

Propagation of *Ficus benjamina* var. Starlight by Stenting Technique under Different Concentrations of IBA in Various Times of Taking Cutting

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Ficus benjamina L. is indoor plant in temperate areas that is a tree species belongs to Moraceae family. Propagation of this plant is down by vegetative method. This study was conducted to evaluate the effect of IBA concentration and time of taking cutting on propagation of *Ficus benjamina* via stenting technique in Gorgan University of Agricultural Sciences and Natural Resources, in 2012. Treatments were consisted of auxin concentrations in four levels (0, 2000, 4000 and 6000 mg/l) and the cutting time (late June and early September). The experiment was performed as factorial in a completely randomized design with four replications so that ten samples were used at each replication. Percentage of graft success, rooting percentage, root number, longest root length and root dry weight were evaluated. Based on the results, largest percentage of graft success obtained in all the treatments that the hormone was used (2000, 4000, 6000 mg/l) and lowest was achieved in the control treatment. Highest rooting percentage and maximum of root number were gained in 4000 mg/l and 6000 mg/l. Longest root length and maximum of root dry weight were recorded in cuttings treated with 4000 mg/l IBA. In treatment of cutting time, all traits were the highest in early September. The results showed that IBA and time taking cutting had a large impact on the success of graft and rooting.

Abstract

Keywords: Auxin, *Ficus benjamina* L., Graft, Rooting, Stenting.

INTRODUCTION

Ficus benjamina L. plant (weeping fig) is a tree species belongs to Moraceae family, it is native to tropical Southeast Asia. Since it has been adapted to indoor conditions, it represents an important component of the foliage interior landscape (Abdou *et al.*, 2004; Veneklass *et al.*, 2002). This plant is propagated through vegetative method (Siddiqui and Hussain, 2007). Stenting is a vegetative method for quick propagation of plants. Cutting and grafting is performed simultaneously. The scion is grafted onto a non-rooted rootstock. The formation of the union and adventitious roots on the rootstock occurs simultaneously. Stenting is now being used worldwide by rose growers (Karimi, 2011; Nazari *et al.*, 2009) and is also a valuable technique in propagating species of conifers and also rhododendron, apple, plum and pear (Hartman *et al.*, 2002). Essential role of auxin has been demonstrated in induction of rooting and root formation. Auxin has an effect on the speed and increasing the percentage of rooting of cuttings. Plants produce natural auxin in the young shoots and leaves, but the synthetic auxin should be used for successful rooting to prevent cuttings death (Stefanic *et al.*, 2006; Kasim and Rayya, 2009). Siddiqui and Hussain (2007) studied the effect of IBA on rooting of *Ficus hawaii* with various concentrations of IBA (1000, 2000, 3000, 4000 and 5000 mg/l) and showed that maximum length and number of roots per cutting, maximum number of branches and leaves and highest sprouting percentage were obtained at a concentration of 4000 mg/l. Time of taking cuttings plays an important role in success rooting and development stages of cuttings. This may be related to changes in the indigenous plant growth regulators or carbohydrate conditions and environmental conditions in nursery (Abdou *et al.*, 2004; Elgimabi, 2008). Ercisli *et al.* (2002) in their study on kiwifruit showed that the highest rooting percentage, maximum length and number of root were in hormonal treatments of 6,000 mg/l. Also taking cuttings in February was better rooting compared to January. Sharma and Verma (2011) studied the impact of cutting time on the rooting response of *Pinus roxburghii*. In this study they collected cuttings in four times (March, June, September, December) and then they were treated with 4000 mg/l IBA. Results showed that June is the best time for rooting of cuttings in *P. roxburghii*. Considering the positive roles of IBA and cutting time on rooting, in the present study, we investigated the effect of different concentrations of IBA and time of taking cuttings in propagation of *F. benjamina* by stenting technique.

