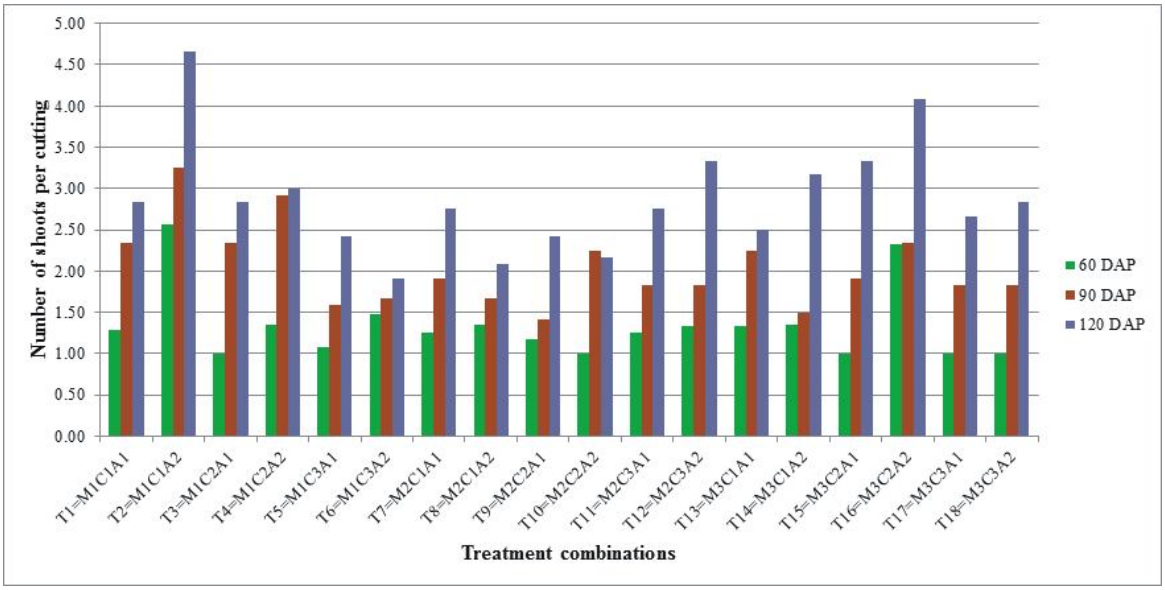

Fig. 1 : Effect of rooting media and IBA concentration on the number of shoots in terminal cuttings of ber cv. Apple ber.

M_1 = Coco peat **C_1** = 1000ppm **A_1** = Cuttings treated with mixture of IBA and talcum powder
M_2 = Vermiculite **C_2** = 1500ppm **A_2** = Cuttings treated with IBA solution for 5 minutes
M_3 = Sawdust **C_3** = 2000ppm **DAP** = (dap)

Number of shoots per cutting

The effect of rooting media, IBA concentration, duration of treatment and their interactions recordedon the number of shoots per cutting at 60, 90 and 120 (dap) and represented in Table 1 and Fig. 1.

At 60 (dap), the maximum number of shoots per cutting (2.56) were recorded in the combination of coco peat media, IBA concentration 1000 ppm and cuttings treated for 5 min ($M_1C_1A_2$) which was on par with ($M_3C_2A_2$) (2.32), while the minimum number of shoots per cutting (1.00) were recorded in the treatment of coco

Table 1 : Effect of rooting media and IBA concentrations on the number of shoots in terminal cuttings of ber cv. Apple ber.

