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Effect of plant growth regulators on rooting of apple root stock MM106 Cuttings

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Abstract
The experiment was conducted in a mist chamber to study the effect of different plant growth regulators comprising of five concentrations each and in combination on rooting and shooting parameters of MM106. Among the various treatments used in the experiment it was found that I_2 (IBA 1000 PPM) gave the best response in respect of all the parameters studied viz., maximum number of roots/cutting (3.93), girth of the thickest root (1.38 mm), length of the longest root (4.47 cm), percentage of rooting/cutting (45.37), survival percentage of rooted cuttings (60.00) number of leaves/cutting (2.27), number of secondary branches/cutting (1.87) cutting and number of leaves/sec. branch (4.60) and minimum was with control. With the increase in concentration of GA3 it has consistently inhibited adventitious root formation.

Keywords: MM - 106, IBA, GA3

Introduction
The root stock was selected in 1932 from a cross of M.2 x 'Northern Spy' by the John Innes Horticultural Institute and the East Malling Research Station in England. MM.106 EMLA is a semi-dwarf rootstock, producing a tree about 60% the size of seedling. It is quite precocious and productive and usually does not need tree support. It is resistant to wooly apple aphid, but is highly susceptible to crown and root rots, susceptible to fire blight, and is hypersensitive to tomato ring spot virus. When used with 'Delicious' and some other cultivars tomato ringspot virus can cause a hypersensitive reaction called "brown line necrosis" and trees decline in vigor and die. MM.106 EMLA should not be planted on wet sites due to crown and root rot problems. Trees produce few burr knots and root suckers. This rootstock has been grown widely throughout North America since the 1960s and may be a good choice for home gardens with well-drained soils and space for semi-dwarf trees, but its use is declining for commercial orchardists who are interested in smaller trees with fewer disease problems. With apple, studies with isolated shoots suggest that the cytokinins which are transported from rootstock to scion in the xylem sap have a major control in shoot growth and any effect of rootstock or interstock on these growth regulators is likely to be of greater significance than effects on the phloridzin, gibberellins or ABA of the sap. The graft unions of dwarfing rootstocks or interstocks with the scion appear to deplete the solute of the xylem sap including the cytokinins. With cherry, studies with the hybrid cherry rootstock 15 (*Prunus avium* x *P. pseudocerasus*) indicate that it is very dwarfing as a scion but very invigorating as a rootstock. As an interstock it has no effect unless allowed to produce some small shoots and then it dwarfs by 20–30%. Vegetative propagation is preferred because it ensures true to type plants, uniform quality & regular bearing. The purpose of treating cuttings with auxin type growth regulators is to increase the percentage of rooting, to hasten root initiation, to increase the number and quantity of roots produced per cuttings and to produce uniformity of rooting. Trees on these rootstocks are vigorous, precocious, less thorny, highly drought resistant and heavy bearer. In view of these characters, the present investigation was carried out.

Material and Methods
The present experiment was conducted in the mist chamber of ICAR-, Central Institute of temperate horticulture. The cuttings were made on April, 2013 and were treated with IBA and GA_3 concentration alone and in combination as per different treatments by quick dip method. There were five different concentrations of IBA (I_0-Distilled water, I_1-500ppm, I_2- 1000ppm, I_3-1500ppm, I_4- 2000ppm) and five different concentrations of GA_3 (G_0-Distilled water,G_1-50ppm, G_2- 100ppm, G_3- 150ppm, G_4-200ppm).Fifteen cutting were taken under each treatment in three replications, so there were five cuttings in each replication under each treatment. About six months old mature branches were selected and cuttings were made about 15-20cm in length possessing 4-6 dormant buds with 2-3 leaves. While making cutting the lower basal cut was made horizontally at right angle to the axis and the upper cut was given just above the opposite side of the bud. The cuttings were dipped in respective growth regulators for 30 seconds. To see the combined effect of IBA & GA_3 the cuttings were treated first with GA_3 solution and then in IBA solution. After dipping the cuttings, they were removed and planted closely in rooting media sand. The cuttings were examined after 15 days of interval. The average number of roots/cuttings, average number of leaves/cutting, average number of secondary branches/cutting, average number of leaves/secondary branch, average length of the longest root, average girth of the thickest root, percentage of rooting/cutting and survival percentage of the rooted cuttings were recorded. The data were analyzed statistically as per method of analysis of variance [3].

Results and Discussion

The highest number of roots/cutting (4.82) was recorded with I_2 (1000ppm IBA) where as significantly lowest number of roots/cuttings (1.90) were recorded with I_O level of IBA. Similarly the highest percentage of rooting/cutting (47.29) was recorded with I_2 (1000ppm IBA) and lowest percentage of rooting/cutting (25.37) were recorded with I_O level of IBA. This might be due to that auxin is required for initiation of adventitious roots on stems and indeed it has been considered that divisions of the first root initial cells are dependent upon either applied or endogenous auxin [4].

