Influence of Some Pregerminaton Treatments on Seed Germination and Seedling Quality of Two Ornamental Palm Species Common in Egypt

I- Golden Cane Palm (*Chrysalidocarpus lutescens* H. Wendl)

Sayed M. Shahin and Hesham F. El-Tayeb

Botanical Gardens. Res. Dept., Hort. Rrs. Inst., ARC, Giza, Egypt

ABSTRACT: A pot experiment was conducted under shade at the nursery of Antoniades Botanical Garden, Hort. Res. Inst., Alexandria, Egypt during 2014 and 2015 seasons in order to overcome the hardseededness of golden cane palm (*Chrysalidocarpus lutescens* H. Wendl.) seeds by subjecting them after removing the fleshy exocarp to the following treatments: untreated depulped seeds (control), soaking in either tap or hot (60-70 °C) water for 48 h. under room temperature, scarifying the hard endosperm by either clefting it with a hacksaw or rasping it at the distal rounded end that facing the placental pointed-end with a file and soaking in concentrated H_2SO_4 (98.5 %) for either 1 or 2 h in a completely randomized design, replicated thrice, each replicate contained 10 seeds. The results have shown that soaking treatments either in tap or hot water for 48 h. gave the highest germination % (87.33 and 85.00 % in the first season and 90.00 and 87.50 % in the second one, respectively) compared to the control and other treatments in the two seasons. The least percent of germination was recorded by soaking in concentrated sulphuric acid for either 1 or 2 h., while the seeds treated with clefting or rasping treatments have failed to germinate in both seasons. The least no. days to either the highest percent of germination (G.V.) or 50 % germination (MGR) was also achieved by soaking either in tap or in hot water treatments. The means of germination rate index (GRI), vigour index (V.I.), seed viability (S.V.) and plumule length, as a real indicator for germination vigour, the lengths of seedling, sheath, leaf, petiole and root and No. leaves/seedling, as well as leaf content of chlorophyll a, b, carotenoids and total soluble sugars were also improved by the various treatments used in this study except the treatments of H_2SO_4 , but the excellence in most previous parameters was for soaking the depulped seeds in tap water treatment, which gave the utmost highest values at all in both seasons and followed by soaking in hot water one. Hence, it can be recommended to soak the depulped seeds of golden cane palm (*Chrysalidocarpus lutescens* H. Wendl.) in either tap or hot water for 48 h. in order to get the best germination characters and seedling quality.

Keywords: *Chrysalidocarpus lutescens* H. Wendl, germination, soaking, thermal scarification, mechanical scarification, chemical scarification.

INTRODUCTION

Golden cane palm (*Chrysalidocarpus lutescens* H. Wendl., syn. *Dypsis lutescens* (H. Wendl) Beentje and J. Dransf.), known also as bamboo palm, yellow palm, Areca palm or butterfly palm (Fam. Palmaceae). It is a beautiful palm tree that can grow up to 6-9 m tall with a golden ringed stem (like bamboo stem). Its leaves are light green with long petioles arise from the main trunk and gracefully arch outward and downward distributing in all directions. It can be used in gardens as sole specimen, in front of buildings, on sides of enterances and in borders. Also used for indoor landscaping in places with enough light to add a tropical touch. It is considered a good tolerant for drought (**Huxley, 1992**).

Golden cane palm is propagated mainly by seeds, which need to 2-6 months to germinate due to their hard, horny endsperm. So, such seeds must be soaked in lukewarm water for two days to enhance germination (**Meerow, 1991**). On other palms, **Al-Fredan and Ali (2008)** found that the highest

germination % in doum seeds was recorded by mechanically scarified seeds for 30 min and then soaked in water for 24 h. **Zarchini *et al*. (2011)** mentioned that seeds of *Cycas revoluta* pretreated with hot water (70-80 °C) for 12h. germinated faster than untreated ones, while the most germination rate (GR) and value (G.V.) were obtained from seeds pretreated with hot water (100 °C) for 1 h along with 25 % H_2SO_4 for 2 h. **Viana *et al*. (2013)** reported that the highest germination rate was found when green fruits of *Livistona rotundifolia* had their pulp removed and soaked in tap water. On triangle palm, **Shahin *et al*. (2014)** observed that soaking the depulped seeds 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 and indoles in the seedling leaves.

Several reports were also obtained for ornamental trees. In this concern, **Alamgir and Hossain (2005)** noticed that immersing seeds of *Albizia saman* in tap water for 24 h may be recommended for maximal germination and initial vigorous seedlings growth in the nursery. On *Acacia mangium,* **Bahar (2011)** stated that hot water soaking for 24 h or H_2SO_4 for 15 min. soaking enhanced germination of seeds to more than 92 %. Likewise, were those results elicited by **Azad *et al*. (2010)** on *albizia richardiana*, **Azad *et al*. (2012)** on *Albizia procera*, **Khan (2013)** on *Cassia auriculata and C. tora* and **Shahin *et al*. (2015)** whom claimed that soaking seeds of Elephant apple (*Dillenia indica*) either in concentrated H_2SO_4 for 3 min or in tap water for 72 h gave the highest germination % and best quality of the seedlings.

