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EFFECT OF STORAGE CONDITIONS (GROWTH CHAMBER) AND IBA TREATMENTS ON ROOTING OF CUTTINGS OF APPLE CLONAL ROOTSTOCK MERTON 793 IN NET HOUSE CONDITIONS

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ABSTRACT
The study on controlled preconditioning storage conditions (growth chamber) and IBA treatments on rooting of cuttings of apple clonal rootstock Merton 793 was carried out in net house conditions of fruit nursery block of Department of Fruit Science, Dr. Y. S. Parmar University of Horticulture and Forestry Nauni, Solan H.P. during 2012-2013. The cuttings were stored at 22 ≤ C with 80 % relative humidity in growth chamber for 7 days, 14 days, 21 days and 28 days as preconditioning treatment and different IBA concentrations of 1500 ppm, 2000 ppm, 2500 ppm and 3000 ppm were applied. The experiment was laid out in randomized block design (factorial) The cuttings stored for 7 days along with IBA 2500 ppm treatment recorded highest rooting percentage, number of primary roots, length and diameter of primary roots, fresh and dry weight of roots recording 46.67 %, 4.60, 28.60 cm, 2.63 mm, 2.89g and 1.83 g, respectively. Hence it is concluded that cuttings when stored in growth chamber for a period of 7 days treated along with IBA 2500 ppm were found to best for better rooting in apple clonal rootstock Merton 793.

INTRODUCTION

The cultivated apple (*Malus* x *domestica* Borkh.) is a member of family Rosaceae and sub-family Pomoideae. Apple is an economically important fruit tree around the world (Karakurt, 2006; Aslantas and Karakurt, 2007). In India, apple is mainly grown in North Western Himalayan region comprising states of Jammu and Kashmir, Himachal Pradesh and Uttrakhand. Apple plants are traditionally propagated through grafting and budding on seedling stock in the nursery. Though, clonal rootstocks are in use in commercial all over the world but, seedlings still continues to be the most commonly used rootstock in India, due to unavailability of elite propagating material of clonal rootstock (Negi, 2011).

Apple clonal rootstocks are conventionally propagated through mound layering (stooling). One of the convenient methods of clonal propagation is through hardwood cuttings (Hartmann *et al.*, 2002). Among the clonal rootstock Merton 793, MM 111 and MM 106 are more suitable for agro climatic conditions of North West Himalayas. Merton 793 has been proved to be suitable rootstock for interplanting of old orchards because of its adaptability to a wider range of soil, precocious as compared to seedling rootstocks, vigorous, resistant to woolly apple aphid, collar rot and tolerant to replant problem. Merton 793 is cross between M 2 and Northern Spy, developed by East Malling and John Innes, Horticultural institute in Merton England, which is a suitable alternative to seedling stock especially in replantation of senile orchards (Webster and Wertheim, 2003).

Rooting in Merton 793 rootstock is difficult and certain factors such as length, diameter, collection date and degree of hardening of the cuttings, injury and heat treatment of the cuttings and the treatment concentrations of auxin-like compounds (Tsipouridis *et al.*, 2003). Apart from these factors rooting hormones, planting time, maturity of the stock plants and propagation environment affect the rooting of stem cuttings (Bhusal *et al.*, 2001).The performance of clonal propagation can be improved through application of preconditioning heat treatments and use of growth regulators. Various growth regulators are already in use since long to increase rooting potentially in hardwood cuttings of woody plants. Endogenous factors like as growth hormone balance, anatomical structure of cutting and carbohydrate level (Hartmann *et al.*, 2002) and exogenous factors such as humidity, air and light condition in rooting environment and age of cuttings are required for satisfactory results in propagation (Ercisli *et al.*, 2003). Keeping in view all these facts, the main objective was to study the effect of preconditioning treatments in addition to plant growth regulators on rooting of apple clonal rootstock viz. Merton 793.

MATERIALS AND METHODS

The present investigation was undertaken in net house conditions of fruit Nursery block of Department of Fruit Science, Dr.

