J. Agric. Sci. Mansoura Univ., 34 (2): 1107 - 1120, 2009

ROOTING SEMI-HARDWOOD STEM CUTTINGS OF *Ficus deltoidea* Jack PLANT

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ABSTRACT

A set of pot experiments was conducted under plastic house conditions at the nursery of Hort. Res. Inst., Giza, Egypt during 2007 and 2008 seasons to detect the response of 10-12 cm long semi-hardwood stem cuttings of *Ficus deltoidea* Jack taken at the last week of February to a basal quick-dip for only 10 seconds in the hydro-alcoholic solutions of 1-Naphthaleneacetic acid (NAA) at the rates of 0, 2000, 4000 and 6000 ppm, and 2,4-Dichlorophenoxyacetic acid (2,4-D) at 0, 200, 400 and 600 ppm levels, with benzyladenine (BA) at the concentration of 100 ppm or without (0.0 ppm).

The obtained results indicated that all treatments significantly increased rooting (%), No. roots/ cutting, root length (cm) and the percent of rooting efficiency index (REI %). Transplant height (cm), No. branches and leaves/transplant, as well as leaves, stem and roots fresh and dry weights (g) were also improved in response to dipping in solutions of the various growth regulators used in this study. Total carbohydrates content (mg/g dry weight) was greatly increased in the leaves of treated transplants, while total indoles and total phenols were significantly decreased with the notice that the rate of decrement in total phenols content was higher than that induced in total indoles content. In general, NAA treatments gave better results than 2,4-D ones, whereas participation of BA (100 ppm) with the aforementioned auxins resulted additional improvements in some parameters unlike some others. However, the prevalence in most of the previous measurements was for the combined treatment between 6000 ppm NAA and 100 ppm BA. Hence, it is recommended to get the best rooting with high quality of the new formed vegetative growth.

INTRODUCTION

Some rare plants may expose to danger of extinction due to either negligence or its difficult propagation. Among these plants in Egypt may be *Ficus deltoidea* Jack (Mistletoe fig) (Fam. Moraceae). It is a large glabrous shrub or small tree to 7 m height, sometimes epiphytic. Normal leaves alternate, bright green above and ferruginous to olive-brown or ochre beneath, entire, stiffy coriaceous, broadly spathulate, base usually cuneate; venation not much elevated, the midrib dichotomous usually below the middle of the blade (Photo, 1). S. Thailand to Sumatra, Java, Borneo and Palawan (Huxley *et al.,* 1992). The demand of this plant is pronouncedly increased through the last few years because of its special kind of beauty and for the wide range of purposes that it can be used for either indoor or outdoor.

Vegetative propagation of many plant species depends mainly upon cuttings of various types. Some types of cuttings are however hard-to-root such as *Ficus* spp*.* that need rooting growth regulators for enhancing roots emission. In this regard, Pimpini *et al.* (1983) stated that NAA at 1000 ppm increased the rooting % and root number of *Ficus elastica* semi-hardwood cuttings, while for the hardwood ones, the rate of 2000 ppm was the most effective. Humar *et al.* (1985) found that a basal quick-dip of *Ficus elastica* cvs. decora and variegata cuttings for 10 seconds in 4000 and 6000 ppm IBA gave the best rooting and survival of transplanted plants. On terminal cuttings of *Ficus benjamina* var. exotica, El-Malt (1989) reported that IBA at 4000 ppm significantly raised rooting %, number of roots/cutting and produced the longest roots. Hossni (1998) mentioned that using of either IBA or NAA at the rate of 4000 ppm gave the highest records of root number and root system fresh and dry weights of both *Ficus benjamina* and *F. nitida* var. Hawaii cuttings, while the least concentration (1000 ppm) gave the highest rooting percentage. Similar observations were also gained by Kwack *et al.* (1989) on *Ficus benjamina* and *F. nitida*. Sarma (2002) on *Ficus fistulosa*, Blythe *et al.* (2004) on *Ficus benjamina* and Ruter *et al.* (2004) on selected woody landscape plants who postulated that rooting percentage, number of roots/cutting and total root length for *Ficus benjamina* cuttings treated by soaking in aqueous solutions of IBA + NAA (15+7.5, 30+15, 45+22.5 or 60+30 ppm) were greater than those for cuttings receiving a basal quick-dip in IBA (1000 ppm) or IBA + NAA (1000 + 500 ppm). Number of shoots/rooted cutting and shoot length, were however mostly similar in all treatments.

