The 1st Conf. of SSFOP "Future of Ornamental Plants in Egypt", Cairo, Egypt, 22/2/2015
Scientific J. Flowers & Ornamental Plants
www.ssfop.com/journal
ISSN: 2356-7864

SEEDS OF ELEPHANT APPLE (*DILLENIA INDICA* L.) RESPONSE TO SOME PRE-GERMINATION TREATMENTS

S.M. Shahin*; Amal S. El-Fouly ** and Azza M. Abdel-Moniem**

* Botanical Gardens Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt.
** Ornamental Plants and Landscape Gardening Res. Dept., Hort. Res. Inst., ARC, Giza, Egypt.

ABSTRACT: This experiment was consummated under shade at the nursery of Hort. Res. Inst., ARC, Giza, Egypt during 2013 and 2014 seasons to explore the effect of some pre-sowing treatments, viz. control (untreated seeds), seeds without mucilage, soaking in tap water for 24, 48, 72 h under ambient conditions, soaking in hot water (60-70°C) for 24h, soaking in absolute ethanol (97%) for either 12 or 24 h and soaking in concentrated sulfuric acid (98.5%) for 3 min on germination measurements of Elephant apple (*Dillenia indica* L.) seeds and growth of the produced seedlings.

The obtained results have shown that seeds of control and those soaked in either hot water or ethanol for 24 h failed to germinate, while seeds without mucilage and those soaked in ethanol for 12 h gave the least germination percentage in the two seasons. The other treatments, however significantly improved germination %, with the superiority of soaking in concentrated H_2SO_4 for 3 min treatment, which elevated such parameter to 100% in both seasons. Besides, germination % was found to progressively increase with elongating soaking period in tap water to reach 100% in the first season and 83.33% in the second one by the longest soaking period (72 h). The germination velocity and mean germination rate were accelerated and the indices of germination rate and vigour, seeds viability and plumule length were significantly improved by some treatments used in this trial, but the prevalence was also for acid treatment which followed by soaking in tap water for 72 h treatment. Similarly, were those result of seedling growth traits and leaf content of chlorophyll a, b, carotenoids, total soluble sugars, indoles and phenols, as the soaking in concentrated H_2SO_4 for 3 min treatment scored the best growth of the seedling and the highest content of the various constituents which was accompanied with the least content of total phenols. Also, soaking in tap water for 72 h occupied second rank.

So, it advised to soak Elephant apple (*Dillenia indica* L.) tree seeds either in concentrated sulfuric acid (98.5%) for 3 min or in tap water for 72 h to obtain the best germination and quality of seedlings.

Key words: Elephant apple (*Dillenia indica* L.) tree, seed germination, pre-sowing treatments, seedling growth.

Scientific J. Flowers & Ornamental Plants, 2(1):39-50 (2015).

Received:
3/12/2014

Revised by:
Prof. Dr. A.Z. Sarhan, Cairo Univ.

Prof. Dr. M.M. Farahat, Agric. & Biol. Res. Div., NRC.

INTRODUCTION

Dillenia indica L., Elephant apple or Chulta (Fam. Dilleniaceae) is an evergreen spreading tree, grown in gardens for its attractive white fragrant flowers, toothed leaves and fleshy globose edible fruits (Huxley *et al*., 1992). It is an ethno-medicinally important plant used for the treatment of severe disease like cancer and diarrhe. The fruit extract has shown significant anit-leukemic activity in human

leukemic cell lines. The fruits possess tonic and laxative properties and is used for abdominal pains. The antioxidant effect of such tree is mainly due to phenolic compounds such as flavonoids, phenolic acids, tannins and phenolic diterpens. Phenolic compounds inhibit free radicals in the body which are responsible for oxidative damages (Gogoi *et al*., 2012). These medicinal uses were documented by Parvin *et al*., (2009), Rahaman *et al*., (2011), Alam *et al*., (2011) and Singha *et al*., (2013) who suggested that the crude extract of *D. indica* plant contains some compounds which have antimicrobial activity, more potent antioxidant activity and α-glucosidase inhibitory activity.