		60 DAP			90 DAP			120 DAP		
		A_1	**A_2**	**Mean MxC**	**A_1**	**A_2**	**Mean MxC**	**A_1**	**A_2**	**Mean MxC**
M_1	C_1	1.28	2.56	1.92	2.33	3.25	2.79	2.83	4.66	3.75
	C_2	1.00	1.35	1.17	2.33	2.91	2.62	2.83	3.00	2.91
	C_3	1.08	1.48	1.28	1.58	1.66	1.62	2.41	1.91	2.16
Mean MxA		1.12	1.79	**1.46**	2.08	2.61	**2.34**	2.69	3.19	**2.94**
M_2	C_1	1.25	1.35	1.30	1.91	1.66	1.79	2.75	2.08	2.41
	C_2	1.16	1.00	1.08	1.41	2.25	1.83	2.41	2.16	2.29
	C_3	1.25	1.33	1.29	1.83	1.83	1.83	2.75	3.33	3.04
Mean MxA		1.22	1.22	**1.22**	1.72	1.91	**1.81**	2.63	2.52	**2.58**
M_3	C_1	1.33	1.35	1.34	2.25	1.50	1.87	2.50	3.16	2.83
	C_2	1.00	2.32	1.66	1.91	2.33	2.12	3.33	4.08	3.70
	C_3	1.00	1.00	1.00	1.83	1.83	1.83	2.66	2.83	2.75
Mean MxA		1.11	1.55	**1.33**	2.00	1.88	**1.94**	2.83	3.36	**3.09**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	1.28	1.75	**1.55**	2.16	2.13	**2.15**	2.69	3.30	**3.00**
	C_2	1.05	1.55	**1.30**	1.88	2.50	**2.19**	2.86	3.08	**2.97**
	C_3	1.11	1.27	**1.19**	1.75	1.77	**1.76**	2.61	2.69	**2.65**
Mean A		**1.15**	**1.52**	**1.34**	**1.93**	**2.13**	**2.03**	**2.72**	**3.02**	**2.87**
Comparing Mean		**SEm (±)**		**CD at 5%**	**SEm (±)**		**CD at 5%**	**SEm (±)**		**CD at 5%**
M		0.064		0.185	0.085		0.244	0.055		0.158
C		0.064		0.185	0.085		0.244	0.055		0.158
A		0.053		0.151	0.070		0.200	0.045		0.129
MxC		0.112		0.320	0.148		0.423	0.095		0.273
MxA		0.091		0.261	0.121		0.346	0.078		0.223
CxA		0.091		NS	0.121		0.346	0.078		0.223
MxCxA		0.158		0.453	0.209		0.599	0.135		0.386

M_1 = Coco peat
M_2 = Vermiculite
M_3 = Sawdust
NS = Non significant

C_1 = 1000 ppm
C_2 = 1500 ppm
C_3 = 2000 ppm

A_1 = Cuttings treated with mixture of IBA and talcum powder
A_2 = Cuttings treated with IBA solution for 5 minutes
DAP = (dap)

peat media, IBA @ 2000 ppm and cuttings dipped in IBA and talcum powder mixture($M_1C_2A_1$). At 90 (dap), in second-order interactions, maximum number of shoots per cutting (3.25) were recorded in the combination of coco peat media, IBA @ 1000 ppm concentration and duration of treatment*i.e.* cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which was followed by $M_1C_1A_1$, $M_1C_2A_1$ and $M_3C_2A_2$ (2.33), while the minimum number of shoots per cutting (1.41) were recorded in the combination of vermiculite media, IBA @ 1500 ppm concentration and cuttings treated with a mixture of IBA and talcum powder ($M_2C_2A_1$).At 120 (dap), the maximum number of shoots (4.66) was recorded in the combination of coco peat media, IBA @ 1000 ppm concentration and cuttings treated with IBA solution for 5 min ($M_1C_1A_2$) which was followed by ($M_3C_2A_2$) (4.08) while a minimum number of shoots per cutting (1.91) were recorded in the combination of coco peat media, IBA @ 2000 ppm concentration and duration of treatment is cuttings treated within IBA solution for 5 min ($M_1C_3A_2$). Terminal cuttings planted in coco peat showed a maximum number of shoots which might be due to the decomposition of lignins

Table 2 : Effect of rooting media and IBA concentrations on the length of longest shoot (cm) in terminal cuttings of ber cv. Apple ber.

