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Studies on the propagation of apple clonal rootstock Merton 793 through hardwood cuttings

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ABSTRACT : The investigation on propagation of apple clonal rootstock Merton 793 (*Malus* x *domestica* Borkh.) through hardwood cuttings was carried out under 70% shade net to find out the effect of growth regulators, pre- conditioning treatments and bio-inoculants on rooting and growth of apple cuttings. There were 13 treatments comprising growth regulators IBA @ 2000, 2500, 3000 ppm each and in combination with pre-conditioning treatments (blanching and girdling) and different bio inoculants like *Bacillus licheniformis* strain CKA B6, *Aneurinibacillus aneurinilyticus* CKMVI and *Bacillus circulans* MTCC8983.CKA4 along with untreated control. Pre-conditioning followed by IBA proved to be superior in all rooting and growth parameters. IBA 2500 ppm + girdling was considered to be the best treatment which resulted in highest per cent rooting, number of primary roots per cutting, primary root length, total root length, fresh and dry weight of shoot, fresh and dry weight of root and root: shoot ratio. Whereas, primary root length, shoot length, leaf number and average leaf area was found to be maximum in IBA 2500 ppm + blanching. However, IBA 2000 ppm + girdling gave highest primary root diameter and shoot diameter. Hence, pre-conditioning treatment in combination with IBA could be conveniently used for the commercial propagation of apple through cuttings planted under 70 per cent shade net, which would be more economical and commercial.

KEY WORDS : *Malus* x *domestica*, Cuttings, Growth regulator, Blanching, Girdling, Bio-inoculants

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Apple (*Malus* x *domestica* Borkh.), the king of temperate fruits, is a popular fruit grown in India for about 28.91 lakh metric tonnes from an area of about 2.89 lakh hectare (NHB, 2011). Clonal propagation of rootstocks through cuttings is of special significance as it is additional tool to increase the production of rootstocks. Whereas, during grafting top portion of rootstock (> 80 %) goes waste. If this part is converted into plantlets through cuttings the multiplication rate of rootstock can be increased manifold. As the old plantations are declining, there is an increase in the demand of quality planting material which has necessitated the need for development of an easier, quicker and economical method of propagation. Due to replantation problem there is poor growth, delayed fruiting of the apple plants planted at the same site. To combat this problem quality planting material in terms of efficient rootstocks are required. In recent years apple rootstock Merton 793 has been introduced by state Department of Horticulture and has been found to be suitable for planting at replant sites (Jindal and Gautam, 2001). In order to enhance rooting of cuttings various growth regulators, pre-conditioning *viz.*, blanching, girdling and bio-inoculants have been reported to improve rooting capacity of cuttings (Hartmann *et al*., 2009). The information on the use of growth regulators, particularly pre-conditioning treatments (blanching and girdling) and bio-inoculants on propagation of apple is scanty. Keeping in view the above factors into consideration, the present investigation was carried out.

RESEARCH METHODS

The present investigation was undertaken during 2010-2011 at Dr. Y.S. Parmar University of Horticulture and Forestry Nauni, Solan. The experiment was laid out in a Randomized Block Design (RBD) with three replications with 20 cuttings in each replication. There were 13 treatments comprising one growth regulator *i.e.* IBA at 2000, 2500 and 3000 ppm, two pre-

conditioning treatments (blanching and girdling) followed by IBA, three bio-inoculants (*Bacillus licheniformis* strain CKA B6, *Aneurinibacillus aneurinilyticus* CKMVI and *Bacillus circulans* MTCC8983.CKA 4) along with untreated control. Cuttings from apple stool shoots were selected in February for pre- conditioning treatments.

(a) Girdling (b) Blanching

Fig. A : Girdling and blanching operations

Blanching was done by covering 2 cm black adhesive tape eight weeks prior to leaf fall just above a node and girdling was done with knife six weeks prior to leaf fall just below the node (Fig.1). The 20 cm long cuttings of pencil thickness were taken from selected stool shoots and slanting cut was given just above the upper most node of the cuttings and clean round cut was given at the base of cuttings. Cuttings were dipped in bio- inoculants for a period of 12 hours before planting of cuttings. Rooting media was prepared by thoroughly mixing vermicompost + cocopeat + sand + forest soil (1:1:1:1) and beds of 2 x 1 meter size were prepared under 70 % shade net house. Adequate space was maintained in between the beds, rows and cuttings for ease of weeding and other cultural operations. The basal portion of the cuttings was dipped in the growth regulators solution for 10- 15 seconds and then planted in beds with one node inside the rooting media. After care such as watering, weeding and plant protection were carried out on need basis. Three sprays of 0.1 per cent bavistin were given at an interval of one month to prevent fungal infection. Observations on shoot and root characteristics were taken at regular intervals. The data on percentage were statistically analyzed after arc sine transformation (Gomez and Gomez, 1984)

