J. Basic. Appl. Sci. Res., 3(1s)570-576, 2013

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Effects of Indole Butyric Acid (IBA), Indole Acetic Acid (IAA) and Naphthalene Acetic Acid (NAA) on Woody Cuttings Rooting of Apple M9, MM106 and MM111 Rootstocks

Katayoon Faghihi [1], Saeed Piri Pyrayvatlo [2], Ali Imani[3]*

[1]Departmentof Horticultural Science, Faculty of Agriculture, Abhar Azad University, Abhar, Iran.
[1]Department of Horticultural Science, Faculty of Agriculture, Abhar Azad University, Abhar, Iran
[3]* Department of Horticultural Science, Seed and Plant Improvement Institute (SPII), Karaj, Iran.
Received: June 12 2013
Accepted: July 8 2013

ABSTRACT

Apple is one of the most important fruit crops that mainly for grown in density systems, are needed to dwarf and semi-dwarf rootstocks .Today's interest to achieve ideal rootstocks, especially easily rooting rootstocks increasing and among the commercial rootstock, MM111, MM106 and M9 rootstocks are used extensively for the Apple culture purpose .But sometimes, propagation these rootstocks using usual methods particularly propagating by cuttings.is difficult .Therefore, to optimize the propagation MM106, M9 and MM111 rootstocks from woody cuttings, the effect of different concentrations of hormones, IBA, IAA and NAA was studied .For this purpose, after preparing woody cuttings of MM111, MM106 and M9 rootstocks with fungicide Benomel was disinfected. After that cuttings with hormone indole Butyric acid (IBA), indole acetic acid (IAA) and naphthalene acetic acid (NAA) at three levels(0, 3500 and 5500 ppm) were treatment and in bed of perlite and sand (50:50 ratios) planted in greenhouse using factorial base on randomized complete bloke design (RCBD) in triplicate. In this study it was found that all the studied traits such as root length, maximum root length ,shoot length, root dry weight and percentage of rooting were affected by hormones. In addition to the ease of rooting, there was significant difference between the rootstocks. So that MM106 rootstock according to rooting was better than M9 and MM111 rootstocks. In finally, it was concluded in effect of different hormone treatments on rooting MM111, MM106 and M9 cuttings, 3500 ppm treatment on rooting traits was affected in comparison with 5500 ppm treatment. Therefore it can be recommended as appropriate concentration for rooting the woody cuttings of these rootstocks.
KEYWORDS: apple, hormone, rootstock, rooting

1. INTRODUCTION

Today, the policy of horticulture in developed countries is toward to make of density orchards in most fruit trees. Apple tree following dwarf rootstock breeding, it was the first fruit trees planted in dense, and currently working on a large scale for developing apple orchards on dwarf rootstocks in different regions of world. Apple is one of the traditional horticultural crops in Iran that due to lack of technical knowledge among growers, lack knowledge on new varieties, especially insisting on the seedling rootstocks and lack usage vegetative rootstocks and finally, lack the transformation of traditional farming systems into the semi-dense and dense plantings, can be limiting factors the increasing production per unit area. Despite recent advances in micro propagation of fruit cultivation, classic vegetative propagation is still popular classic plays an important role in creating the tree fruit orchards [13, 8].However, it can be linked to graft a uniform method of vegetative propagation of new tree fruit orchards will be considered, but the potential of individual rootstocks to cope with adverse environmental conditions and biotic and abitic stresses was unaware [12**,** 19].Today, in addition to identify the superior cultivars, the rootstocks for the root system to obtain uniformity and earliness are used .In using of rootstocks ,traits such as to control the size(vigor), the ability to adapt to the soil conditions (PH, dryness ,texture, drainage), tolerance to soil diseases and pests (nematodes, insects, diseases) and increased resistance to low temperature particular ease of propagation was considered [11] .Achieve this goal, the reports shows that most of the apple rootstocks has been propagated by cuttings, although in recent years tissue culture is used [1].Both producers and researchers busy for many years the fruit trees propagation by cuttings .Except that the fruits of several species that root easily, others have not propagated successfully by cuttings .Researchers are working on propagation, their success is two-fold by discovering the plant hormone in 1930 [9] .Today, Colonal apple rootstocks by various layering methods, but these methods have some disadvantages as slowly, being bulky and high cost [1, 6].