The purpose of this study, however is determining the response of Golden cane palm seeds to some pre-sowing treatments for higher germination percentage and velocity along with better seedling quality.

MATERIALS AND METHODS

The current work was performed under shade at the nursery of Antoniades Botanical Garden, Hort. Res. Inst., Alexandria, Egypt throughout the two consecutive seasons of 2014 and 2015 to overcome the hardseededness of yellow areca palm by some pre-sowing treatments, and to explore the effect of these treatments on growth and quality of the produced seedlings.

Thus, the yellow-ripened fruits of Golden cane palm (*Chrysalidocarpus lutescens* H. Wendl.) were collected at maturity stage (on mid September) for each season and the fleshy exocarp was removed, then were stored at room temperature inside paper bag. The mean weight of 10 seeds after exocarp removal ranged between 3.80-4.27 g. On March, 15th, the depulped seeds were surface sterilized with 10 % solution of sodium hydrochloride for 10 minutes, then rinsed several times in a sterile distilled water and directly undergone to the following treatments:

1. Untreated depulped seeds, referred to as control.
2. Soaking in tap water for 48 hours under ambient conditions.
3. Soaking in hot water (60-70 °C) for 48 hours as thermal scarification treatment.

4. Mechanical scarification by either clefting one side of the mesocarp with a hacksaw or rasping the distal rounded end that facing the placental pointed-end with a file.
5. Soaking in concentrated sulphuric acid (98.5 %) for either 1 or 2 h. as chemical scarification treatments.

The treated and control seeds were then directly sown in 16-cm-diameter plastic pots (10 seeds/pot) filled with about 1.5 kg of sand and clay mixture (1 : 1, by volume) and kept under shade till the end of the experiment. The physical and chemical analyses of the sand and clay used in the two seasons were determined and listed in Table (1).

Table (1). The physical and chemical analyses of the used sand and clay in both seasons.

Soil type	Particle size distribution (%)				S.P.	E.C. (dS/m)	pH	Cations (meq/L)				Anions (Meq/L)		
	Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sand	81.03	10.15	2.30	6.52	23.11	3.51	7.90	7.50	1.63	33.60	0.50	3.20	22.50	17.53
Clay	7.86	21.29	31.67	39.18	55.18	2.21	8.10	7.82	2.12	15.40	0.75	6.60	8.20	11.29

The layout of the experiments in the two seasons was a completely randomized design (**Silva and Azevedo, 2009**) with 3 replicates, as each pot contained 10 seeds represents one replicate. Irrigation and the other agricultural practices were done whenever needed as usually farmer did. The data were recorded as follows:

A. Germination characteristics:-

1- Germination percentage (G %) from the following equation:
G. % = (No. germinated seeds/ Total No. sown seeds) x 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 (MGR) in days = mean number of days till 50 % germination (**Odetola, 1987**).
4- Germination rate index (GRI), 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 (VI) = G % x 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**).
7- Plumule length of the germinated seeds (cm).

B. Seedling growth characters:-

At the end of each season (on July, 15th), seedlings from the different treatments were gently lifted to measure the following parameters: seedling,

sheath, leaf and petiole lengths (cm), number of leaves/seedling, number of leaflets/leaf, root length (cm) and leaves and roots fresh and dry weights (g).

C. Chemical determinations:-

In fresh leaf samples taken only from the seedlings produced in the second season, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g. f.w.) and total soluble sugars (mg/100 g f.w.) were measured according to the methods described by **Yadava (1986)** and **Dubois *et al.* (1966)**, respectively.

Data were then tabulated and subjected to analysis of variance according to **SAS Institute (2009)** program and the means of various treatments were differentiated using Duncan's New Multiple Range Test at 5 % level (**Steel and Torrie, 1980)**.

RESULTS AND DISCUSSION

Effect of pre-germination treatments on:

1- Germination characteristics:

Data in **Table (2)** show that soaking treatments in either tap or hot water for 48 h gave the highest germination percentage compared to control in the two seasons. However, the superiority in both seasons was for soaking in tap water treatment which slightly improved this trait over soaking treatment in hot water with non-significant differences among them. This may be attributed to that hot water may injure embryos of some seed species. In this connection, **Souza *et al.* (2012)** stated that after treating the seeds of *Schizolobium parahyba* with hot water, the lens detached from the coat. Blocking water from contacting the lens inhibited water absorption in hot-water-treated seeds. Moreover, **Kavita and Kumar (2014)** reported that seeds of *Stylosanthes guianensis* cv. Cook which were treated with hot water showed maximum death compared to other treatments. On the other hand, the least percent of germination was recorded by soaking in concentrated H_2SO_4 for either 1 or 2 h, whereas the seeds either clefted with a hacksaw or rasped with a file failed to germinate giving 0.0 % germination in the two seasons. This may indicate the negative effect of H_2SO_4 on seed germination of this palm due to prolonging time exposure. In this regard, **Chikumba *et al.* (2006)** found that exposing seeds of *Macrotyloma daltonii* to concentrated H_2SO_4 for 10 min increased germination % from 21 to 80 %, but 20-min. exposure reduced germination and increased the number of dead seeds. Combining pre-chilling with 10-min of acid treatment damaged seeds and impaired germination.