Photo (1): *Ficus deltoidea* Jack

On many other ornamentals, similar findings were attained by Nanda *et al.* (1996) who pointed out that dipping stem cuttings of *Hibiscus rosa-sinensis* in 50-400 ppm IAA for 24 h increased sprouting, rooting, root length, number of roots and leaves/cutting, leaf area and field survival percentage. Stankova and Panetsos (1997) revealed that IBA treatment enhanced rooting percentage and root quality of *Cupressus sempervirens* softwood stem cuttings of different genotypes. On the same line, were those results of Akhtar *et al.* (2002) on *Rosa centifolia* and *R. damascena*, Morini *et al.* (2003) on *Myrtus communis, Phillyrea angustifolia* and *Pistacia lentiscus,* Grolli *et al.* (2005) on *Platanus acerifolia* and Song *et al.* (2006) on *Thuja koraiensis.*

Besides auxins, there are other growth regulators that may activate root formation on several cuttings. In this concern, Zhang *et al.* (1997) claimed that the best rooting of *Jasminum sambac* cuttings was obtained from 15 mg BA/L treatment. Lee and Suh (1997) affirmed that shoot length and the number of roots developed from root cuttings of *Ardisia japonica* were promoted by GA_3 (200 mg/L), GA_{4+7} (200 mg/L) and BA (100 mg/L). Atta-Allah *et al.* (1997) reported that BA at 6 ppm, kinetin at 12 ppm + NAA at 10 ppm or isopentenyladenine at 9 ppm + NAA at 10 ppm significantly produced highest number of shoots and roots on the shoot tips of *Yucca aloifolia, Y. filamentosa* and *Y. filamentosa* var. variegata. Similarly, the naturally occurring cytokinins; zeatin and their derivatives, stimulated primary root length. Zeatin and dihydrozeatin promoted secondary root growth, but only at very low concentrations (Taylor and Van Staden, 1998).

This work, however aims to improve the propagation technique by cuttings for conservation of genetic sources of the endangered Mistletoe fig tree and keeping it from extinction.

MATERIALS AND METHODS

An investigation was conducted under plastic house conditions at the nursery of Hort. Res. Inst., Giza, Egypt throughout the two consecutive seasons of 2007 and 2008 aiming to find out the effect of a basal quick-dip in NAA and 2,4-D at various concentrations, with or without BA on rooting and shoot formation of Mistletoe fig semi-hardwood stem cuttings, as well as on some chemical constituents of the new proliferated leaves.

So, semi-hardwood stem cuttings (10-12 cm long and 8-9 mm diameter) were taken from the middle parts of branches of *Ficus deltoidea* Jack stock plants (6 years-old) on February, 25^{th} for both seasons, sterilized with a mixture of Topsin (70%) and Rizolex (50%), Sumitomo Chemical Co., Ltd., Osaka, Japan at the rate of 0.5 g/L for each, and then subjected to a basal quick-dip for 10 seconds only in the hydro-alcoholic solutions of the following growth regulators :

1. 1-Naphthaleneacetic acid (NAA) or 2,4-Dichlorophenoxyacetic acid (2,4-D), products from Sigma Chemical Co., USA, at the rates of 0, 2000, 4000 and 6000 ppm for NAA, while for 2, 4-D, the rates were 0, 200, 400 and 600 ppm.
2. Benzyladenine (BA), 99% of 6-benzylaminopurine, F.W. 225.25 manufactured by Aldrich Chemical Co., Inc., Wisconsin, USA at the levels of 0 and 100 ppm.
3. Each level of both NAA and 2,4-D was combined with the two levels of BA to form fourteen interaction treatments.

Control cuttings, were however dipped in alcoholic distilled water for the same time (10 seconds).