		60 DAP			90 DAP			120 DAP		
		A_1	A_2	Mean MxC	A_1	A_2	Mean MxC	A_1	A_2	Mean MxC
M_1	C_1	5.59	7.68	6.63	10.27	16.68	13.48	35.78	40.22	38.00
	C_2	5.62	5.68	5.65	14.86	13.02	13.94	36.46	35.62	36.04
	C_3	4.44	4.88	4.66	12.47	11.93	12.20	35.72	36.88	36.30
Mean MxA		5.22	6.08	**5.65**	12.54	13.88	**13.21**	35.98	37.57	**36.78**
M_2	C_1	6.12	6.06	6.09	12.28	12.46	12.37	35.25	35.72	35.48
	C_2	5.54	4.60	5.07	12.04	13.48	12.76	36.34	36.51	36.42
	C_3	5.28	7.10	6.19	14.29	15.69	14.99	35.98	37.18	36.58
Mean MxA		5.65	5.92	**5.78**	12.87	13.88	**13.37**	35.82	36.47	**36.16**
M_3	C_1	4.30	3.04	3.67	14.47	15.27	14.87	35.63	36.22	35.92
	C_2	5.88	7.26	6.57	15.23	16.23	15.73	36.34	39.25	37.79
	C_3	5.15	4.90	5.02	15.73	14.58	15.16	36.10	35.78	35.94
Mean MxA		5.11	5.06	**5.08**	15.14	15.36	**15.25**	36.02	37.08	**36.55**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	5.34	5.59	**5.46**	12.34	14.80	**13.57**	35.55	37.38	**36.47**
	C_2	5.68	5.84	**5.76**	14.05	14.24	**14.14**	36.38	37.12	**36.75**
	C_3	4.96	5.62	**5.29**	14.16	14.07	**14.11**	35.93	36.61	**36.27**
Mean A		**5.32**	**5.69**	**5.50**	**13.52**	**14.37**	**13.94**	**35.96**	**37.04**	**36.50**
Comparing Mean		**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**
M		0.068		0.195	0.307		0.879	0.122		0.349
C		0.068		0.195	0.307		NS	0.122		0.349
A		0.056		0.159	0.250		0.718	0.211		0.604
MxC		0.118		0.338	0.531		1.523	0.099		0.285
MxA		0.096		0.276	0.434		NS	0.172		0.493
CxA		0.096		0.276	0.434		1.244	0.172		0.493
MxCxA		0.167		0.478	0.751		2.154	0.298		0.855

M_1 = Coco peat
M_2 =Vermiculite
M_3 = Sawdust
C_1 = 1000 ppm
C_2 = 1500 ppm
C_3 = 2000 ppm
A_1 = Cuttings treated with mixture of IBA and talcum powder
A_2 = Cuttings treated with IBA solution for 5 minutes
DAP = (dap)
NS = Non significant

present in coco peat resulting in the formation of humic fractions (Kadalli *et al*., 2001). Coco peathasthe property of retaining moisture and is also helpful in increasing the number of shoots per cutting as reflected in the present study. The cuttings treated with IBA 1000 ppm recorded a greater number of shoots per cutting which could be attributed to the enhancement of physiological functions in the cuttings favorably (Iqbal *et al*., 1999) at this concentration. Earliness to sprouting, increase in the number of sprouts and sprout length might be due to better utilization of stored carbohydrates, nitrogen and other factors with the aid of growth regulators (Chandramouli, 2001).

Length of longest shoot (cm)

The effect of rooting media, IBA concentration, duration of treatment and their interactions recorded significantly on the length of the longest shoot represented in Table 2 and Fig. 2