Dillenia indica usually propagates by seeds borne within large indehiscent fruits. When extracted fresh, seeds are glued together by the sticky mucilage on the seedcoat. This sticky mucilage does not promote or inhibit germination, but it does restrict the inflow of water into seeds during the initial stages of imbibition. The embryo of *D. indica* is under developed. Thus, the seeds have morphological dormancy (Thapliyal *et al*., 2008). The mucilaginous layer in *Dillenia* species acts as a physical barrier and prevents germination by reducing diffusion of water and oxygen to the inner tissue of the seed (Panigrahi, 1986). In this regard, Thapliyal *et al*., (2008) found that there were no significant effects of mucilage on either germination % or mean germination time (MGT) of *D. indica* seeds. Seeds with intact mucilage and without mucilage germinated to 92 and 97%, respectively, and MGT was 28 and 26 days, respectively.

There is a limited body of information in the literature regarding breaking the physical or morphological dormancy of *D. indica* seeds, but the following observations may be valied in this concern. Alamgir and Hossain (2005) reported that immersing seeds of *Albizia saman* in tap water for 24 h may be recommended for maximum germination and initial vigorous seedlings growth in the nursery. Bhardwaj *et al*. (2007) elicited that *Albizia lebbeck* seeds pre-treated with concentrated H_2SO_4 for 8 min followed by soaking in tap water for 3 h gave significant germination and better seedling growth under both laboratory and nursery conditions. On *Acacia mangium*, Bahar (2011) revealed that hot water soaking for 24 h or H_2SO_4 for 15 min soaking enhanced germination of seeds to more than 92%. Like results were also obtained by Singh and Dhillon (2007) on *Acacia nilotica*, *Prosopis cineraria* and *Lucaena leucocephala*, Azad *et al*. (2010) on *Albizia richardiana* and *Lagerstroemia speciosa*, Azad *et al*. (2012) on *Albizia procera*, Khan (2013) on *Cassia auriculata* and *Cassia tora*, Pivetta *et al*. (2013) on Carnauba palm and Shahin *et al*. (2014) whom observed that soaking the depulped seeds of triangle palm in concentrated H_2SO_4 for 3 h gave the best germination percentage and velocity, higher means of vigour index, seed viability and plumule length, best growth of the resulted seedlings, as well as higher content of pigments, soluble sugars, indoles and phenols in the leaves.

This study aims to detect the most appropriate treatments for enhancing seed germination of Elephant apple tropical tree along with getting high quality seedlings.

MATERIALS AND METHODS

This trial was carried out at the nursery of Hort. Res. Inst., ARC, Giza, Egypt throughout the consecutive seasons of 2013 and 2014 in order to improve germination of Elephant apple tree seeds and quality of the produced seedlings using some pre-sowing treatments.

Thus, the round fruits of Elephant apple (*Dillenia indica* L.) tree were collected from Giza Zoo on March, 15th for each season, then seeds were extracted from carples immediately on the second day (each fruit consists of 16-20 carples, each containing 5 seeds or more, so each fruit gives around 80-100 seeds). The seeds were left exposed to air 24 h until been dried, then were preserved

in paper bag till the time of planting (Figs. 1, 2 and 3).

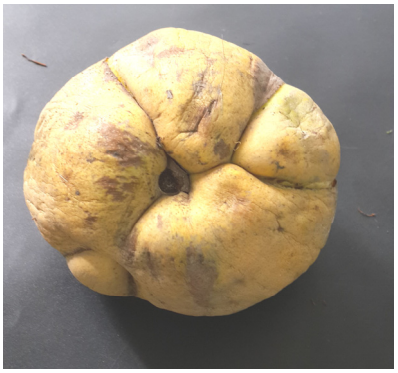

Fig. 1. The intact fruit.

Fig. 2. The carples after removing pseudocarpes.

Fig. 3. The seeds.

On April, 1st, the seeds were sterilized with sodium hydrochloride solution (10%) for 10 minutes, then rinsed several times with sterile distilled water and directly subjected to some pre-sowing treatments as follows:

1- Untreated seeds, referred to as control.

2- Seeds without mucilage, where mucilage was scraped off completely from the surface of seeds by rubbing them gently on a fine wire-net mesh for several minutes.