RESEARCH FINDINGS AND DISCUSSION

The two pre-conditioning treatments and their combination with synthetic auxin *i.e.* IBA at various concentration showed a significant influence on root parameters of apple cuttings compared to control. Cutting treated with IBA 2500 ppm + girdling recorded highest rooting per cent (64.00), primary root length (77.97 cm), number of primary roots per cuttings (Pratima and Rana, 2011), total root length (0.56 m), fresh and dry weight of roots 13.31 g and 10.67 g, respectively (Table 1). Similar observations are in agreement with the findings of Pandey and Bisen (2010) who recorded increase in root characters in lower portion of ringed branch, which might be due to optimum increase in endogenous auxin level, phenols, carbohydrates and other bio compounds which stimulate cell division, cell enlargement and growth. The findings are also in close conformity with the mark of Srivastava *et al.* (2006) who recorded maximum root length in MM 106 apple clonal rootstock when stool shoots were treated with IBA 2500 ppm and girdled from the base in trench layering. However, IBA 2000 ppm + girdling recorded maximum diameter of primary roots. Slow translocation, higher stability of IBA at higher concentration accumulation of carbohydrate and root promoter in girdled portion might be the reason of root thickness. Khoe (2005) studied the effect of some pre-conditioning treatments on the rooting of cutting in peach cv. July Elberta. The semi-hardwood cuttings were treated with blanching and girdling alone or both in combination with 2000 ppm IBA. Maximum rooting percentage (70 %) was registered in treatment blanching + girdling + IBA 2000 ppm. Similar trends were observed by Alam *et al.* (2007) who reported that maximum root diameter (3.0 cm) was observed in cuttings of kiwi with 4000 ppm IBA followed by 2.8 cm with 5000 ppm. The increase in root diameter might be due to more vegetative growth and accumulation of carbohydrate. All the root parameters were lowest in control. Exogenous application of auxin breaks starch into simple sugars, which is needed to greater extent for the production of new cells and for increased respiratory activity in the regeneration tissue at the time of initiation of new root primordia. However, induction of maximum number of roots per cuttings might be due to the fact that cambial activity involved in root initiation was stimulated by growth

IBA 2500 ppm + Girdling

Fig. 1 : Effect of IBA and pre-conditioning treatment on rooting of cutting of Merton793

Table 1 : Effect of growth regulators, preconditioning and bio-inoculants on rooting of apple clonal rootstock Merton 793 cuttings

	Concentration	Percentage of rooted cuttings	Number of primary roots per cutting	Primary root length (cm)	Primary root diameter (mm)	Total root length (m)	Shoot Length (cm)	Shoot diameter (mm)	Fresh shoot weight (g)	Dry shoot weight (g)	Leaf number per cutting	Avg. leaf area (cm^2)	Fresh root weight (g)	Dry root weight (g)	Root : shoot ratio (Dry weight basis)
T_1	IBA 2000 ppm	44.67 (41.94)	12.33	48.54	1.22	0.18	75.29	12.88	44.81	31.53	83.67	26.04	5.80	3.96	1.26
T_2	IBA 2500 ppm	56.33 (48.64)	12.67	65.47	1.90	0.18	88.18	12.95	45.43	32.80	88.33	26.90	7.90	6.11	1.84
T_3	IBA 3000 ppm	45.67 (42.51)	11.33	43.89	1.37	0.17	93.25	12.85	36.28	21.52	95.33	32.90	4.20	3.07	1.66
T_4	IBA 2000 ppm + Blanching	52.00 (46.15)	17.67	75.97	2.14	0.27	93.35	14.37	41.97	27.48	93.33	33.96	10.27	7.24	2.66
T_5	IBA 2500 ppm + Blanching	62.00 (51.95)	17.00	83.18	2.45	0.47	98.75	15.71	47.60	31.94	99.67	42.71	12.28	9.44	2.97
T_6	IBA 3000 ppm + Blanching	54.33 (47.49)	12.33	59.50	2.22	0.28	82.69	13.58	37.15	23.86	95.67	35.20	8.03	4.77	2.34
T_7	IBA 2000 ppm + Girdling	48.33 (44.05)	13.00	65.50	4.80	0.30	90.75	17.92	48.30	35.21	98.67	40.96	11.42	6.87	1.93
T_8	IBA 2500 ppm + Girdling	64.00 (53.14)	19.00	77.97	3.81	0.56	96.92	15.30	49.89	36.07	96.00	38.12	13.31	10.67	2.96
T_9	IBA 3000 ppm + Girdling	55.00 (47.87)	12.67	66.26	1.61	0.19	84.97	14.05	38.27	25.53	90.33	29.25	7.29	5.79	2.67
T_{10}	*Bacillus licheniformis* strain CKA B6	27.00 (31.30)	10.33	33.42	1.47	0.18	59.24	12.65	33.78	19.69	80.33	25.46	3.61	2.09	1.07
T_{11}	*Aneurinibacillus aneurinilyticus* CKMVI	23.67 (29.10)	9.00	35.72	1.18	0.13	69.43	11.67	34.01	20.80	79.33	24.56	4.85	3.52	1.71
T_{12}	*Bacillus circulans* MTCC8983.CKA 4	28.67 (32.37)	9.33	31.70	1.13	0.12	65.04	10.65	37.14	18.71	86.67	26.51	3.23	2.28	1.22
T_{13}	Control	21.67 (27.73)	7.66	30.71	0.94	0.11	48.37	8.55	30.90	16.88	67.67	22.14	2.80	1.57	0.93
	C.D (P=0.05)	4.35	2.95	3.14	0.50	0.10	2.44	3.08	3.11	3.34	3.34	2.56	3.11	3.34	0.13