***Corresponding Author:** Ali Imani, Corresponding author: Department of Horticultural Science, Seed and Plant Improvement Institute (SPII), Karaj, Iran. E-mail: Imani_a45@yahoo.co

Currently, only three rootstocks M9, MM106 and M7 widely were used in commercial orchards. The other rootstocks are added to the Malling rootstocks, which were later removed from the farming business for various reasons. In rootstocks propagation and often the cuttings treated with hormones due to the simplicity of the procedure, but according to report of Morgan and Richards (1993)[13] for successful rooting ,biased of auxin ,other materials is required that are made from the leaves and buds are known as rooting Co-factors .They can be made of sugar and nitrogen in leaves is included Observations have shown that phenolic compounds such as caffeic acid and acid clorojinic interaction with auxin and may stimulate rooting .But hormones particular hormone auxin widely was used in commercial in rootstocks propagation.amoung hormones auxin, some of them have the more effecr on rooting than others. According to report of Ersoy et al (2010)[7], the highest number of roots (27.677) and the maximum length of the root (4/196cm) in treatment whit hormone indole-butyric acid 3500 ppm. Boozari (1995)[5] in her studies on propagation of M9, M26 and MM 106 rootstocks reported that the MM 106 cuttings with rooting percentage was higher than the other two rootstocks and M9 rootstock has the lowest percentage. Cuttings treated with rooting hormones IBA and NAA have highe rooting than control. In this regard, at present research, the effects of Indole Butyric Acid (IBA), indole acetic acid (IAA) and naphthalene acetic acid (NAA) on rooting of woody cuttings of apple M9, MM106 and MM111 rootstocks to optimize thier propagation by cutting was studied.

MATERIALS AND METHODS

This research using plant material including annual woody cuttings with disearable distance between the node and branch diameters of apple M9, MM106 and MM111 rootstocks from mother trees from nursery Moma in Abhar in January 2012 were well prepared and were transferred to the greenhouse in the shortest time possible .Facilities and materials needed to be tested for hormones, IBA, NAA, IAA ,greenhouses, perlite- sand substrate, mist system, heating system and fan system for control heat and moisture .after that,cuttings of M9, MM106 and MM111 was collected from mother orchards and disinfected by 0.003 fungicide Benomel solution for 5 second, were immersed in 0,3500 and 5500 ppm IBA for 5 second and then planted in sand + Perlitee (50:50) mediums usin factorial base on randomized complete bloke design (RCBD) in triplicate in a greenhouse include mist and fan systems. IBA, NAA and IAA hormones, the production of SIGMA company in Germany was Used .Cuttings were handled and prepared by method Sun and Bassuk (1991) [14] for planting in bed of greenhouse.

Bottom heating temperature was set in 23° and 5 sec misting was conducted with 20 min of time intervals in rooting unit. Any chemicals and fertilizers not used during the research. At the end of propagation period, number of rooted cuttings was determined for each treatment and the roots number of plants obtained at the end of propagation. Plant diameters were measured on the section 5 cm higher above soil surface. Plant lengths were measured from bed surface. Also dry weight of root, maximum root long and number of new shoots on pant evaluated. The statistical analysis was performed using Microsoft Excel (2007) and SAS software (SAS Institute Inc, 1990) and means were compared using Duncan's Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Results recorded from the five major traits and characteristics of cuttings tested M9, MM106 and MM111 at different stages of propagation including root length, maximum root length, branch length, dry root weight and percentage of rooting are presented in Tables 1 to 3 and Figures 1 to15.