MATERIALS AND METHODS

This experiment was performed in a mist greenhouse, Gorgan University of Agricultural Sciences and Natural Resources, in 2012. The experiment was performed as factorial in a completely randomized design with two factors in four replications so that ten sample of cutting-grafting was used at each replication. The first factor included different concentrations of IBA (0, 2000, 4000 and 6000 mg/l) and the second factor was the time of taking cuttings (late June and early September). In this study, '*F. benjamina* var. starlight' and '*F. benjamina* var. Green leaf' were used as scion and stock, respectively. Grafting operation was performed with "omega grafting tools". The stock and scion were taken from leafy shoots to be 5 to 10 cm in length and a 0.5-1 cm in diameter. Bottom of the rootstocks were treated with IBA hormone at different concentrations and then were placed in the medium of cocopeat and perlite in a 1:1 ratio. After 50 days, samples were removed from the bed and the desired traits were measured. These traits included the percentage of graft success, percentage of rooting, longest root length, root number and root dry weight. To prevent of fungal infection, samples were sprayed with fungicides 'Benomyl' every 15 days. Data analysis conducted via SAS software and mean comparison was done using LSD test.

RESULTS AND DISCUSSION

Based on analysis of variance (Table 1), different concentrations of IBA in level of %1 and time of taking cutting in level of 5% were significant on the percent of graft success while the in-

teraction of experimental treatments did not affect on traits significantly. Data mean comparison of auxin concentrations (Table 2) showed that the largest percentage of graft success obtained in all the treatments that the hormone was applied (2000, 4000 and 6000 mg/l). So that they did not make a significant difference but significant differences had with the control. Auxin levels of stock and scion are variable. Plant hormones, especially auxin play an important role in callus induction, stimulate of cell division, cambium layer formation and differentiation of vascular tissue play (Kazankaya *et al.*, 1997; Mehmet *et al.*, 1997). Data mean comparison of time of taking cutting (Table 3) showed that early September has highest percent of graft success compared with late June. Environmental and physiological conditions of the plant have a significant impact on the graft success. Suitable environmental conditions cause the rapid flow of plant sap at the stock and scion which led to formation of cambium layer, vascular tissue and graft success (Islam *et al.*, 2004; Sharma and Verma, 2011).

Based on analysis of variance (Table 1), different concentrations of IBA and time of taking cutting were significant in level of %1 on percentage of rooting and number of root per sample. The interaction of experimental treatment was significant in level of %1 on number of root while did not affect on percentage of rooting significantly. Data mean comparison of auxin concentrations (Table 2) showed that the highest percentage of rooting and number of roots obtained in 4000 and 6000 mg/l IBA. Natural or synthetic auxin is necessary for root formation on stem. Auxin also stimulates the formation of adventitious roots in many species through facilitating of carbohydrates transferring and nitrogen materials transferring to the cutting base and root primordia motivating (Hartman *et al.*, 2002). Data mean comparison of time of taking cutting (Table 3) showed that early September has highest percentage of rooting and number of root per cutting compared with late June. The amount of endogenous growth regulators, rooting cofactors and carbohydrates is different during the growing season and for this reason, taking cuttings done at the suitable time of year (Hartman *et al.*, 2002). Environmental conditions in the greenhouse can also be effective on rooting of cutting-grafting (Nair *et al.*, 2008). High temperature and high light cause heat stress

Table 1. Analysis of variance of treatments effect on the measured traits.

Source of variations	df	MS				
		Percent of graft success	Root percentage	Longest root length	Root number	Root dry weight
Replication	2	35.62	1.1	0.28	0.253	0.00001
Factor A (IBA)	3	323.04 **	1250 **	12.01 **	35.69 **	0.0002 **
Factor B (cutting time)	1	276.96 *	816.66 **	81.65 **	26.27 **	0.0025 **
A × B	3	10.10 ^{ns}	5.55 ^{ns}	1.22 ^{ns}	3.69 **	0.00006**
Error	14	32	90.47	0.74	0.58	0.000007
CV (%)	-	6.57	14.09	12.31	11.44	9.05

ns: Nonsignificant differences - * & **:significant difference at 1% and 5%

Table 2. Data mean comparison of IBA concentration on the measured traits.

IBA concentration (mg/l)	Percent of graft success	Root percentage	Longest root length (cm)	Root number	Root dry weight (g)
0	75.83b	50b	5.66c	4.41b	0.023d
2000	87.61a	61.66b	6.24bc	4.76b	0.029c
4000	88.14a	81.66a	8.90a	8.31a	0.037a
6000	93.14a	76.66a	7.14b	9.20a	0.033b

The dissimilar letters in each column indicate significant differences between them.