3- Soaking in tap water for 24, 48 and 72 hours at room temperatures (about 33 °C for the two seasons).

4- Soaking in hot water (60–70 °C) for 24 hours.

5- Soaking in absolute ethanol (97%) for 12 and 24 hours.

6- Soaking in concentrated sulfuric acid (98.5%) for 3 minutes.

The treated seeds and those of control were sown immediately after treatment in 16-cm-diameter pots (10 seeds/pot) filled with about 1.8 kg of sand and clay mixture (1:1, by volume). Some physical and chemical properties of the sand and clay used in both seasons are presented in Table (1).

The layout of the experiment in the two seasons was a completely randomized design, replicated thrice, as each pot contained 10 seeds exemplifies one replicate (Mead *et al*., 1993). Clearly visible plumule protrusion was used as a criterion for germination. All agricultural practices needed for care the seeds were done. Number of germinated seeds was recorded every day and plumule length (cm) was measured after a week from emergence.

The experiment was terminated 120 days after seed sowing (on July, 30th for each season), the time at which no additional seeds had germinated for 2 weeks. At that time, the following germination characteristics were calculated:

1- Germination percentage (G. %) from the following equation:

G. % = No. germinated seeds / Total No. sown seeds × 100

2- Germination velocity (G.V.) in days, which equal average number of days from sowing till emergence of the final plumule .

3- Mean germination rate (M.G.R.) in days = mean number of days till 50% germination (Odetola, 1987).

Table 1. The physical and chemical analysis of the used sand and clay during 2013 and 2014 seasons.

Soil type	Particle size distribution (%)				S.P.	E.C. (dS/m)	pH	Cations (meq/l)				Anions (mq/l)		
	Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sand	89.03	2.05	0.40	5.52	25.00	7.75	6.73	11.11	6.08	58.20	10.34	0.96	58.99	25.78
Clay	7.54	22.28	30.55	39.63	40.00	7.80	1.97	4.96	3.10	10.64	1.09	1.02	11.32	7.45

4- Germination rate index (G.R.I.), which calculated from Bartled equation indicated by Hartmann and Kester (1983). GRI = A + (A + B) + (A + B + C) + … /N (A + B + C ….).

- Where: A, B, C, …. etc. are number of germinated seeds counted at different times, and N is number of times at which the germinated seeds were counted.

5- Vigour index (V.I.) = G. % × mean length of plumule (Selvaraju and Selvaraj, 1994)

6- Seed viability (SV) = number of survived seedlings in each treatment after excluding the deteriorated and dead ones (Odetola, 1987).

In addition, data of the resulted seedlings from the different treatments was recorded as follows: seedling length (cm), number of leaves/seedling, root length (cm), number of roots/seedling, as well as fresh and dry weights of top growth and roots (g).

In fresh leaf samples, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f.w.) and the percentages of total soluble sugars, indoles and phenols were evaluated according to the methods described by Moran (1982), Dubois *et al*. (1956), A.O.A.C. (1990) and William *et al*. (1965), respectively.

Data were then tabulated and statistically analyzed according to program SAS Institute (1994), using Duncan's Multiple Range Test (Duncan, 1955) to elucidating the significancy between the means of the different treatments.

RESULTS AND DISCUSSION

Effect of pre-sowing treatments on:

1- Germination characteristics:

Data in Table (2) exhibit that germination % reached the maximum by soaking in concentrated H_2SO_4 for 3 min treatment which gave 100% germination in the two seasons. The soaking in tap water for 72 h treatment gave 100% germination in the first season, but in the second one it recorded only 83.33% germination occuping the second rank after acid treatment. However, germination percent was progressively increased with elongating the period of soaking in tap water, especially in the second season. The least percent of germination was attained by the seeds without mucilage and those soaked in ethanol for either 12 or 24 h. On the other side, seeds of control and of those soaked in hot water for 24 h failed to germinate in the two seasons, besides the seeds soaked in ethanol for 24 h in the second one, as these treatments registered zero % of germination.