At 60 (dap), in second-order interactions,the

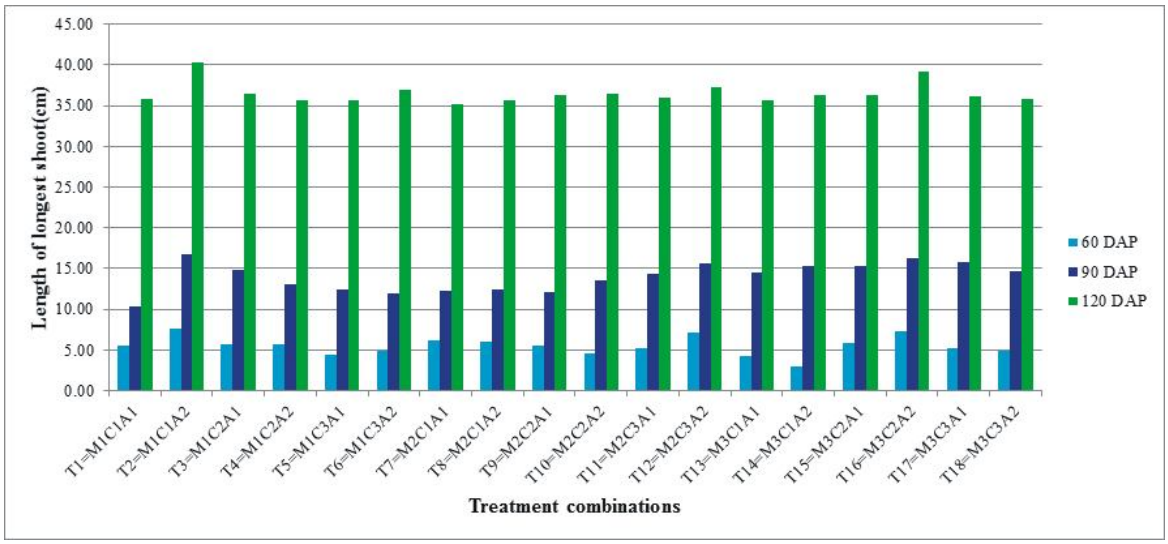

Fig. 2 : Effect of rooting media and IBA concentration on the length of longest shoot (cm) in terminal cuttings of ber cv. Apple ber.

M_1 = Coco peat
M_2 = Vermiculite
M_3 = Sawdust
C_1 = 1000ppm
C_2 = 1500ppm
C_3 = 2000ppm
A_1 = Cuttings treated with mixture of IBA and talcum powder
A_2 = Cuttings treated with IBA solution for 5 minutes
DAP = (dap)

maximum length of shoot (7.68 cm) was recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which was followed by $M_3C_2A_2$ (7.26 cm), while the minimum length of the shoot (3.04 cm) was recorded in the combination of sawdust media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_1C_3A_2$) at 60 (dap).At 90 (dap), in second-orderinteraction, the maximum length of the shoot (16.68 cm) was recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which was on par with $M_3C_2A_2$, $M_3C_3A_1$, $M_2C_3A_2$, $M_3C_1A_2$, $M_3C_2A_1$ and $M_3C_3A_2$ treatment combinations with a value of 16.23 cm, 15.73 cm, 15.69 cm, 15.27 cm, 15.23 cm and 14.58 cm, respectively. The minimum length of the shoot (10.27 cm) was recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated with a mixture of IBA and talcum powder ($M_1C_1A_1$) at 90 (dap). At 120 (dap), in second-order interactions,the maximum length of shoot (40.22 cm) was recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated in IBA solution for 5 min ($M_1C_1A_2$), which was followed by $M_3C_2A_2$ (39.25), while minimum shoot length (35.25 cm) was recorded in the combination of vermiculite media, IBA @ 1000 ppm and cuttings treated with mixture of IBA and talcum powder ($M_2C_1A_1$) at 120 (dap). Among the three rooting media, the terminal cuttings planted in coco peat recorded the maximum length of the sprout. It could be attributed to the adequate supply of oxygen, water and nutrients by the coir pith for the proper functioning of the root (Jeyaseeli and Paulraj, 2010), which might have facilitated better absorption of moisture and nutrients resulting in shoot elongation to the highest degree. Auxin-mediated shoot growth might had resulted from the fundamental elongation of stems and leaves through cell division accounting for a larger number of leaves and longer shoot cells in huge numbers. Among the IBA treatments, IBA 1000 ppm recorded the maximum number of roots per cutting in the present study and therefore could have enhanced the nutrient uptake and resulted in more photosynthate production providing the desired energy for cell division and cell elongation which in turn could result in the maximum shoot length (Ratnakumari,2014). Food in the form of photosynthetates provide the required energy for cell division and cell elongation thus facilitating maximum length of shoot (Shahab *et al*., 2013).

Number of leaves per cutting

Effect of rooting media IBA and duration of treatment their interactions recorded significant on number of leaves per cutting at 120 days and represented in Table 3 and Fig. 3.

At 60 (dap), the maximum number of leaves per cutting (8.75) were recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which was on par with $M_3C_2A_2$ and $M_3C_3A_2$ treatment combination with values of 8.33 and 8.00 respectively, while the minimum number of leaves per cutting (4.25) were recorded in the combination of vermiculite media, IBA @ 1500 ppm concentration and cuttings treated with IBA solution for

Table 3 : Effect of rooting media and IBA concentrations on the number of leaves in terminal cuttings of ber cv. Apple ber.