Table 1 Analysis of variance for the effects of various hormones on the rooting characteristics of apple rootstocks

SOV	DF	M.S				
		Root length	Maximum root length	Branch length	Dry root weight	Rooting
Repeat	2	0.048 ns	ns 0.074	0.0657 ns	0.000038 ns	34.3 ns
Rootstock	2	7.778 *	10.890 *	5.6335 *	0.110998**	1008.3 **
Hormone	8	90.450 **	108.376 **	16.7045	0.115496**	7552.1 **
Rootstock × Hormone	16	1.226 ns	1.050 ns	0.5757 *	0.001343 ns	38.9 *
Error	32	0.025 ns	0.01 ns	0.0246 ns	0.000156 ns	25.8 *
%CV		1.61	1.24	3.18	3.13	8.10

** Means are significantly different at p<0.01.;* means are significantly different at p<0.05.; ns means are not significantly different

As can be seen in the table above, effect of rootstock on cuttings root length of apple rootstocks of choice is statistically significant at the 0.01 level. Besides comparing the results of (Figure 1) that the maximum(10.36 cm) and a minimum (9.43 cm) length was observed in rooted cuttings of the rootstocks MM 106 and MM 111and M9

respectively. Also, the analysis of variance (Table 1) shows that the rootstock effect on the maximum character length was significant at the 5% level, and compare the results (Figure 2), the highest maximum root length in rootstock MM 106 (11.49 cm) and minimum root length in rootstocks M9 and MM 111was obtained.

With regard to analysis of variance (Table 1),it was founded that the rootstock effec on branch at 5% level was significant, so that the maximum length of the branches in rooted cuttings of the rootstock MM 106 (5.42cm) and minimum root length in rootstock of MM 111 (4.53 cm) was observed (Figure 3) .The analysis of variance of Table 1 shows that the rootstock type effect on root dry weight at 1% level was significantly,so that the highest root dry weight in rootstock MM 106 (0.46 g) and the lowest root dry weight in rootstock MM 111 (0.33 g) was pragmatic(Figure 4).Rooting rate was also affected by rootstock type (Table 1) so that the highest rate of rooting in rootstock MM 106 (68.70%) and the lowest rooting in rootstock MM 111 (56.48%) was obtained (Figure 5).As in Figure 6 can be seen in terms of the length of root cuttings influence of three hormones, IBA and NAA and IAA applied to the difference between them is statistically significant at the 1% level, there was so much rootstock length (13.82 cm) Hormone levels of 3500 ppm is the lowest hormone IBA (5.10 cm) at a concentration of 5500 ppm hormone IAA was observed, According to Alvarze et al (1989)[3],this may be due to concentration for rooting,because the inhibitory effect of high concentration and low concentration is due to insufficient production of roots, and the report shows that the most effective rooting hormones like IBA, stimulates root primordia development in cuttings home is perhaps why there is a difference compared to control [15].