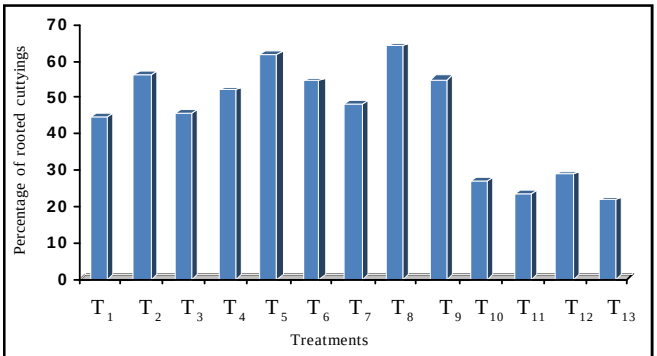

Fig. 2 : Effect of IBA, pre-conditioning and bio-inoculant treatments on percentage of rooted cuttings of apple clonal rootstock Merton793

regulator in many spp (Ullah *et al.*, 2005). Among the shoot parameter (Table 1) maximum shoot length was recorded in the treatment IBA 2500 ppm + blanching which was statistically at par with IBA 2500 ppm + girdling with a value of 98.75 cm and 96.92 cm respectively which differed significantly with control. The better shoot length in the cuttings with pre-conditioning treatment in combination with IBA can be related to the fact that IBA affect the elongation of root and shoot by way of cell division and cell elongation. On the other hand, blanching prevents the photo-oxidation of IAA and on the same side; higher irradiance could increase photosynthesis and super optimal concentration of carbohydrate. Preet and Rana (2011) observed that blanching of semi-hardwood cuttings with black adhesive tape just above a node in second week of July followed by girdling below a node in first week of July and IBA at 5000 ppm application improved shoot and root characteristics like shoot length and fresh and dry weight of shoot and root. A similar trend was also observed by Wu *et al*. (2006) who reported that etiolation resulted in increase in starch concentration. In general, application of pre-conditioning treatments followed IBA progressively increase the average leaf area and leaf number. IBA 2500 ppm + blanching produce maximum average leaf area (42.71 cm^2) which was followed by IBA 2000 ppm + girdling (40.96 cm^2). The maximum leaf area can be related to the more shoot length. It may also be the consequence of better root system which might have played an active role in the development of leaves on such cuttings by facilitating the supply of water and nutrient from soil.

Conclusion:

On the basis of the results obtained from the present research work, it may be concluded that among the different concentrations of IBA, pre-conditioning (Blanching and Girdling) alone or in combinations with IBA and bio-inoculants, the IBA 2500 ppm + girdling (T_8) was found to be the best treatment for inducing better root system in apple clonal rootstock Merton 793 in terms of rooting percentage, number of primary roots, total root length, fresh and dry weight of roots. Other associated parameters like number of leaves, leaf area, and length of primary roots in this treatment were also at par with IBA 2500 + blanching and IBA 2000 ppm + girdling.

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