		60 DAP			90 DAP			120 DAP		
		A_1	**A_2**	**Mean MxC**	**A_1**	**A_2**	**Mean MxC**	**A_1**	**A_2**	**Mean MxC**
M_1	C_1	5.83	8.75	7.292	13.33	19.08	16.20	20.08	31.00	25.54
	C_2	5.41	6.66	6.04	12.83	13.58	13.20	17.83	21.25	19.54
	C_3	6.50	5.00	5.75	10.66	10.50	10.58	19.08	24.25	21.66
Mean MxA		5.91	6.80	**6.36**	12.27	14.38	**13.33**	19.00	25.50	**22.25**
M_2	C_1	5.00	5.00	5.00	10.50	10.33	10.41	21.16	19.00	20.08
	C_2	4.83	4.25	4.54	11.58	17.08	14.33	25.25	24.41	24.83
	C_3	5.66	6.16	5.91	13.58	13.75	13.66	20.25	18.66	19.45
Mean MxA		5.16	5.13	**5.15**	11.88	13.72	**12.80**	22.22	20.69	**21.45**
M_3	C_1	5.66	5.58	5.62	13.33	14.00	13.66	18.33	24.58	21.45
	C_2	5.75	8.33	7.04	16.33	19.66	18.00	24.25	28.33	26.29
	C_3	6.33	8.00	7.16	16.83	15.83	16.33	21.08	20.25	20.66
Mean MxA		5.91	7.30	**6.61**	15.50	16.50	**16.00**	21.22	24.39	**22.80**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	5.50	6.44	**5.97**	12.38	14.47	**13.43**	19.86	24.86	**22.36**
	C_2	5.33	6.41	**5.87**	13.58	16.77	**15.18**	22.44	24.66	**23.55**
	C_3	6.16	6.38	**6.27**	13.69	13.36	**13.52**	20.13	21.05	**20.59**
Mean A		**5.66**	**6.41**	**6.04**	**13.22**	**14.87**	**14.04**	**20.81**	**23.52**	**22.16**
Comparing Mean		**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**
M		0.197		0.565	0.384		1.100	0.306		0.878
C		0.197		NS	0.384		1.100	0.306		0.878
A		0.161		0.462	0.313		0.898	0.250		0.717
MxC		0.341		0.979	0.664		1.905	0.530		1.520
MxA		0.279		0.799	0.542		NS	0.433		1.241
CxA	0.279	NS	0.542	1.556	0.433		1.241			
MxCxA	0.483	1.385	0.94	2.695	0.749		2.150			

M_1 = Coco peat
M_2 =Vermiculite
M_3 = Sawdust
NS = Non significant

C_1 = 1000 ppm
C_2 = 1500 ppm
C_3 = 2000 ppm

A_1 = Cuttings treated with mixture of IBA and talcum powder
A_2 = Cuttings treated with IBA solution for 5 minutes
DAP = (dap)

5 min ($M_2C_2A_2$). At 90 (dap), in second-order interactions, the maximum number of leaves per cutting (19.66) were recorded in the combination of sawdust media, IBA @ 1500 ppm and cuttings treated with IBA solution for 5 min ($M_3C_2A_2$), which was on par with $M_1C_1A_2$ and $M_2C_2A_1$ treatment combination with values of 19.08 and 17.08, respectively. Minimum numbers of leaves per cutting (10.33) were recorded in vermiculite media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_2C_1A_2$). At 120 (dap), in second-order interactions, the maximum number of leaves per cutting (31.00) were recorded in the combination of coco peat media, IBA @ 1000 ppm and cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which was followed by ($M_3C_2A_2$) (28.33) while the minimum number of leaves per cutting (17.83) were recorded in the combination of coco peat media and IBA @ 1500 ppm and cuttings treated with a mixture of IBA and talcum powder (M1C2A1) at 120 (dap). The maximum number of leaves per cutting was produced in terminal cuttings planted in coco peat, which might be due to superior root development in this medium. It could be in turn attributed to the higher moisture retention