Immediately after dipping, the treated cuttings and those of control were inserted for 4-5 cm into 12-cm-diameter plastic pots (4 cuttings/pot) filled with about 1.2 kg of sand + loam + peat moss rooting medium (1:1:1, v/v/v) under a plastic house conditions (as the mean of temperatures during the course of study ranged between 21-36°C and relative humidity between 50-75%). Cuttings were irrigated soon after sticking, as each pot received 100 ml of a tap-water. Besides, the lower part of pots was buried in the wet soil of plastic house. The physical and chemical analysis of the used sand and loam are shown in Table (a), while properties of the used peat moss are averaged in Table (b).

The layout of the experiment in the two seasons was a complete randomized design in factorial experimental type (Mead *et al.,* 1993). Each treatment consisted of nine pots (each pot contained four cuttings) Thus, every treatment contained thirty six cuttings. Four months later, rooted cuttings were transplanted (on June, 25^{th}) into 12-cm-diameter plastic pots (one cutting/pot) containing 1.2 kg of the same rooting mixture mentioned above. During transferring, number of rooted cuttings was registered for each treatment and the rooting percentage was calculated from the following equation: Rooting (%) = R / T × 100.

Where: R = Number of rooted cuttings, and T = Total number of cuttings in the treatment.

After three other months on September, 25^{th}, the resulted transplants were lifted and the following data were recorded: number of roots/cutting, the longest root length (cm), transplant height (cm), number of branches and leaves/cutting and the fresh and dry weights (g) of leaves, stem and roots. The rooting efficiency index as a percentage (REI %) was calculated as described by Ruter *et al.* (2004) from the following equation:

REI % = Mean root length of the treated cutting / Mean root length of control cutting × 100.

In dry leaf samples, the content of total carbohydrates (mg/g dry weight) was determined according to the method of Herbert *et al.* (1971), while in fresh samples, total indoles and total phenols contents (mg/100 g fresh weight) were assessed as recommended by A.O.A.C. (1990).

SAS program (1994) was used for statistical analyses and Duncan's Multiple Range Test (1955) was employed to verify the differences among the means of various treatments.

Ta-b

RESULTS AND DISSCUSSION

Effect of NAA, 2,4-D, BA and their interaction on:
1. Rooting parameters:

Data in Table (1) reveal that all auxin treatments significantly increased rooting (%) of treated cuttings compared to untreated ones in the two seasons, especially in the absence of BA. In general, NAA treatments gave higher rooting percentages than 2,4-D ones, with the superiority of 6000 ppm level that registered the utmost high means in both seasons either in the presence or absence of BA. However, number of roots/cutting and the longest root length (cm) were significantly improved in most cases of the two seasons in response to either auxin treatments or BA ones. So, the highest records in these two traits in the first and second seasons were obtained from the combined treatment between NAA at 6000 ppm and BA at 100 ppm.

For rooting efficiency index percentage (REI %), as a real indicator for rooting strength, data in Table (1) show that it was progressively increased with elevating concentration of either growth regulators used in such trial compared to control in both seasons, whereas BA treatment (100 ppm) significantly reduced it comparing with either NAA or 2,4-D treatments. The mastery in the two seasons was found due NAA treatment at 6000 ppm in the absence of BA, as this treatment raised such index to 216.67 and 210.25 % in comparison to 100% for control in the first and second seasons, respectively (Photo, 2).

Improving rooting percentage and quality may explain the role of auxins in encouragement of the cambium cells, besides some other meristematic cells (especially parenchyma cells) for division and enlargement near the base of stem cuttings to form adventitious roots (Morini *et al.,* 2003). Moreover, BA promotes cell division, enhances callus formation at the cutting base and may cause transport of many solutes from older tissues to the new formed ones (Taylor and Van Staden, 1998). These results are in accordance with those attained by both Pimpini *et al.* (1983) and Humar *et al.* (1985) on *Ficus elastica*, El-Malt (1989) and Hossni (1998) on *Ficus benjamina*, Sarma (2002) on *Ficus fistulosa* and Grolli *et al.* (2005) on *Platanus acerifolia*.

