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IMPACT OF HORMONE AND ROOTING MEDIA ON ROOT GROWTH OF BER (*ZIZIPHUS MAURITIANA* LAMK) CV. APPLE BER

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ABSTRACT

The experiment conducted from October 2018 to March 2019, overseen by the Department of Fruit Science at the College of Horticulture, Venkataramannagudem, Andhra Pradesh, revealed varying root lengths and weights across different treatment combinations. The longest root (19.34 cm) was observed in M1C1A2, followed by M1C1A1 (16.92 cm), whereas the shortest (8.30 cm) was in M2C1A1. In terms of fresh root weight, M1C1A2 recorded the highest (3.09 g), followed by M3C2A2 (2.61 g), while the lowest (1.29 g) was in M3C1A1. For dry root weight, M1C1A2 and M3C2A2 exhibited the maximum (0.62 g and 0.57 g, respectively), whereas the minimum (0.19 g) was noted in M3C3A1.

Key words : Apple ber, Fresh weight, Dry weight, Roots, IBA.

Introduction

India is bestowed with a varied agro-climate, which is highly favorable for growing a large number of horticultural crops. It has large range of varieties of fruits in its basket and accounts for 10% of world's total fruit production with an area of 6480 thousand hectares and production of 92846 MT (Anonymous, 2017). In Indian arid regions having high temperature, low and variable precipitations are spread over about 31.7 million hectares limiting the scope for high horticultural productivity. However, these conditions greatly favour development of high quality in number of fruits. 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 entitled "Effect of rooting media and IBA on rhizogenesis and growth of terminal cuttings in Ber (*Ziziphus mauritiana* Lamk) cv. Apple Ber3 was carried out during the period from October, 2018 to March, 2019 in mist house at Kadiyadda village, Tadepalligudem mandal of West Godavari District, Andhra Pradesh.

The meteorological data pertaining to the maximum, minimum temperature and relative humidity were recorded during the period of investigation with monthly averages both in mist chamber and shade net conditions at Kadiyadda village.

A slant cut was given at the basal end of the terminal cuttings to expose maximum absorbing surface area for induction of effective rooting. The basal parts (1-2 cm depth) of the terminal cuttings were dipped in IBA solutions (at 1000, 1500 and 2000 ppm) for 5 minutes as per treatments, subsequently the cuttings were air dried for 5 minutes. For another treatment of IBA, the basal part of the terminal cuttings was dipped in the IBA powder formulations (at 1000, 1500 and 2000 ppm) and then just taped the cuttings to remove excess powder on the cuttings. The treated cuttings were planted in portrays containing respective rooting media *i.e*. coco peat, vermiculite and saw dust up to one node depth. The

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

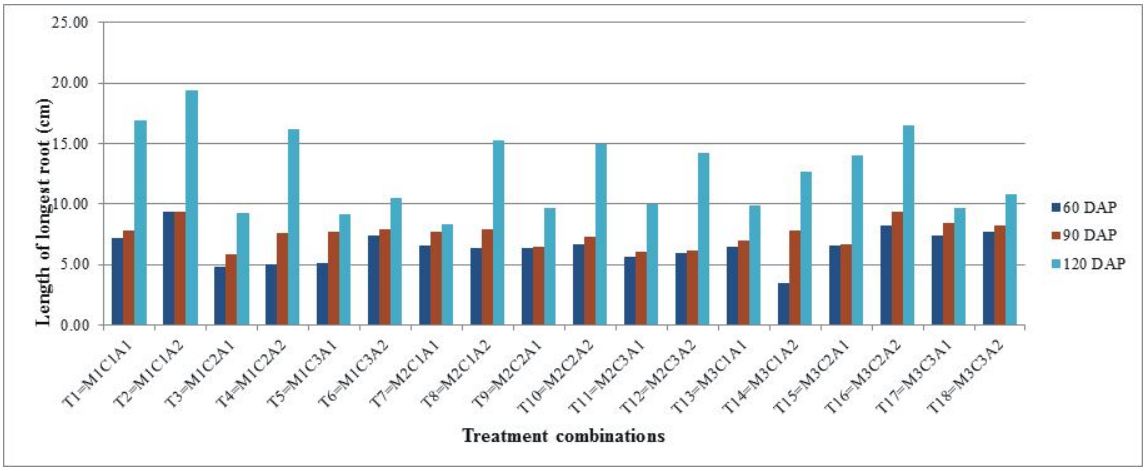

Fig. 1 : Effect of rooting media and IBA concentration on length of the longest rooted (cm) in terminal cuttings of ber cv. Apple ber.