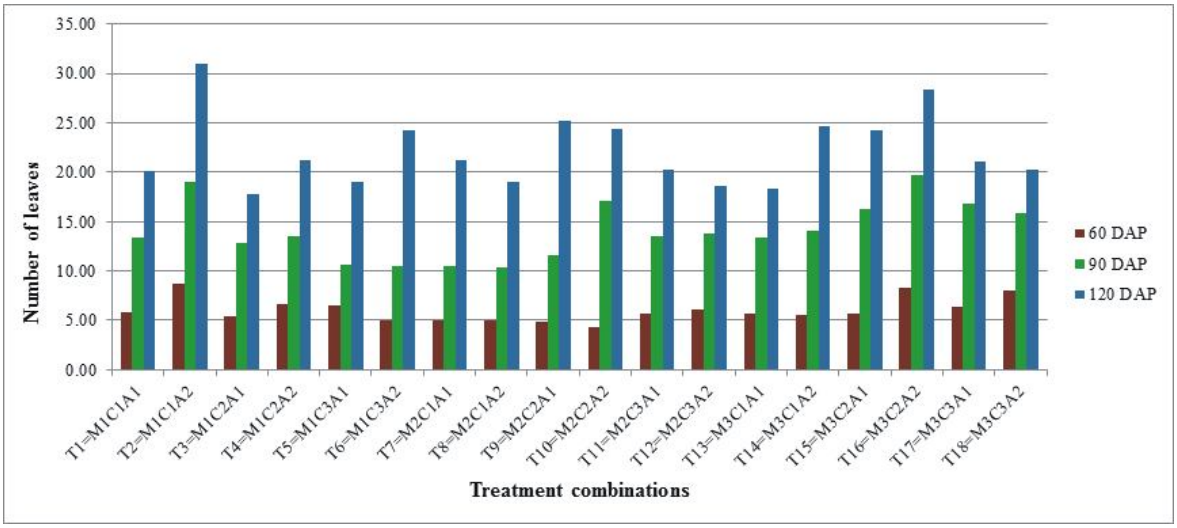

Fig. 3 : Effect of rooting media and IBA concentration on the number of leaves in terminal cuttings of ber cv. Apple ber.

M_1 = Coco peat **C_1** = 1000ppm **A_1** = Cuttings treated with mixture of IBA and talcum powder
M_2 = Vermiculite **C_2** = 1500ppm **A_2** = Cuttings treated with IBA solution for 5 minutes
M_3 = Sawdust **C_3** = 2000ppm **DAP** = (dap)

capacity, porosity and nutrient status of coir pith (Nagarajan *et al*., 1985) as proven in coco peat medium. The maximum number of leaves was produced in cuttings treated with IBA 1000 ppm, which might be due to the activation of shoot growth leading to an increased number of nodes that leads to the development of more leaves. The increase in several leaves per cutting might be due to the reason that the plant might divert maximum assimilate quantities to the leaf buds, since the leaves are one of the production sites of natural auxins in them besides being very important for vital processes like photosynthesis and respiration (Wahab *et al*., 2001).

IBA @ 1000 ppm was found best since IBA plays a direct role in enhancing root development, which in turn increased shoot length and number of leaves. Also, a better response for an increased number of leaves may be due to the increased activity of photosynthesis, transpiration and respiration in leaves (Narayan *et al*., 2013). The results followBemkaireima*et al*. (2012) in passion fruit and Sulaiman and Alrahman (2014) incitron.

Conclusion

The study looked at how rooting media, IBA concentration and treatment period affected cutting growth characteristics such shoot number, shoot length, and leaf number. Coco peat performed better as a rooting medium due to its moisture retention and nutrient availability, resulting in strong growth. IBA at 1000 ppm dramatically increased shoot number and length by improving physiological activities, highlighting its importance in horticulture. The combination of coco peat and IBA at 1000 ppm, with a 5-minute treatment time, produced the best results across all criteria. These findings support prior study on similar crops, proving the efficacy of coco peat and IBA. The study emphasizes the significance of controlling growing conditions for optimal propagation and crop output in horticulture. Further investigation of these interconnections promisesto enhance propagation methodologies for sustainable agriculture.

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