Y. S. Parmar University of Horticulture and Forestry Nauni, Solan H.P. during 2012-2013.The one year old stool shoots of diameter 1.00 cm - 1.25 cm and 30 cm in length were collected in the month of January on 12/01/2012 from arial portion of rooted mound layer stool of Merton 793, during dormancy. A slant cut was given slightly above a node on the apical end and longitudinal wounding cut of 1.00 - 2.00 cm were made at basal end of cuttings to facilitate absorption of IBA. Nursery beds were prepared by mixing coco peat, sand and forest soil in the ratio (1:1:1; v/v). Rooting media was thoroughly mixed and nursery beds of 2 m x 1 m size were prepared in the net house. The cuttings were planted at a spacing of 10 cm row to row and 7.5 cm apart in the row. The cuttings were stored at 22 ≤ C with 80 % relative humidity in growth chamber as preconditioning treatment for different storage time. Basal portion of the cuttings was dipped for 10-15 seconds in different IBA concentrations prepared in 50 per cent ethanol (Quick Dip Method).In this experiment, the percentage of rooting was calculated and number, length and diameter, fresh and dry weight of rooted cuttings were measured (Hartmann *et al.*, 2002). In all there were 16 treatment combinations of storage time and IBA concentrations each having 4 storage time (7 days, 14 days, 21 days and 28 days) and 4 IBA concentrations (1500 ppm, 2000 ppm, 2500 ppm and 3000 ppm) replicated thrice in a randomized block design (Factorial). The data on percentage were statistically analyzed using arc sine transformation to treat the data for removing skewness (Gomez and Gomez 1984). The level of significance for different variables was tested at 5 per cent value of significance.

RESULTS AND DISCUSSION

The results obtained in the present investigation revealed that the storage conditions and IBA treatments exert a significant effect on rooting of cuttings (Table 1).The maximum rooting percentage of 37.08 % was observed in cuttings stored for 7 days at 22ºC in incubator (growth chamber) and the minimum rooting (6.67 %) in longest storage time of 28 days. The application of IBA also exerts a significant effect on rooting of cuttings. The maximum rooting of 28.33 % was observed in cuttings treated with IBA 2500 ppm and in comparison to only (16.67 %) in IBA 1500 ppm which was least. The interaction effect between storage time and IBA concentrations on percentage of rooted cuttings was found to be non significant. The highest rooting of 46.67 % was recorded in cuttings stored in growth chamber with treatment combination of 7 days storage time along with IBA 2500 ppm. Whereas, the minimum rooting percentage of 5.00 % was recorded in cuttings stored in growth chamber with treatment combination of 28 days storage time along with IBA 1500 ppm and 3000 ppm. The exposure of cuttings to higher temperature of 22ºC resulted in quick callus formation, essential for root initiation. Longer storage of cuttings in incubator reduced rooting due to encouragement of saprophytic and causing cuttings mortality. Similar results were also obtained by Child and Hughes (1978) when basal ends of hardwood cuttings of apple cultivars were given exposure of 25-30ºC in specially constructed rooting bins, rooting in very high percentage of rooted cuttings obtained. Pandit *et al.* (2011) also reported that highest rooting percent, maximum number and length of primary roots were obtained with 3000 ppm IBA with rootstock MM.106 and MM.111.

The effect of different storage conditions and IBA treatments on number of primary roots was found to be significant as revealed by the results obtained in present investigations (Table 1).The maximum number of primary roots per cuttings (4.05) was recorded in cuttings stored for 7 days and the minimum number of primary roots (2.50) in 28 days storage time at 22ºC irrespective of IBA treatments. The IBA concentration also exerted a significant effect on average number of primary roots per cuttings. The maximum number of primary roots (3.78) was recorded in cuttings treated with IBA 2500 ppm and the minimum number of primary roots (3.07) was found in cuttings treated with IBA 1500 ppm. As evident from the perusal of results obtained the interaction effect between storage time and IBA concentrations exerted a significant effect on number of primary roots. The maximum number of primary roots (4.60) was recorded in cuttings with treatment combination of 7 days storage time along with IBA 2500 ppm and the minimum number of primary roots (2.40) was observed in cuttings with treatment combination of 28 days storage time along with IBA 1500 ppm. The preconditioning treatment of 22ºC for 7 days encourages the quick callusing and application of IBA is responsible for encouraging root initials and root growth. There was as synergistic effect of preconditioning treatment of 7 days and IBA at 2500 ppm for primary root number. The induction of maximum number of roots in the treated cuttings may be due to the fact that cambial

Table 1: Effect of storage conditions and IBA treatments on percentage of rooted cuttings and number of primary roots per cuttings of apple clonal rootstock Merton 793.