The least number of days to either 100% or 50% germination in both seasons was also attributed to soaking in concentrated H_2SO_4 for 3 min treatment, which was followed by soaking in tap water for 72 h treatment. The best means of germination rate index (GRI), as a real indication for germination accelerating was also achieved in the two seasons by acid treatment which significantly reduced such parameter to 0.50 in the 1st season and to 0.51 in the 2nd one. Moreover, the highest means of vigour index

Table 2. Effect of pre-germination treatments on germination traits of *Dillenia indica* L. seeds during 2013 and 2014 seasons.

Treatments	Germination (%)	Germination velocity (day)	Mean germination rate (day)	Germination rate index (G.R.I.)	Vigour index (V.I.)	Seed viability (S.V.)	Plumule length (cm)
				First season: 2013			
Control	0.00e	-	-	-	-	-	-
Seeds without mucilage	33.33c	86.80a	-	0.67ab	47.33d	2.00d	1.42d
Soaking in tap water for 24 h	77.78b	70.69c	62.13ab	0.51bc	144.67c	4.00b	1.86c
Soaking in tap water for 48 h	77.78b	70.33c	63.50a	0.53b	155.56c	4.33b	2.00b
Soaking in tap water for 72 h	100.00a	68.09cd	61.67b	0.53b	200.00b	3.00c	2.00b
Soaking in hot water for 24 h	0.00e	-	-	-	-	-	-
Soaking in absolute ethanol for 12 h	38.89c	74.40b	-	0.54b	75.06d	2.00d	1.93bc
Soaking in absolute ethanol for 24 h	11.11d	89.00a	-	0.75a	17.78e	0.00e	1.60cd
Soaking in concn. H_2SO_4 for 3 min	100.00a	62.30d	59.33c	0.50c	250.00a	15.00a	2.50a
				Second season: 2014			
Control	0.00e	-	-	-	-	-	-
Seeds without mucilage	27.78d	94.74a	-	0.71a	41.67e	2.00c	1.50d
Soaking in tap water for 24 h	55.56cd	75.36b	71.33a	0.54b	107.23d	3.27b	1.93c
Soaking in tap water for 48 h	66.67cd	73.60b	70.90a	0.56b	140.01c	3.78b	2.10bc
Soaking in tap water for 72 h	83.33b	71.48bc	70.27a	0.54b	188.33b	4.00b	2.26b
Soaking in hot water for 24 h	0.00e	-	-	-	-	-	-
Soaking in absolute ethanol for 12 h	33.58d	85.50a	-	0.57b	68.17e	2.00c	2.03c
Soaking in absolute ethanol for 24 h	0.00e	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 3 min	100.00a	63.00c	59.07b	0.51c	263.00a	14.33a	2.63a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

(V.I.), seed viability (S.V.) and plumule length (cm) were also due to soaking the seeds in concentrated H_2SO_4 for 3 min treatment that gave means suprpassed those of other treatments in both seasons.

Improving germination characters by concentrated sulfuric acid as indicated above may be ascribed to the role of this acid in softening and lightening the seed coats and that consequently permits the ease permeable of water and gasses across the soften coats which finally leads to activating enzymes that decay the stored foods in the endosperm and producing sugars and energy required for growth of the embryo (Bahar, 2011). In this connection, Khan (2013) manifested that 80% seeds were germinated in *Cassia auriculata* and 88% seeds were germinated in *Cassia tora* after 5 min soaking in concentrated H_2SO_4. The previous gains were supported by those declared by Alamgir and Hossain (2005) on *Albizia saman*, Bhardwaj *et al*. (2007) on *Albizia lebbeck*, Pivetta *et al*. (2013) on Carnauba palm and Shahin *et al*. (2014) on Triangle palm.

2- Seedling growth characters:

It can be seen from Tables (3 and 4) and Fig. (4) that the best growth of seedlings was attained by soaking the seeds in concentrated H_2SO_4 for 3 min, as this treatment recorded the longest seedling and root lengths (cm), the highest No. leaves and roots/seedling, as well as the heaviest fresh and dry weights of top growth and roots (g) with significant differences compared to other treatments in the two seasons. Furthermore, soaking in tap water for 72 h treatment caused a significant increment in the various growth traits of seedlings giving averages closely near to those of the acid treatment with non-significant differences between them in some instances of both seasons. However, the least records of seedling growth criteria were referred to removing mucilage treatment which gave the shortest seedling and root lengths, the least No. leaves and roots/seedling accompanied with the lightest fresh and dry weights of top growth and roots in the two seasons.