The maximum length of rooted cuttings rootstock in the study found that this trait is also affected by hormonal treatments and control. Treatment 3500 ppm Hormone IBA was superior to the other treatments (Figure 7). So, the most effect on maximum length of rooted cuttings (15.30 cm) was observed in the IBA 3500 and Minimum is hormone IAA 5500 (5.74 cm). The side effect of treatment with hormones on the branching rooted cuttings compared with control (Figure 8) showed that There was significant difference between the control and hormone IBA concentration of 3500 ppm, with the highest shoot length (7.07 cm) and determined that the IBA rooting hormone is more effective than branch development [5,7]. The lowest branch of rooted cuttings (3.08 cm) was observed in hormone IAA 5500. Data from different levels of hormones, IBA and NAA and IAA treatments on root dry weight of rooted cuttings (Figure 9) showed the highest root dry weight (0.56 g) in 3500 ppm hormone treatments NAA and the lowest (0.26 g) is levels of 5500 ppm treatment IAA. In connection with the study of hormones on rooting cuttings (Figure 10) also revealed the highest rate of rooting (88.33%) was in hormone NAA 3500 and the lowest amount of rooting (18.89 %) in hormone IAA 5500. Evaluation of rootstock and woody cuttings interactions on cuttings rooting, it was found that all the properties affected by the interaction of hormones and rootstock and have a significant difference thier between. As Figure 11 is observed , the length of rooted cuttings in MM106 rootstock treated with hormones NAA3500 and IBA 3500 had the most effect on root length (14.63 and 14.20 cm, respectively) and the length of rooted cuttings of MM111 rootstock in hormone-treated IAA 5500 had minimum length (4.00 cm). Figure 12 also shows the maximum length of the MM106 rootstock cuttings treated with hormone IBA 3500 (4.83 cm) was obtained while minimum effect on root length (16.13 cm) on MM111 rootstock cuttings with hormone treatment at the IAA 5500 have been followed. In Figure 13, the highest stem length (7.63) in rootstock MM106 cuttings treatment by hormone NAA 3500 and the lowest shoot length (2.63 cm) on the MM111 rootstock cuttings treated with hormone IAA 5500 were found. Figure 14 showed significant differences between treatments on root dry weight so that you can see the most root dry weight (0.6g) in rooted cuttings of MM106 with hormone treatment NAA 3500 and the lowest root dry weight in rooted cuttings of MM111, 0.2167 and 0.21 gr with hormones IAA 5500 and IBA 5500 were found respectively.Finally, Figure 15 shows that the highest rooting (95%) in the cuttings of MM106 and treated with hormones, NAA 3500, IBA 3500 IAA 3500 and the lowest rooting (16.66%) had the MM111 cuttings treated with hormones, NAA 5500, IBA 5500 IAA 5500.

In this experiment, it was found that effect of rootstock and hormone on rooting cuttings traits such as root length, maximum root length, shoot length, root dry weight and cuttings rooting was different and statistically significant at 1% and 5% 5500 concentrations of each of these hormones had the least impact on each of the traits. Sometimes, control had effect better than 5500 concentrations of each of these hormones. Similar results were tested and the highest number of roots (27.67) and the maximum length of the root (4.19 cm) in treated with hormone indole-butyric acid was 3500 ppm [7]. Hormones may be in higth consentration have inhibitor effects on cullusing and rooting the cuttings. In comparting hormones, hormoneIAA effect compared to two other hormones was litile, and of course, in the comparison rootstocks, it was founded, rootstocks MM 111 compared to the other low tendency to hormones indicated. According to, report of Bouzari, MM106 as easy to root and hormone IBA effective were observed. Also similar results reported in Alvarze et al (1989)[4] and Karakurt et al (2009), the use of IBA in increasing rooting at the rootstock of the M26 and M9. On the other hand, according to Delargy and Wright (2006)[5] and Alston and Watkins (1973)[2] Indole Butyric Acid increases rooting and root elongation in cuttings of

Bramly cultivar of apple. Also , Sun and Bassuk,(1991)[14] showed that in cutting of MM106 rootstock, 2000 to 5000ppm IBA increased cutting rooting in comparative with control(without hormone treatment).At present research ,cuttings of MM106 and M9 almost had similar physiological behavior. In general, it can be recommended, concentrations 3500 ppm of NAA and IBA will be suitable for rooting rootstocks especially MM106.