	Percentage of rooted cuttings					Number of primary roots				
Concentratin(C) Days (D)	1500 ppm	2000ppm	2500 ppm	3000 ppm	Mean (D)	1500 ppm	2000 ppm	2500 ppm	3000 ppm	Mean (D)
7 days	28.33 (32.13)	31.67 (34.21)	46.67 (43.07)	41.67 (40.18)	37.08 (37.40)	3.47	3.80	4.60	4.33	4.05
14 days	23.33 (28.84)	26.67 (31.06)	38.33 (38.23)	33.33 (35.24)	30.42 (33.34)	3.30	3.50	4.37	3.93	3.78
21 days	10.00 (18.04)	11.67 (19.88)	18.33 (25.18)	11.67 (19.88)	12.92 (20.74)	3.10	3.17	3.57	3.37	3.30
28 days	5.00(12.92)	6.67 (14.75)	10.00 (18.04)	5.00 (12.92)	6.67 (14.66)	2.40	2.50	2.60	2.50	2.50
Mean (C)	16.67 (22.98)	19.17 (24.98)	28.33 (31.13)	22.92 (27.05)		3.07	3.22	3.78	3.53	
CD (0.05)										
D	1.98					0.11				
C	1.98					0.11				
D × C	NS					0.23				

* Data in parenthesis are angularly transformed values

Table 2: Effect of storage conditions and IBA treatments on length and diameter of roots of cuttings of apple clonal rootstock Merton 793

	Length of roots (cm)					Diameter of roots (mm)				
Concentration(C)	1500	2000	2500	3000	Mean (D)	1500	2000	2500	3000	Mean (D)
Days (D)	ppm	ppm	ppm	ppm		ppm	ppm	ppm	ppm	
7 days	23.67	27.79	28.60	26.73	26.70	1.77	2.61	2.63	2.37	2.33
14 days	22.81	24.86	26.15	24.25	24.52	1.75	1.94	2.27	2.17	2.03
21 days	17.99	17.37	19.56	18.94	18.46	1.58	1.58	1.99	1.95	1.78
28 days	16.68	17.23	18.90	18.12	17.73	1.32	1.45	1.79	1.76	1.58
Mean (C)	20.29	21.81	23.30	22.01		1.60	1.90	2.16	2.06	
CD (0.05)										
D	1.36					0.18				
C	1.36					0.18				
D × C	NS					NS				

Table 3: Effect of storage conditions and IBA treatments on fresh weight and dry weight of roots of cuttings of apple clonal rootstock Merton 793

	Fresh weight of roots (g)					Dry weight of roots (g)				
Concentration(C)	1500	2000	2500	3000	Mean	1500	2000	2500	3000	Mean
Days (D)	ppm	ppm	ppm	ppm	(D)	ppm	ppm	ppm	ppm	(D)
7 days	1.35	1.41	2.89	2.48	2.03	0.35	0.40	1.83	1.42	1.00
14 days	1.28	1.35	2.56	2.38	1.89	0.50	0.40	1.48	1.38	0.94
21 days	1.20	1.24	2.21	2.13	1.70	0.18	0.36	1.03	0.93	0.62
28 days	1.10	1.20	2.10	2.09	1.62	0.23	0.58	1.05	1.02	0.72
Mean (C)	1.23	1.30	2.44	2.27		0.32	0.44	1.35	1.19	
CD (0.05)										
D	0.10					0.18				
C	0.10					0.18				
D × C	0.19					0.35				

activity involved in root initiation is stimulated by growth regulators in many species as opined by Ullah *et al.*,(2005). Diengngan and Murthy (2014) also obtained highest number of primary roots (5.00) per micro cuttings in medium supplemented with 1mg/L IBA in strawberry cv. Festival.