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 = Days after planting

terminal open ends of cuttings were smeared with blitox paste to avoid fungal infections. The portrays were kept in mist chamber and maintained in the congenial atmosphere for rooting of cuttings.

Length of longest root per cutting (cm)

Effect of rooting media, IBA concentration and methods of application and their interactions recorded significant on length of longest root at 60 and 120 DAP and non-significant results were found at 90 DAP and represented in the Table 1 and Fig. 1, Plate 1.

At 60 DAP, in second-order interactions, (M×C×A) the longest root length (9.31 cm) was recorded in coco peat media, cuttings treated with IBA solution for 5 min ($M_1C_1A_2$) which was followed by $M_3C_2A_2$ (8.16 cm). While, the minimum length of root (3.45 cm) was recorded in sawdust media, IBA @ 1000 ppm and cuttings treated

Table 1 : Effect of rooting media and IBA concentrations on length of the longest root (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	7.20	9.31	8.25	7.82	9.36	8.59	16.92	19.34	18.13
	C_2	4.84	4.98	4.91	5.81	7.63	6.72	9.27	16.20	12.73
	C_3	5.12	7.33	6.22	7.70	7.92	7.81	9.10	10.50	9.80
Mean MxA		5.72	7.21	**6.46**	7.11	8.30	**7.71**	11.76	15.35	**13.55**
M_2	C_1	6.58	6.33	6.45	7.73	7.86	7.79	8.30	15.29	11.80
	C_2	6.31	6.68	6.50	6.50	7.27	6.88	9.65	14.91	12.28
	C_3	5.60	5.88	5.74	6.03	6.19	6.11	10.00	14.11	12.08
Mean MxA		6.17	6.22	**6.23**	6.75	7.11	**6.93**	9.32	14.79	**12.05**
M_3	C_1	6.43	3.45	4.96	6.99	7.84	7.41	9.82	12.65	11.23
	C_2	6.58	8.16	7.34	6.68	9.39	8.04	13.95	16.45	15.20
	C_3	7.40	7.64	7.52	8.42	8.17	8.29	9.65	10.78	10.22
Mean MxA		6.79	6.42	**6.60**	7.08	8.46	**7.91**	11.14	13.29	**12.22**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	6.75	6.36	**6.55**	7.39	8.35	**7.93**	11.68	15.76	**13.72**
	C_2	5.89	6.61	**6.25**	6.33	8.10	**7.21**	10.96	15.85	**13.41**
	C_3	6.04	6.95	**6.50**	7.38	7.42	**7.40**	9.58	11.82	**10.70**
Mean A		**6.23**	**6.64**	**6.43**	**7.03**	**7.96**	**7.52**	**10.74**	**14.48**	**12.61**
Comparing Mean			**SEm** (±)	**CD at 5%**	**SEm** (±)	**CD at 5%**		**SEm** (±)	**CD at 5%**	
M		0.075		0.216	0.246	0.707		0.147	0.422	
C		0.075		0.216	0.246	NS		0.147	0.422	
A		0.062		0.177	0.201	0.577		0.120	0.345	
MxC		0.131		0.375	0.427	1.224		0.255	0.731	
MxA		0.107		0.306	0.348	NS		0.208	0.597	
CxA		0.107		0.306	0.348	NS		0.208	0.597	
MxCxA		0.185		0.530	0.603	NS		0.360	1.034	

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

with IBA solution for 5 min ($M_3C_1A_2$) at 60 DAP.

At 90 DAP, the interaction among media, IBA concentration and methods of application was non-significant at 90 DAP.

At 120 DAP, in second order interactions, (M×C×A), maximum length of root (19.34 cm) was recorded in the treatment 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 $M_1C_1A_1$ (16.92cm), while minimum length of root (8.30 cm) was recorded in the treatment combination of vermiculite media, IBA @ 1000 ppm and cuttings treated with mixture of IBA and talcum powder ($M_2C_1A_1$) at 120 days after planting.