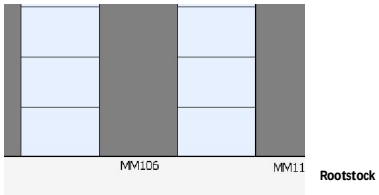

Figure 2. Effect of the rootstock on the maximum root length

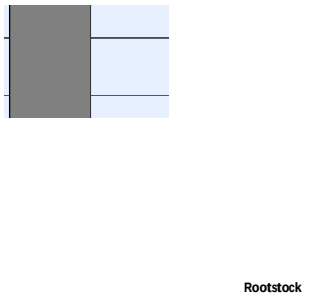

Figure 1. Effect of the rootstock on the root length

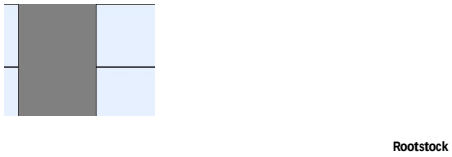

Figure 4 .Effect of the rootstock on the dry root weight

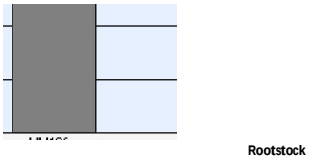

Figure 3 .Effect of the rootstock on the branch length

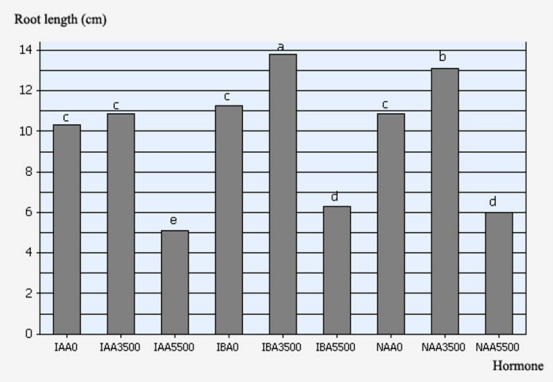

Figure 6 . Effect of the hormone on the root length

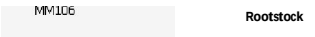

Figure 5 . Effect of the rootstock on the rooting

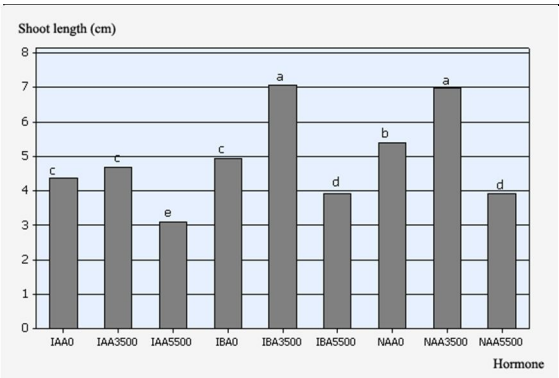

Figure 8 -Effect of the hormone on the branch length

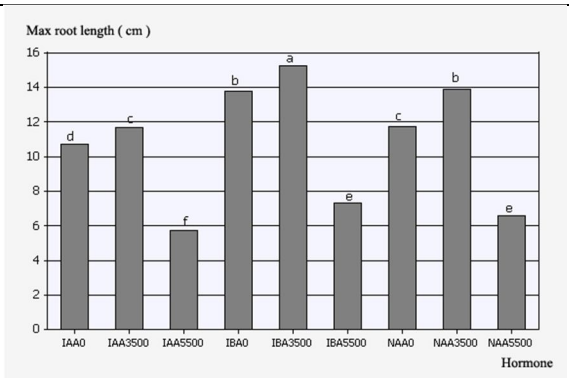

Figure 7 - Effect of the hormone on the maximum root length