T1

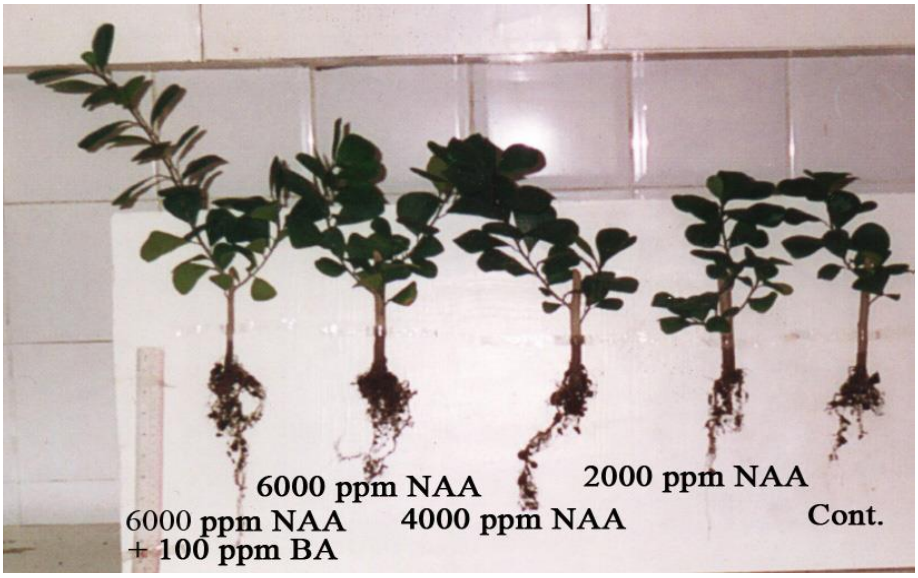

Photo (2): Effect of some treatments on vegetative and root growth of the rooted cuttings

2. Vegetative growth parameters of the resulted transplants:

From data averaged in Tables (2 and 3), it could be concluded that transplant height (cm), number of both branches and leaves/transplant and fresh and dry weights (g) of leaves, stem and roots were markedly increased, with few exceptions in both seasons as a result of dipping the cuttings before planting in solutions of the different growth regulators used in the current work. The prevalence in most cases of the two seasons was for the combination of 6000 ppm NAA + 100 ppm BA, as this treatment gave the highest values in all previous measurements comparing with the means of control and other treatments. This may be ascribed to the synergistic effect of both NAA, as a promotive agent for growth and development and BA, as a factor accelerates cell division, branching and leaf formation. It was also noticed that, BA treatment improved only number of branches and leaves/transplant, roots fresh weight, as well as stem and roots dry weights in comparison with the absence of such growth regulator.

However, these findings are similar to those of Kwack *et al.* (1989) on *Ficus benjamina* and *F. nitida*, Blythe *et al.* (2004) and Ruter *et al.* (2004) on *Ficus benjamina*, Nanda *et al.* (1996) on *Hibiscus rosa-sinensis*, Akhtar *et al.* (2002) on *Rosa centifolia* and *R. damascena* and Song *et al.* (2006) on *Thuja koraiensis.*

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3. Some leaf chemical constituents:

It is clear from data presented in Table (4) that total carbohydrates content (mg/g dry weight) in the leaves of treated transplants was gradually increased with elevating the concentration of either NAA or 2,4-D, either in the absence or presence of BA with significant differences in most cases of the two seasons. The opposite was the right concerning BA treatment (100 ppm), which gave less means than those recorded in its absence. This may be due to that BA stimulates the movement of sugars, starch and many other solutes from mature organs to primary tissues of other ones. In this connection, Day and Laveys (1998) suggested that seasonal variation in propagation success by cuttings may be caused by the changes in endogenous plant growth regulators or carbohydrate concentrations.