The interaction effect between rooting media, IBA and method of application was found to be significant for the length of root per cutting. The longest root per cutting (19.34 cm) was found in terminal cuttings planted in coco peat and dipping of cutting in IBA solution at 1000 ppm ($M_1C_1A_2$). The possible reason for the longest root per

Table 2 : Effect of rooting media and IBA concentrations on fresh weight of roots (g) 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	0.16	0.28	0.22	1.86	2.34	2.10	1.90	3.09	2.49
	C_2	0.27	0.16	0.21	1.06	1.95	1.51	1.93	2.31	2.12
	C_3	0.14	0.16	0.15	1.15	1.80	1.47	2.21	2.13	2.17
Mean MxA		0.19	0.20	**0.19**	1.36	2.03	**1.69**	2.01	2.51	**2.26**
M_2	C_1	0.16	0.20	0.18	1.08	1.80	1.44	1.35	2.53	1.94
	C_2	0.15	0.16	0.15	1.07	1.30	1.18	1.62	1.56	1.59
	C_3	0.24	0.18	0.21	1.35	1.68	1.52	1.60	1.81	1.70
Mean MxA		0.18	0.18	**0.18**	1.17	1.60	**1.38**	1.52	1.97	**1.75**
M_3	C_1	0.16	0.34	0.25	1.27	1.34	1.31	1.29	2.19	1.74
	C_2	0.19	0.27	0.23	1.28	2.31	1.79	1.60	2.61	2.10
	C_3	0.14	0.18	0.16	1.39	1.48	1.44	1.63	1.94	1.78
Mean MxA		0.17	0.26	**0.21**	1.31	1.71	**1.51**	1.50	2.25	**1.88**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	0.16	0.27	**0.22**	1.40	1.83	**1.62**	1.51	2.60	**2.06**
	C_2	0.20	0.20	**0.20**	1.13	1.86	**1.50**	1.72	2.16	**1.94**
	C_3	0.17	0.17	**0.17**	1.30	1.65	**1.48**	1.81	1.96	**1.89**
Mean A		**0.18**	**0.21**	**0.20**	**1.28**	**1.78**	**1.53**	**1.68**	**2.24**	**1.96**
Comparing Mean		**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**	**SEm** (±)		**CD at 5%**
M		0.013		NS	0.086		0.247	0.035		0.100
C		0.013		NS	0.086		NS	0.035		0.100
A		0.011		0.031	0.070		0.201	0.029		0.082
MxC		0.023		0.065	0.149		0.427	0.06		0.173
MxA		0.019		0.053	0.122		NS	0.049		0.142
CxA		0.019		0.053	0.122		NS	0.049		0.142
MxCxA		0.032		NS	0.211		NS	0.086		0.245

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 = Days after planting
NS = Non significant

cutting may be due to amount of food reserves in cuttings (Jain *et al*., 1999). The terminal cuttings planted in coco peat gave maximum length of root which might be due to better texture and porosity of coco peat, as it enabled the downward movement of water and nutrients (Singh *et al*., 2002) and lead to easy penetration of roots (Siddagangaiah *et al*., 1996) in the medium and also being a well-drained one promoting better rooting characters.

The treatment of cuttings with IBA @ 1000 ppm initiate the formation of longest roots could be due to the hydrolysis of polysaccharides stored in the cuttings into physiologically active sugars, which provide energy through respiratory activity to the root primordia and helps in rapid elongation of the meristematic cells and there by initiate the longest root (Singh *et al*., 2014).

Fresh weight of roots (g)

Effect of rooting media, IBA and methods of application and their interactions recorded significant on fresh weight of roots at 120 DAP and represented in Table 2 and Fig. 2. The interaction effect of media concentration and method of application at 60 DAP was

Table 3 : Effect of rooting media and IBA concentrations on dry weight of roots (g) 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	0.08	0.09	0.08	0.22	0.35	0.28	0.32	0.62	0.47
	C_2	0.02	0.03	0.02	0.18	0.25	0.22	0.26	0.41	0.34
	C_3	0.04	0.06	0.05	0.17	0.24	0.21	0.25	0.32	0.28
Mean MxA		0.05	0.06	**0.05**	0.19	0.28	**0.23**	0.28	0.45	**0.36**
M_2	C_1	0.03	0.04	0.03	0.36	0.25	0.30	0.53	0.34	0.43
	C_2	0.03	0.06	0.05	0.27	0.23	0.25	0.41	0.35	0.38
	C_3	0.01	0.07	0.04	0.31	0.20	0.26	0.47	0.27	0.37
Mean MxA		0.02	0.06	**0.04**	0.31	0.23	**0.27**	0.47	0.32	**0.39**
M_3	C_1	0.02	0.03	0.03	0.23	0.22	0.22	0.33	0.33	0.33
	C_2	0.19	0.09	0.14	0.30	0.39	0.35	0.45	0.57	0.51
	C_3	0.03	0.07	0.05	0.17	0.16	0.17	0.19	0.25	0.22
Mean MxA		0.08	0.06	**0.07**	0.23	0.26	**0.25**	0.32	0.38	**0.35**
Mean CxA			Mean C			Mean C			Mean C	
	C_1	0.04	0.05	**0.05**	0.27	0.27	**0.27**	0.39	0.43	**0.41**
	C_2	0.08	0.06	**0.07**	0.25	0.29	**0.27**	0.37	0.44	**0.41**
	C_3	0.03	0.07	**0.05**	0.22	0.20	**0.21**	0.30	0.28	**0.29**
Mean A		**0.05**	**0.06**	**0.06**	**0.24**	**0.26**	**0.25**	**0.36**	**0.38**	**0.37**