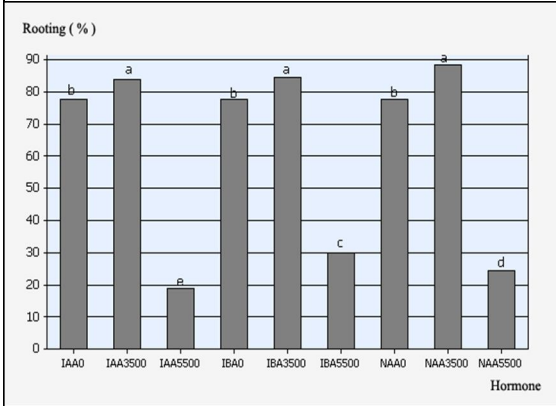

Figure 10 .Effect of the hormone on the rooting

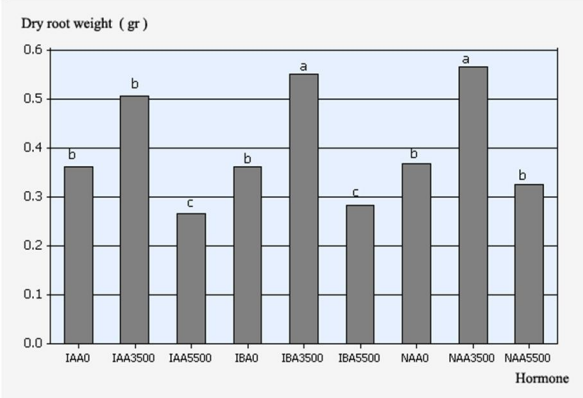

Figure 9 .Effect of the hormone on the dry root Weight

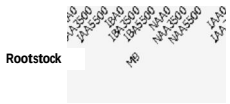

Figure 12. rootstock and hormone interactions on maximum root length

Figure 11. rootstock and hormone interactions on root length

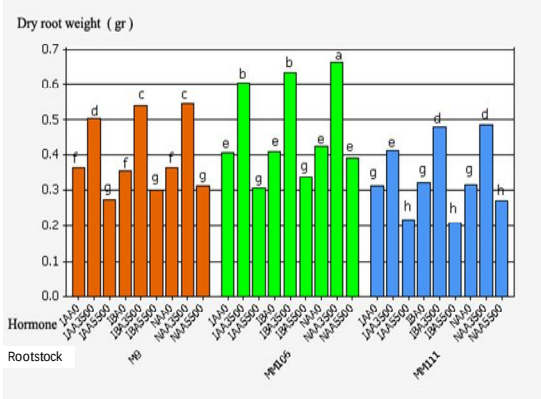

Figure 14. rootstock and hormone interactions on dry root weight

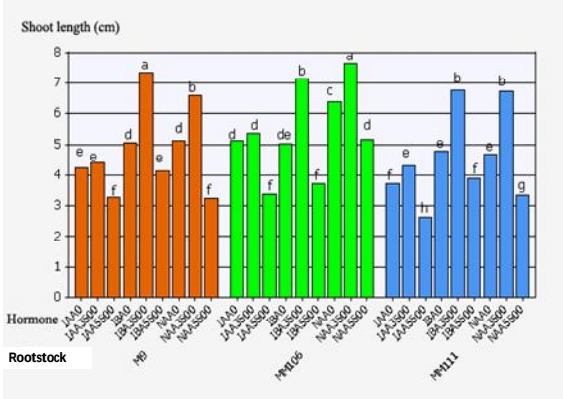

Figure 13. rootstock and hormone interactions on branch length

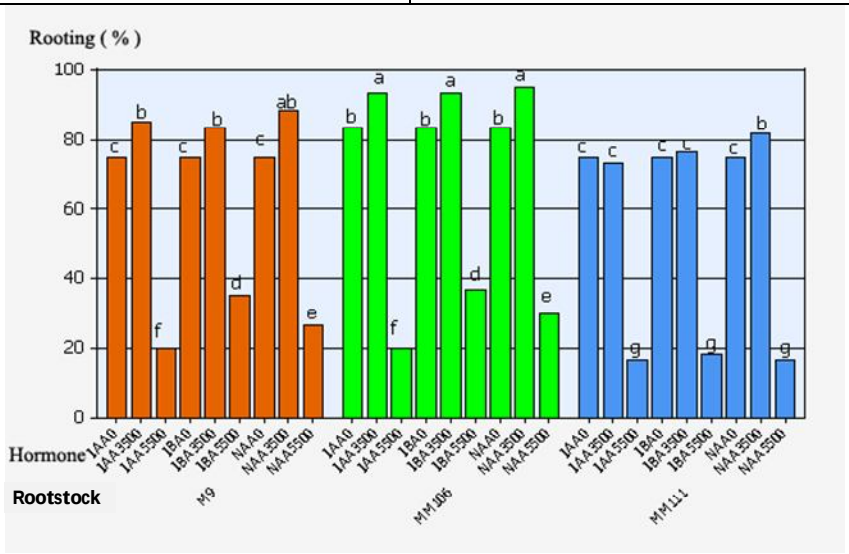

Figure 15 - rootstock and hormone interactions on rooting

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