As for the content of both total indoles and total phenols (mg/100 g fresh weight), they were cumulatively declined as the level of either NAA or 2,4-D was increased, except for 2,4-D treatments, which caused a progressive increment in such two constituents when coupled with BA at 100 ppm. However, the rate of decrement in total phenols content was higher than that in total indoles content. This may be a suitable manner for stimulating growth of the new formed vegetative parts. In this regard, Kawai *et al.* (2001) on *Vitis coignetiae* stated that level of extractable indoles was highest in the start of cutting, but it was low after that. Likewise, Vuylsteker *et al.* (1998) found that the most reproducible and significant changes occurring after the application of NAA was a decrease in the level of zeatin-O-glucoside conjugates. Hydrolysis of these conjugates might deliver free zeatin-type compounds which were consumed during the lateral root growth, and disappear afterwards.

Similarly, were those results revealed by Stankova and Panetsos (1997) on *Cupressus sempervirens*, Zhang *et al.* (1997) on *Jasminum sambac* and Lee and Suh (1997) on *Ardisia japonica.*

According to the aforementioned results, it could be recommended to dip the semi-hardwood stem cuttings of *Ficus deltoidea* Jack taken at the last week of February in a hydroalcoholic solution of 1-Naphthaleneacetic acid (NAA) at 6000 ppm + Benzyladenine (BA) at 100 ppm for 10 seconds for the best rooting and high quality of the resulted vegetative growth.

T4

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تجذير العقل الساقية النصف خشبية لنبات الفيكس دلتا

أمل صلاح الفولى[1] ، جيهان حسن عبد الفتاح [1] و محمد يونس على عبد الله [2]
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أجريت مجموعة من تجارب الأصص داخل إحدى الصوبات البلاستيكية بمشتل معهد بحوث البساتين، الجيزة، مصر خلال موسمي ٢٠٠٧، ٢٠٠٨ للتعرف على مدى استجابة العقل الساقية النصف خشبية لنبات الفيكس دلتا (*Ficus deltoidea* Jack) المأخوذة بطول ١٠-١٢ سم في الاسبوع الأخير من شهر فبراير للنقع السريع (١٠ ثوان فقط) في المحاليل المائية - الكحولية لنفثالين حمض الخليك (NAA) بتركيزات: صفر، ٢٠٠٠، ٤٠٠٠، ٦٠٠٠ جزء في المليون و ٢,٤- داي كلوروفينوكسي حمض الخليك (2,4-D) بتركيزات: صفر، ٢٠٠، ٤٠٠، ٦٠٠ جزء في المليون، وذلك فى وجود البنزايل آدينين (BA) بتركيز ١٠٠ جزء في المليون او فى غيابه (صفر جزء فى المليون).

ولقد أوضحت النتائج المتحصل عليها أن جميع المعاملات أحدثت زيادة معنوية في النسبة المئوية للتجذير، عدد الجذور/عقلة، طول الجذر والنسبة المئوية لمعامل كفاءة التجذير (REI%). أيضاً فإن قياسات النمو الخضري للشتلات الناتجة بعد التجذير (أرتفاع الشتلة، عدد الأفرع والأوراق/شتلة والوزن الطازج والجاف للأوراق، الساق والجذور) قد زادت معنوياً نتيجة للنقع في محاليل منظمات النمو سالفة الذكر. كذلك، فقد زاد محتوى الأوراق من الكربوهيدرات الكلية بشكل واضح، بينما إنخفض محتواها من الإندولات و الفينولات الكلية، مع ملاحظة أن معدل الإنخفاض في محتوى الفينولات كان أكبر من معدل الإنخفاض في محتوى الإندولات. **وبصفة عامة،** فإن معاملات نفثالين حمض الخليك أعطت نتائج أفضل من معاملات الداي كلوروفينوكس حمض الخليك، بينما أحدثت مشاركة البنزايل آدنين (١٠٠ جزء في المليون) لمواد التجذير سابقة الذكر تحسناً اضافياً في بعض الصفات دون البعض الآخر. هذا، ولقد كانت السيادة في معظم القياسات السابقة للمعاملة المشتركة بين نفثالين حمض الخليك بتركيز ٦٠٠٠ جزء في المليون + البنزايل آدينين بتركيز ١٠٠ جزء في المليون.

وعليه.. يمكن التوصيه بهذه المعاملة للحصول على أفضل تجذير للعقل مصحوباً بأعلى جودة للنموات الخضرية الناتجة.