Comparing Mean		**SEm** (±)		**CD at 5%**	**SEm** (±)	**CD at 5%**	**SEm** (±)	**CD at 5%**
M	0.005	0.015	0.007	0.020	0.011	0.030		
C	0.005	0.015	0.007	0.020	0.011	0.030		
A	0.004	NS	0.006	NS	0.009	0.025		
MxC	0.009	0.027	0.012	0.034	0.018	0.053		
MxA	0.008	0.022	0.010	0.028	0.015	0.043		
CxA	0.008	0.022	0.010	0.028	0.015	0.043		
MxCxA	0.013	0.038	0.017	0.048	0.026	0.074		

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 = Days after planting

non-significant for this trait.At 90 DAP, second order interaction *i.e.* media, IBA concentration and methods of application (M×C×A) were found to be non-significant for fresh weight of roots at 90 DAP.

At 120 DAP, in second order interactions, (M×C×A) maximum fresh weight of roots (3.09 g) was recorded in the treatment 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 (2.61 gm) ($M_3C_2A_2$), while minimum fresh weight of roots (1.29 gm) was recorded in the treatment combination of sawdust media, IBA @ 1000 ppm and cuttings treated with mixture of IBA and talcum powder ($M_3C_1A_1$).

The interaction between rooting media and IBA treatments for fresh weight of roots was tested significant. Maximum fresh weight of roots (3.09 g) was found in the terminal cuttings planted in coco peat media, IBA @ 1000 ppm cuttings treated with IBA solution for 5 min ($M_1C_1A_2$), which might be due to better aeration and drainage conditions and water maintenance capability (Khayyat *et al.*, 2007).

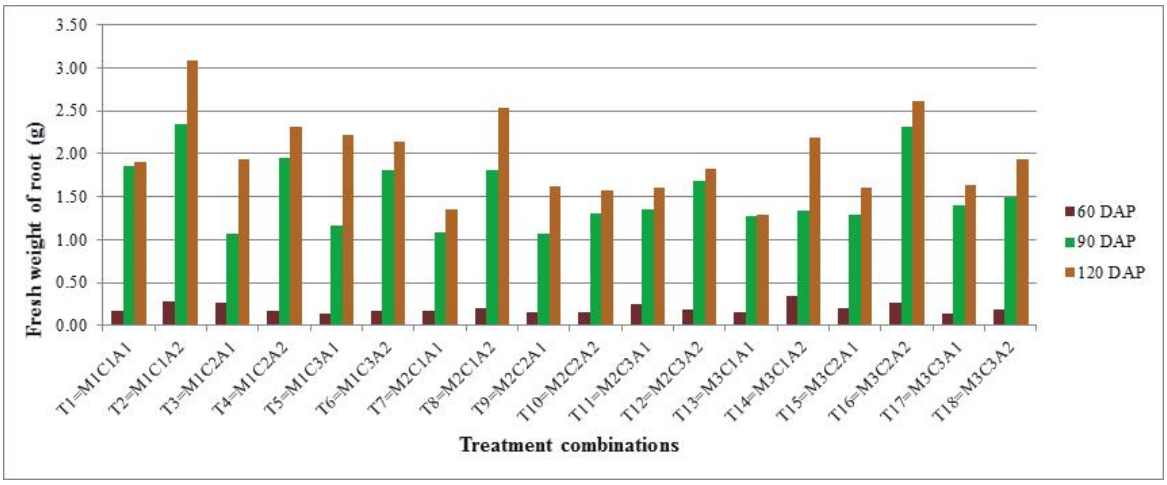

Fig. 2 : Effect of rooting media and IBA concentration on fresh weight of roots (g) in terminal cuttings of ber cv. Apple ber.