Improving vegetative and root growth of seedlings by acid treatment may indicate the role of sulfuric acid on softening the outer seed coats and altering lens structure, consequently permits the seeds to absorb more water and gasses necessary for activating enzymatic systems that induce hydrolysis of the complex food reserves to absorbable forms. Besides, the early germination under this treatment saving more time for the resulted seedlings to grow well, whereas seeds under other treatments are still dormant. Similarly, were those results explored by Singh and Dhillon (2007) on *Acacia nilotica*, *Prosopis cineraria* and *Lucaena leucocephala*, Azad *et al*. (2010) on *Albizia richardiana and Lagerstroemia speciosa* and Khan (2013) on *Cassia auriculata* and *Cassia tora*.

3- Chemical composition:

It is clear from data illustrated in Table (5) that chlorophyll a, b and carotenoids content (mg/g f.w.), as well as the percentages of total soluble sugars and total indoles were improved in the leaves of seedlings raised from seeds soaked in tap water (for any period), ethanol for 12 h or concentrated H_2SO_4 for 3 min compared to those raised from seeds without mucilage, with the dominance of soaking in concentrated sulfuric acid for 3 min treatment which gave the utmost high content of the above named constituents. In addition, content of the previous components was progressively increased with prolonging the period of soaking in tap water. The opposite was the right concerning the content of total phenols (%) which markedly decreased in response to soaking in tap water (a progressive decrement in such parameter was attained with protraction of soaking period), ethanol for 12 h and in concentrated H_2SO_4 for 3 min treatment that reduced content of such constituent to the least value (0.0022 against 0.011% for seeds free of mucilage).

This may be explain why this treatment scored the highest and earliest germination, and may indicate the inhibitory effect of phenols which modify the activity of IAA-

Table 3. Effect of pre-germination treatments on growth traits of *Dillenia indica* L. seedlings during 2013 and 2014 seasons.

Treatments	Seedling length (cm)		No. leaves per seedling		Root length (cm)		No. roots per seedling	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	-	-	-	-	-	-	-	-
Seeds without mucilage	2.68d	2.47d	2.00c	2.00c	3.50d	3.10d	2.00c	2.00d
Soaking in tap water for 24 h	3.10c	3.18c	3.00b	2.76bc	4.33c	3.56cd	2.27bc	2.00d
Soaking in tap water for 48 h	3.60b	3.58b	3.00b	3.00b	4.50c	4.33c	3.00b	2.56c
Soaking in tap water for 72 h	3.80ab	4.00ab	4.00ab	3.83ab	6.20b	5.21b	3.00b	3.00ab
Soaking in hot water for 24 h	-	-	-	-	-	-	-	-
Soaking in absolute ethanol for 12 h	3.36bc	3.42bc	3.33b	3.00b	5.81bc	5.40b	3.00b	2.79b
Soaking in absolute ethanol for 24 h	2.76d	-	2.00c	-	3.67d	-	2.35bc	-
Soaking in concn. H_2SO_4 for 3 min	4.20a	4.36a	4.50a	4.37a	7.33a	6.89a	3.67a	3.38a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 4. Effect of pre-germination treatments on top growth and roots fresh and dry weights of *Dillenia indica* L. seedlings during 2013 and 2014 seasons.

Treatments	Fresh weight (g)				Dry weight (g)			
	Top growth		Roots		Top growth		Roots	
	2013	2014	2013	2014	2013	2014	2013	2014
Control	-	-	-	-	-	-	-	-
Seeds without mucilage	0.27b	0.25c	0.031c	0.027c	0.070c	0.065d	0.012c	0.010c
Soaking in tap water for 24 h	0.28b	0.30bc	0.030c	0.025c	0.090b	0.096b	0.015bc	0.013bc
Soaking in tap water for 48 h	0.31ab	0.31b	0.045b	0.041b	0.094ab	0.097b	0.020b	0.018b
Soaking in tap water for 72 h	0.33ab	0.35ab	0.050a	0.043b	0.100ab	0.103ab	0.023b	0.020b
Soaking in hot water for 24 h	-	-	-	-	-	-	-	-
Soaking in absolute ethanol for 12 h	0.30b	0.31b	0.039bc	0.036bc	0.081bc	0.082c	0.014bc	0.013bc
Soaking in absolute ethanol for 24 h	0.28b	-	0.034c	-	0.080bc	-	0.021b	-
Soaking in concn. H_2SO_4 for 3 min	0.38a	0.40a	0.110a	0.098a	0.120a	0.126a	0.046a	0.041a