Similarly GA_3 application at G_O level had recorded significantly the highest number of roots/cutting and highest percentage of rooting/cutting followed by G_1 level of GA_3 and lowest due to G_4 (200ppm GA_3) (Table.1).It is seen that GA_3 also increased number of roots/cutting from higher level to lower level, may be due to cell elongation by synthesizing enzymes and the effect of inhibitors [5].The proportional decrease in number of roots/cutting and percentage of rooting/cutting have been recorded with the increase in the levels of GA_3 [6]. The maximum girth of the thickest root (1.38mm) and length of the longest root (4.47cm) were recorded significantly with I_2 (1000ppm IBA) level and minimum girth of the thickest root (0.80mm) and length of the longest root (2.20cm) were recorded with Io level of IBA. Similarly Go level of GA_3 produced the maximum girth of the thickest root and length of the longest root as compared to other levels of GA_3, whereas minimum girth of the longest root and length of the thickest root was recorded with G_4 level of GA_3. (Table 1). This may be due to that auxin play an important role in the metabolic activities and cell division which results in an increase of the growth of root [8, 9]. Thus it may be concluded that increase in the size of roots judged in terms of length and diameter was due to IBA treatment. This result was in confirmity with the findings of Dhua *et.al* [10] in Jack fruit, Sandhu *et.al.* [11] in Sweet lime and Kin *et. al* [12] in *Citrus junos*.. The maximum survival percentage of rooted cuttings (60.00) was also recorded with I_2 level of IBA and minimum survival percentage of rooted cuttings (34.66) was recorded with Io level of IBA. Similarly Go level of GA_3 recorded maximum survival percentage than other level of GA_3 and G_4 level recorded minimum survival percentage of rooted cuttings.

The maximum number of leaves/cutting (2.27) was recorded with I_2 level of IBA and minimum number of leaves/cutting (1.17) was with Io where as other treatments remain at par. Similarly in case of GA_3, Go level recorded the highest number of leaves/cutting and G_4 recorded the lowest number of leaves/cutting (Table 2). The present finding suggested that number of leaves increased in the same trend as the number of roots increased with the same treatment. This may be attributed to its effect of shifting of assimilate partitioning from roots to leaves or leaves to roots and increased levels of chlorophyll and carbohydrates in leaves, stems and roots besides increased mineral content, hormonal balance and soluble protein in leaves.

The highest number of secondary branches/cutting (1.87) and number of leaves/sec. branch (4.60) were recorded with I_2 (1000ppm IBA) where as lowest number of secondary branches (1.33) and number of leaves/sec branch (2.06) were recorded with Io. Similarly Go level of GA_3 recorded the highest number of secondary branches/cutting and number of leaves/secondary branch and was lowest with G_4 level of GA_3. As the number of roots increased under IBA treatment so more number of apical roots also increased which are responsible for synthesis of cytokinin thus lead to the formation of more number of secondary branch per cutting and number of leaves/secondary branch. This result was in conformity with the findings of Abdul *et. al.* [15]

Table 1: Effect of different doses of growth regulators on Rooting Parameters of cuttings.

Treatments	Number of roots/ cutting	Girth of the thickest root (mm)	Length of the longest root (cm)	Percentage of rooting/cutting	Survival percentage of rooted cuttings
I_O (Distilled water)	2.20	0.80	2.20	25.37	34.65
I_1 (500 PPM)	3.27	1.05	2.87	37.05	45.49
I_2 (1000 PPM)	4.82	1.38	4.47	47.29	60.00
I3 (1500 PPM)	3.33	1.11	3.13	38.45	53.06
I_4 (2000 PPM)	2.60	1.07	2.47	31.50	42.26
C.D at 5%	1.32	0.20	0.60	5.72	4.01
G_O (Distilled water)	5.26	1.76	6.20	60.12	57.69
G_1 (500 PPM)	3.33	1.22	3.27	39.97	50.12
G_2 (1000 PPM)	2.73	0.93	2.40	31.53	45.89
G_3 (1500 PPM)	1.90	0.82	1.78	25.35	42.79
G_4 (2000 PPM)	1.80	0.68	1.48	20.78	38.33
C.D at 5%	1.32	0.20	0.60	5.72	4.01
Interaction (IxG) C.D. at 5%	2.96	0.45	1.36	12.79	8.97

Table 2: Effect of different doses of growth regulators on vegetative parameters of cuttings.

Treatments	Number of leaves/cutting	Number of secondary branches/cuttings	Number of leaves/sec. branches
I_O (Distilled water)	1.17	1.33	2.06
I_1 (500 PPM)	2.00	1.60	2.87
I_2 (1000 PPM)	2.27	1.87	4.60
I3 (1500 PPM)	1.93	1.60	3.27
I_4 (2000 PPM)	1.73	1.53	2.60
C.D at 5%	0.31	0.17	0.66
G_O (Distilled water)	2.60	2.15	6.20
G_1 (500 PPM)	2.27	1.80	3.40
G_2 (1000 PPM)	1.73	1.60	2.47

G_3 (1500 PPM)	1.33	1.33	1.84
G_4 (2000 PPM)	1.17	1.05	1.48
C.D at 5%	0.31	0.17	0.66
Interaction (IxG) C.D. at 5%	0.71	0.38	1.49

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