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** = Days after planting

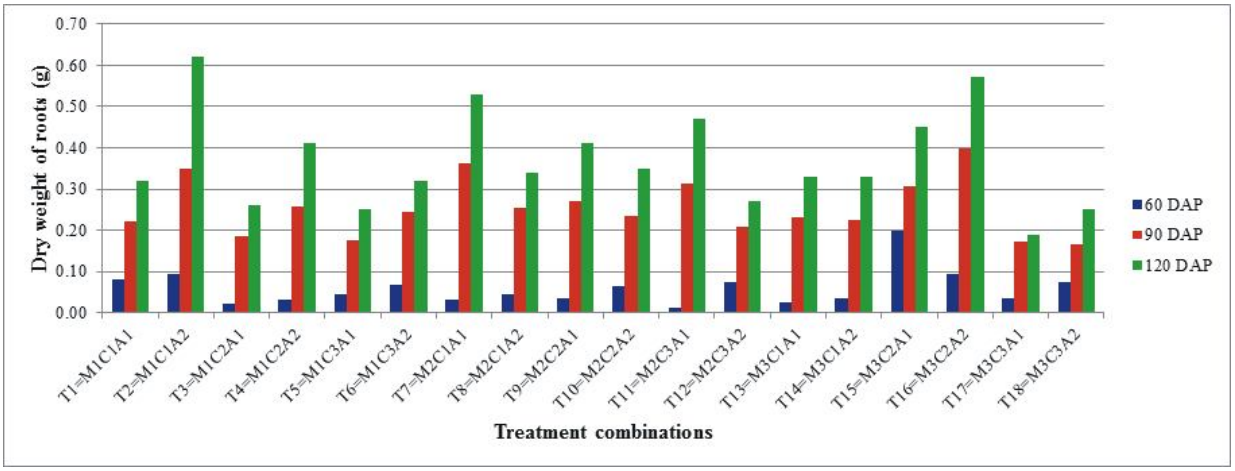

Fig. 3 : Effect of rooting media and IBA concentration on dry weight of roots (g) in terminal cuttings of ber cv. Apple ber.

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** = Days after planting

Fresh weight of roots is more in shade net conditions due to favorable conditions for the cuttings in producing a greater number of roots, increase in root length and thereby absorption of a greater number of nutrients and water (Sandhu and Singh, 1986). Increase in fresh weight in IBA @ 1000 ppm treated cuttings is due to increase in number of leaves, and length of shoots per cutting. These findings are in line with Krishan and Chouhan (2016) inphalsa.

Dry weight of roots (g)

Effect of rooting media, IBA concentrations and methods of application and their interactions were found significant on dry weight of roots at 120 DAP (Table 3) and non-significant results were found at 60 and 90 DAP.

At 60 DAP, in second order interactions, (M×C×A), the maximum dry weight of roots (0.19 g) was recorded in the treatment combination of sawdust and IBA @1500 ppm along with cuttings treated with mixture of IBA and talcum powder ($M_3C_2A_1$), which was followed by $M_1C_1A_2$ (0.09 g) , while minimum dry weight of roots (0.01 gm) was recorded with vermiculite and IBA @ 2000 ppm and cuttings treated with mixture of IBA and talcum powder ($M_2C_3A_1$).

At 90 DAP, in second order interaction, (M×C×A), maximum dry weight of roots (0.39 g) was recorded in the treatment 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 0.36 g, 0.35 g recorded in treatment combination $M_2C_1A_1$, $M_1C_1A_2$ respectively. Minimum dry weight of roots (0.16 g) was recorded in

the treatment combination of sawdust media, IBA @ 2000 ppm and cuttings treated with IBA solution for 5 min ($M_3C_3A_1$).

At 120 DAP, in second order interaction, (M×C×A) maximum dry weight of roots (0.62 g) was recorded in the treatment 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 ($M_3C_2A_2$) (0.57 g), while minimum dry weight of roots (0.19 g) was recorded in the treatment combination of sawdust media, IBA @ 2000 ppm concentration and cuttings treated with mixture of IBA and talcum powder ($M_3C_3A_1$).

Conclusion

The study looked at the root characteristics of terminal cuttings planted in various media and treated with IBA at 1000ppm. The results at 120 days after planting (DAP) showed that vermiculite medium with IBA treatment provided the largest fresh and dry root weights, most likely due to increased sprouting. Cuttings in coco peat medium had the highest dry root weight, probably because to increased root quantity and length. IBA-treated cuttings had a considerable increase in root weight due to increased cell division, which promoted primary and secondary root growth (Krishan and Chouhan, 2016). Auxins, like as IBA, promote root primordial initiation, hence improving vascular connection and root development. Climatic circumstances significantly influenced root weight, with shadow net cuttings having greater dry weights. IBA's role in shoot growth and cell division also helped to improve root weight. These findings align with previous studies on different plant species, highlighting the specificity and effectiveness of auxins in root development (Husen *et al.,* 2008).

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