In the present study storage conditions and IBA treatments exhibited a great effect on length and diameter of primary roots (Table 2). The maximum length of primary roots (26.70 cm), diameter of primary roots (2.33 mm) was recorded in cuttings stored for a period of 7 days at 22 ≤ C in growth chamber and minimum length of primary roots (17.73 cm), diameter of primary roots (1.58 mm) was observed in cuttings stored for 28 days in growth chamber. So far as the effect of IBA treatments is concerned, the maximum length of primary roots (23.30 cm), diameter of primary roots (2.16 mm) was recorded in cuttings treated with IBA 2500 ppm and the minimum length of primary roots (20.29 cm), diameter of primary roots (1.60 mm) was observed in cuttings treated with IBA 1500 ppm. The interaction effect between storage time and IBA concentration was found to be non- significant. The maximum length of roots (28.60 cm) and diameter of roots (2.63 mm) was recorded in cuttings with treatment combination of 7 days storage time along with IBA 2500 ppm. The storage of cuttings for 7 days enhances the callusing and initials of root initiation process. Therefore, the longer primary roots could have been achieved with optimal preconditioning treatment of 7 days storage. So far as IBA application is concerned, results in general are in agreement with the findings of Wagner and Oprita (1985) who reached the same conclusion in sweet cherry that low auxin concentration cause lower root numbers but increase its length and higher concentration increases the root number and decreases its length. Application of IBA may have triggered the early anticlinal cell division and root primordial formation than and considered better than NAA (Ali *et al.*, 2009).These findings are also in agreement with Abousalim *et al.* (1993), who also observed maximum number of roots and diameter in cuttings of olive when treated with increasing level of IBA up to 4000 ppm. Parasana *et al.* (2013) recorded maximum length of root (36.17 cm) in mango seedling in growing media i.e. Soil + Sand + Farm Yard Manure (2: 1: 1) under net house conditions.

The results revealed that storage conditions and different IBA treatments exhibited a significant effect on average fresh weight of roots and dry weight of roots (Table 3).The maximum fresh weight of roots (2.03 g) was recorded in cuttings stored for 7 days in growth chamber and the minimum fresh weight of roots (1.62 g) was observed in cuttings stored for 28 days. As evident from the perusal of results obtained in this experiment that the IBA concentrations also exerted a significant effect on fresh weight of roots. The maximum fresh weight of roots (2.44 g) was recorded in cuttings treated with IBA 2500 ppm and the minimum fresh weight of roots (1.23 g) was found in cuttings treated with IBA 1500 ppm. The effect of interaction between storage time and IBA concentration was found to be significant on fresh weight of roots. The maximum fresh weight of roots (2.89 g) was recorded in cuttings with treatment combination of 7 days of storage time along with IBA 2500 ppm. However, the minimum fresh weight of roots (1.10 g) was recorded in cuttings with treatment combination of 28 days storage time along with IBA 1500 ppm.These observations are supported by the findings of Bhat (2000) who obtained greater number, diameter and length of root in pomegranate cuttings with IBA treatment (500ppm) along with Borax 1% and consequently resulted in greater fresh and dry weight of

roots. The increase in fresh weight of the roots reflects the root growth in terms of length as well as number therefore the cuttings with 7 days of preconditioning heat treatment and 2500 ppm IBA application in apple was found to be optimal

As evident from the perusal of the results obtained in studies revealed that the storage conditions and IBA treatments exert a significant effect on dry weight of roots. The maximum dry weight (1.00 g) was recorded in cuttings stored for 7 days in growth chamber and the minimum dry weight of roots (0.62 g) was observed in cuttings stored for 21 days irrespective of IBA treatments. As evident from the results obtained in the studies conducted indicates that the maximum dry weight of roots (1.35 g) was recorded in cuttings treated with IBA 2500 ppm. However, the minimum dry weight of roots (0.32 g) was found in cuttings treated with IBA 1500 ppm.The effect of interaction between storage time and IBA concentrations was found to be significant on dry weight of roots The maximum dry weight of roots (1.83 g) was recorded maximum in cuttings with treatment combination of 7 days storage time with IBA 2500 ppm and the minimum dry weight of roots (0.18 g) was recorded in cuttings with treatment combination of 21 days of storage time with IBA 1500 ppm. These observations are in agreement with the findings of Dutra *et al.*,(2002) who recorded the greater dry matter of roots as well as highest rooting percentage and more number of roots with treatment of IBA in the cuttings of peach cv. Diamante, Capdeboscq and BR-2. Webster *et al*., (1990) reported that temperature of 21°C was found to be most suitable for most rootstock, whereas higher temperature were required for successful rooting of apple scions.

The result obtained in this experiment indicates that cuttings stored in growth chamber for a period of 7 days treated along with IBA 2500 ppm were found to be the best for better rooting in cuttings of apple clonal rootstock Merton 793.

REFERENCES

Abousalim, A., Walali, L. D. M. and Slaqui, K. 1993. Effect of phonological stage on rooting of olive cuttings in heated flames. *Olivae*. **46:** 30-37.