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Table 5. Effect of pre-germination treatments on some constituents in the leaves of *Dillenia indica* L. seedlings during 2014 season.

Treatments	Pigments content (mg/g. f.w.)			Total soluble sugars (%)	Total indoles (%)	Total phenols (%)
	Chlorophyll (a)	Chlorophyll (b)	Carotenoids			
Control	-	-	-	-	-	-
Seeds without mucilage	0.465d	0.174c	0.186c	1.377e	1.033e	0.0110a
Soaking in tap water for 24 h	0.534c	0.206bc	0.281ab	1.591d	1.299d	0.0046b
Soaking in tap water for 48 h	0.551c	0.223b	0.284ab	1.718c	1.869c	0.0039b
Soaking in tap water for 72 h	0.621b	0.241ab	0.291ab	2.243ab	2.370b	0.0035b
Soaking in hot water for 24 h	-	-	-	-	-	-
Soaking in absoulate ethanol for 12 h	0.542c	0.229b	0.265b	1.988b	1.057c	0.0102a
Soaking in absoulate ethanol for 24 h	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 3 min	0.685a	0.278a	0.315a	2.392a	2.778a	0.0022c

- Means within a column having the same letters are not significantly different according to Duncan's Multiple Range Test (DMRT) at 5% level.

Fig. 4. Effect of acid treatment (4) and tap water for either 72 h (3) or 48 h (2) on seedling growth of *Dillenia indica* L. compared to seedling raised from seeds without mucilage (1).

oxidase and might therefore be acting on plant activities through changes endogenous auxins activity (Kenneth, 1979).

From the foregone, it is concluded that soaking the seeds of Elephant apple (*Dillenia indica* L.) tree in either concentrated sulfuric acid (98.5%) for 3 min or tap water for 72 h may be suitable methods for improving germination and seedling quality.

REFERENCES

Alam, M.B.; Chowdhury, N.S.; Mazumder, M.E.H. and Haque, M.E. (2011). Antimicrobial and toxicity study of different fractions of *Dillenia indica* L.: Bark extract. Inter. J. of Pharma. Sci. & Res. (IJPSR), 2(4):860-866.

Alamgir, M. and Hossain, M.K. (2005). Effect of pre-sowing treatments on germination and initial seedling development of *Albizia saman* in the nursery. J. Forsetry Res., 16(3):200-204.

A.O.A.C. (1990). Association of Official Agricultural Chemists "Official Methods of Analysis of the Association of Official Agricultural Chemists". 15th Ed., Arlington, Virginia 22201: 877-878.

Azad, M.S.; Biswas, R.K. and Abdul Matin, M. (2012). Seed germination of *Albizia procera* (Roxb) Benth. in Bangladesh: a basis for seed source variation and pre-sowing treatment effect. Forestry Studies in China, 14(2):124-130.

Azad, M.S.; Paul, N.K. and Abdul Matin, M. (2010). Do pre-sowing treatments affect seed germination in *Albizia richardiana* and *Lagerstroemia speciosa*?. Frontiers of Agriculture in China, 4(2):181-184.

Bahar, N. (2011). Evaluation of pretreatment techniques to enhance seed germination of *Acacia mangium* Wild. Annals of Forestry, 19(2):221-226.

Bhardwaj, S.D.; Kumar, M.; Panwa, P. and Gautm, J. (2007). Effect of Pre-sowing seed treatments on germination behaviour of *Albizia lebbeck* seeds. Indian J. Forestry, 30(1):55-57.

Dubois, M.; Smith, F.; Illes, K.A.; Hamilton, J.K. and Rebers, P.A. (1956). Colorimetric mehod for determination of sugars and related substances. Ann. Chem., 28(3):350-356.