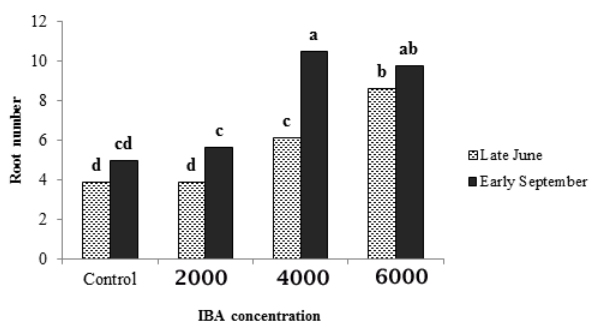


Fig. 1. The interaction of IBA concentration and cutting time on root number per cutting.

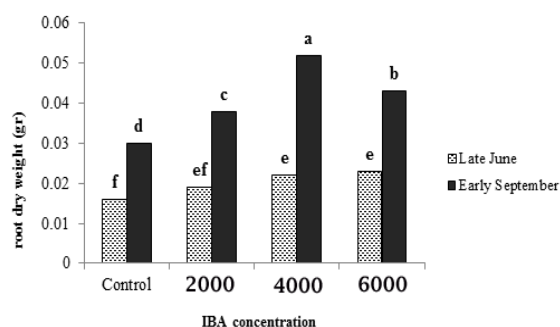


Fig. 2. The interaction of IBA concentration and cutting time on root dry weight.

and loss of cutting moisture which may result in reduction of rooting in late June compared to early September. Data mean comparison of the interaction of experimental treatment (Fig. 1) revealed that the highest number of root was seen at 4000 and 6000 mg/l IBA and time of taking cutting of early September.

Based on analysis of variance (Table 1), different concentrations of IBA and time of taking cutting were significant in level of %1 on root length while the interaction of experimental treatment did not affect on trait significantly. Data mean comparison of auxin concentration (Table 2) showed that the longest root length was obtained in 4000 mg/l IBA. Auxin might have caused hydrolysis and translocation of carbohydrates and nitrogenous substances at the base of cuttings and resulted in accelerated cell elongation and cell division in suitable environment (Singh *et al.*, 2003). High concentrations of auxin inhibit root elongation but causes cell differentiation and cell division and the formation of lateral roots (Teale *et al.*, 2005). Data mean comparison of time of taking cutting (Table 3) showed that early September has longest root length compared with late June. As stated, the physiological conditions and the amount of carbohydrates in cuttings and environmental conditions throughout the season of the year have great influence on rooting and root size.

Based on analysis of variance (Table 1), different concentrations of IBA, time of taking cutting and interaction of experimental treatment were significant in level of %1 on root dry weight. Table 2 shows that maximum of root dry weight belongs to 4000 mg/l IBA. Data mean comparison of time of taking cutting (Table 3) showed that early September has maximum of root dry weight compared with late June. The higher dry weight of roots may be attributed to increased number of roots and roots length (Ingle and Venugopal, 2009). Auxin causes transfer of leaf carbohydrate and nitrogen to the roots and therefore causes an increase in the root dry weight (Hartman *et al.*, 2002). Data mean comparison of the interaction of experimental treatment (Fig. 2) revealed that the highest root dry weight was seen at 4000 mg/l IBA and time of taking cutting of early September. Fig. 2 shows that at all levels of IBA, cutting time in early September compared to late June had higher root dry weight.

According to the results of this study, time taking cuttings and IBA concentration had significant effects on the success of graft and rooting. The auxin concentration in 4000 mg/l and time taking cutting in early September, were the best treatments in propagation of *F. benjamina* by stenting Technique.

Table 3. Data mean comparison of cutting time on the measured traits.

Cutting time	Percent of graft success	Root percentage	Longest root length (cm)	Root number	root dry weight (g)
Late June	82.78b	61.66b	5.14b	5.62b	0.020b
Early September	89.58a	73.33a	8.83a	7.72a	0.041a

The dissimilar letters in each column indicate significant differences between them.

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