Ali, A., Touqeer, A., Nadeem, A. A. and Ishfaq, A. H. 2009. Effect of different concentration of auxins on in vitro rooting of olive cultivar 'Moraiolo'. *Pakistan J. Botany*. **41(3):** 121-123.

Aslantas, R. and Karakurt, H. 2007. The changes in vegetative growth, pomological characteristics and chemical contents of some apple cultivars growing in two different altitude sea levels. Turkish with English Abstract. *Turkish V. National Horticulture Congress*. **7**: 842-846.

Bhat, J. D. 2000. Effect of plant growth regulators and other chemicals on rooting of cuttings in pomegranate (*Punica granatum* L.) cv. Ganesh. M.Sc. Thesis. Department of Fruit Science.Dr. Y S Parmar University of Horticulture and Forestry, Nauni, Solan- 173230 (H.P).

Bhusal, R. C. Mizutani, F. Moon, D. G. and Rutto, K. L. 2001. Propagation ofcitrus by stem cuttings and seasonal variation in rooting capacity. *Pakistan J. Biological Sciences*. **4**: 1294-1298.

Child, R. D. and Hughes, R. F. 1978. Factors influencing rooting in hardwood cuttings of apple cultivars. *Acta Horticulturae*. **79:** 43-48.

Diengngan, S. and Murthy, B. N. S. 2014. Influence of plant growth promoting substances in micropropagation of strawberry cv. *Festival*. *The Bioscan*. **9(4):** 1491-1493.

Dutra, L. F. Kersten, E. and Fachinello, J. C. 2002. Cutting time indole-3-butyric acid and tryptophan in rooting of peach tree cuttings. *Scientia Agricola*. **59(2):** 327-333.

Ercisli, S. Esitken, A. Cangi, R. and Sahin, F. 2003. Adventitious root formation of kiwifruit in relation to sampling date, IBA and *Agrobacterium rubi* inoculation. *Plant Growth Regulators*. **41:** 133-137.

Gomez, K. A. and Gomez, A. A. 1984. In: Statistical Procedure for Agricultural Research 2nded. New York: Willey Interscience. pp. 304-309.

Hartmann, H. T. Kester, D. E. Davies, F. T. and Geneva, R. L. 2002. Plant propagation: principles and practices, 7th Edition. **1:** 410.

Karakurt, H. 2006. Determination of effects of some bacteria strains on fruit setting, fruit properties and plant growth on apple. *M.Sc. Thesis Graduate School of Natural and Applied Sciences, Ataturk University*.

Negi, A. 2011. Studies on the multiplication of apple clonal rootstocks through cuttings. *M. Sc. Thesis Dr. Yashwant Singh Parmar University of Horticulture and Forestry Nauni, Soaln (H.P.)* p. 69.

Pandit, A. H. Bhat, K. M. Wani, M. S. Mir, M. A. Mir, S. M. Dalal, M. R. and Dar, B. N. 2011. Effect of indole -3- butyric acid on cuttings of MM 106 and MM 111 apple rootstocks. *Acta Horticulturae*. **903:** 431-433.

Parasana, J. S. Leua, H. N. and Ray, N. R. 2013. Effect of different growing medias mixture on germination and seedlings growth of mango (*Mangifera indica* L.) cultivars under net house conditions. *The Bioscan*. **8(3):** 897-900.

Tsipouridis, C., Thomidis, T. and Isaakidis, A. 2003. Rooting of peach hardwood and semi - hardwood cuttings. *Australian J. Experimental Agriculture*. **43:** 1363-1368.

Ullah, T. Wazir, F. U. Ahmad, M. Analoui, F. Khan, M. U. and Ahmad, M. 2005. A breakthrough in guava (*Psidium guajava* L.) propagation from cutting. *Asian J. Plant Sciences*. **4:** 238-243.

Wagner, S. T. and Oprita, V. 1985. Sweet cherry inter specific hybrids propagation by soft cutting using stimulators. *Acta Horticulturae*. **169:** 363-367.

Webster, A. D. Christine, A. Howard, B. H. and Harrison, R. S. 1990. Factors involved in the rooting response of apple winter cuttings to high basal temperatures. *J. Horticultural Science*. **65:** 7-14.

Webster, A. D. and Wertheim, S. J. 2003. Apple rootstocks. In: Ferre, D.C. and Warrington I.J. (eds.). Apples: Botany, Production and Uses. pp. 91-124.