Duncan, D.B. (1955). Multiple range and multiple F. Tests. Biometrics,11: 1- 24.

Gogoi, B.J.; Tsering, J. and Goswami, B.C. (2012). Antioxidant activity and phytochemical analysis of *Dillenia indica* L. fruit of sonitpur, Assam, India. Inter. J. Of Pharma. Sci. and Res. (IJPSR), 3(12):4909-4912.

Hartmann, H.T. and Kester, D.E. (1983). Plant Propagation: Principles and Practices. Printic-Hall Inc., Englewood Cliffs, New Jersey, USA.

Huxley, A.; Griffiths, M. and Levy, M. (1992). The New Royal Hort. Society Dictionary of Gardening. The Stockton Press Ltd., New York, 257 Park Avenue South, New York, N. Y. 10010, USA, Vol. 2, 747 pp.

Kenneth, V.T. (1979). Physiology of Plant Growth and Development. B. Willkins TaTa, McGraw-Hill Publishing Co. Ltd., New Delhi.

Khan, M.R. (2013). The effects of pretreatments on seed germination of *Cassia auriculata* L. and *Cassia tora* L. Advances in Plant Sciences, 26(1):253-256.

Mead, R.; Curnow, R.N. and Harted, A.M. (1993). Statistical Methods in Agriculture and Experimental Biology. 2nd Ed., Chapman & Hall Ltd., London, 335 pp.

Moran, R. (1982). Formula for determination of chlorophyllous pigment extracted with N-N-dimethyl formamide. Plant Physiol, 69:1376-81.

Odetola, J.A. (1987). Studies on seed dormancy, viability and germination in ornamental palms. Principes, 31(1):24-30.

Panigrahi, S.G. (1986). Seed dormancy of *Rotala* L., *Ammannia* L., *Nesaca* Kunth and *Hionanthera* Fernan and *Diniz* (Lytheraceae). Botanical J. of the Linnean Soci., 93:389-404.

Parvin, M.N.; Rahman, M.S.; Islam, M.S. and Rashid, M.A. (2009). Chemical and biological investigations of *Dillenia indica* L. Bangladesh J. Pharmacol., 4:122-125.

Pivetta, K.F.D.; Andrea, F.; Penariol, A.P.; daLuza, P.B.; deCastro A.; Patista, G.S. and Romani, G.N. (2013). Effect of temperature and scarification on seeds germination of *Copernicia prunifera* (Mill) H. E. Moore (Arecaceae). Acta Hort., 1000:367-372.

Rahman, M.S.; Shams-Ud-Doha, K.M. and Rahman, R. (2011). Antidiarrhoeal activity of the leaf and fruit extracts of *Dillenia indica* L. Inter. J. of Biosciences (IJB), 1(6):39-46.

SAS, Institute. (1994). SAS/STAT User`s Guides Statistics. Vers. 6.04, 4th Ed., SAS Institute Inc., Cary, N.C., USA.

Selvaraju, P. and Selvaraj, J. A. (1994). Effect of pre-sowing treatments on germination and vigour of seed in marigold (*Tagetes erecta* L.). Madras Agric. J., 81(9):469-497.

Shahin, S.M.; Ahmed, Magda A. and Noor El-Deen, T.M. (2014). Germination of hard to germinate tringle palm (*Neodypsis decaryi* Jumelle) seeds. J. Biol. Chem. & Environ. Sci., 9(4):517-530.

Singh, A. and Dhillon, G.P.S. (2007). Enhancing germination potential of three leguminous tree species through pre-sowing seed treatments. Indian J. Forestry, 30(2):145-146.

Singha, A.K.; Bhattacharjee, B.; Ghosh, R.; De, U. and Maiti, D. (2013). Antibacterial, anti α-glucosidase and antioxidant properties of *Dillenia pentagyna* Roxb. (Dilleniaceae). Asian J. of Pharma. & Chemical Res., 6(4):173-177.

Thapliyal, R.C.; Phartyal, S.S.; Baskin, J.M. and Baskin, C.C. (2008). Role of mucilage in germination of *Dillenia indica* (Dilleniaceae) seeds. Australian J. of Botany, 56:583-589.

William, M.; Chichlilo, P.; Clifford, P.A. and Reynolds, M. (1965). Official Methods of Analysis of the Association of Official Agriculture Chemists, 10th Ed., Washington D.C. 20044: 52-55.

إستجابة بذور شجرة تفاحة الفيل (*Dillenia indica* L.) لبعض معاملات ما قبل الإنبات

سيد محمد شاهين*، أمل صلاح الفولى** و عزة محمد عبد المنعم**
* قسم بحوث الحدائق النباتية، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.
** قسم بحوث الزينة وتنسيق الحدائق، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر.

أجريت هذه التجربة تحت الظل بمشتل معهد بحوث البساتين مركز البحوث الزراعية، الجيزة، مصر خلال موسمي ٢٠١٣، ٢٠١٤ لدراسة تأثير بعض معاملات ما قبل الإنبات على قياسات الإنبات ونمو الشتلات الناتجة من بذور شجرة تفاحة الفيل (*Dillenia indica* L.) وكانت المعاملات كالآتي:- المقارنة (بذور بدون معاملة)، بذور بدون طبقة الموسيلاج، النقع فى ماء الصنبور لمدة ٢٤، ٤٨، ٧٢ ساعة تحت ظروف الغرفة العادية، النقع في ماء دافئ (٦٠ – ٧٠ °م) لمدة ٢٤ ساعة، النقع في كحول إيثانول مطلق (٩٧ %) لمدة ١٢ أو ٢٤ ساعة والنقع في حمض كبريتيك مركز (٩٨.٥ %) لمدة ٣ دقائق.

أوضحت النتائج المتحصل عليها أن بذور الكنترول والبذور التي نقعت في الماء الدافئ أو كحول الإيثانول لمدة ٢٤ ساعة فشلت في الإنبات، بينما أعطت البذور منزوعة الموسيلاج وتلك التي نقعت في كحول الإيثانول لمدة ١٢ ساعة أقل نسبة إنبات على الإطلاق في كلا الموسمين. أما باقي المعاملات فقد أحدثت تحسناً معنوياً في نسبة الإنبات، مع تفوق معاملة النقع في حمض الكبريتيك المركز لمدة ٣ دقائق والتي رفعت هذا القياس إلى ١٠٠ % بكلا الموسمين. بجانب ذلك، لوحظ أن النسبة المئوية للإنبات قد زادت بزيادة مدة النقع في ماء الصنبور لتصل إلى ١٠٠ % في الموسم الأول، ٨٣.٣٣ % في الموسم الثاني بالنقع لمدة ٧٢ ساعة. ولقد تحسنت معنوياً سرعة الإنبات، متوسط معدل الإنبات، دليل معدل الإنبات، دليل قوة الإنبات، حيوية البذور وكذلك طول الريشة ببعض المعاملات المطبقة بهذه الدراسة، لكن السيادة كانت أيضاً للمعاملة بالنقع فى الحمض والتي تلتها معاملة النقع في ماء الصنبور لمدة ٧٢ ساعة. بالمثل كانت نتائج قياسات نمو الشتلات الناتجة ومحتوى الأوراق من كلوروفيللى أ، ب، الكاروتينويدات، السكريات الكلية الذائبة، الإندولات والفينولات، حيث سجلت معاملة النقع في حمض الكبريتيك المركز لمدة ٣ دقائق أفضل معدل لنمو الشتلات الناتجة وأعلى محتوى من مختلف المكونات الكيميائية سالفة الذكر والتي كانت مصحوبا بأقل محتوى للفينولات الكلية. أيضاً، احتلت معاملة النقع في ماء الصنبور لمدة ٧٢ ساعة المرتبة الثانية بخصوص القياسات المذكورة آنفاً.

وعليه، يمكن النصح بنقع بذور شجرة تفاحة الفيل (*Dillenia indica* L.) إما فى حمض الكبريتيك المركز لمدة ٣ دقائق أو في ماء الصنبور لمدة ٧٢ ساعة للحصول على أفضل صفات إنبات وأعلى جودة للشتلات الناتجة.