Furthermore, the least number of days to the highest germination percent (G.V.) or 50 % germination (MGR) was also achieved by soaking either in tap or in hot water for 48 h. treatments which recorded means closely near together with non significant differences in between in both seasons. However, soaking in hot water treatment shortened G.V. means to less number of days than soaking in tap water one, while prolonged MGR means to more number of days than tap water soaking treatment in the two seasons, like result was also obtained by **Shahin *et al.* (2014)** who noted that seeds of triangle palm soaked in previously boiling water failed to germinate because of rotting their pith.

Data also indicated that means of G.R.I., V.I. and plumule length (cm), as real indicators for germination vigour were greatly increased in response to the most used treatments, but the prevalence was also for soaking in tap water treatment for 48 h., which scored the highest values in the two seasons and directly followed by hot water treatment that occupied the second rank. This may indicate the hyper-ability of tap or hot water in softening the hard, horny endosperm of such seeds, which consequently permits the ease permeable of water across this soften endosperm which finally leads to activating enzymatic systems that decay the complex nutritional substances of this endosperm to produce energy required for activating the embryo.

The previous results are in accordance with those revealed by **Meerow (1991)** on golden cane palm, **Zarchini *et al*. (2011)** on *Cycas revoluta*, **Alamgir and Hossain (2005)** on *Albizia saman*, **Khan (2013)** on *Cassia auriculata and C. tora* and **Shahin *et al*. (2015)** on *Dillenia indica*.

Table (2). Effect of pre-germination treatments on germination traits of *Chrysalidocarpus lutescens* H. Wendl palm seeds during 2014 and 2015 seasons.

Pre-germination treatments	Germination percentage (G. %)	Germination velocity (G.V., day)	Mean germination rate (MGR, day)	Germination rate index (GRI)	Vigour index (VI)	Seed viability (S.V.)	Plumule length (cm)
First season: 2014							
Control	60.00b	95.28a	89.33a	0.87c	196.80c	3.00c	3.28c
Soaking in tap water for 48 h.	87.33a	49.88c	36.50b	2.58a	392.99a	8.33a	4.50a
Soaking in hot water for 48 h.	85.00a	46.33c	41.00b	1.36b	338.30b	6.76b	3.98ab
Clefting with a hacksaw	00.00e	-	-	-	-	-	-
Rasping with a file	00.00e	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	20.50d	87.50b	-	0.95c	71.75e	1.76d	3.50a
Soaking in concn. H_2SO_4 for 2 h	33.67c	81.29b	-	1.00bc	117.85d	2.35d	3.50b
Second season: 2015							
Control	55.49b	97.48a	93.50a	0.84d	163.70c	3.00b	2.95c
Soaking in tap water for 48 h.	90.00a	50.33c	37.26b	2.21a	378.00a	9.00a	4.20a
Soaking in hot water for 48 h.	87.50a	48.56c	44.00b	1.31b	308.00b	8.71a	3.52ab
Clefting with a hacksaw	00.00e	-	-	-	-	-	-
Rasping with a file	00.00e	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	20.00d	88.00b	-	0.99c	62.80e	1.90c	3.14b
Soaking in concn. H_2SO_4 for 2 h	35.10c	83.78b	-	1.03bc	112.32d	3.00b	3.20b

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

2- Seedling growth parameters:

It is obvious from data averaged in **Tables (3 and 4)** that all pre-sowing treatments employed in such work improved the means of the various seedling growth traits, with significant differences relative to control means in most cases of both seasons.

Number of leaflets/leaf is the only trait which was not affected by the applied treatments. So, the differences among them were non-significant in the two seasons. In general, the mastery in all parameters of seedling growth was for soaking in tap water treatment (48 h.) that registered the tallest lengths of seedling, sheath, leaf, petiole and root, the highest No. of leaves and the

heaviest fresh and dry weights of leaves and roots with few exceptions in the two seasons. Also, soaking in hot water for 48 h. treatment came to the second position giving records near, to some extent to those of the dominant treatment in most instances of the 1st and 2nd seasons (Photo,1).

Photo (1). A comparison between control seedling and the best treatment one (Tap water, 48 h.).

Improving growth of the resulted seedlings by tap and hot water treatments may be attributed to that these two treatments accelerate seed germination before the other treatments and consequently saving enough time for the new formed seedlings to grown better than those formed lately. Besides, soaking in water for proper time helps the water to penetrate the hard endosperm and hence increases ability of the seeds to absorb more water necessary for hydrolysis of the complex food reserves to absorbable forms. Analogous observations were also obtained by **Meerow (1991)** on golden cane palm, **Al-Fredan and Ali (2008)** on doum palm and **Viana *et al*. (2013)** on *Livistona rotundifolia*. In this connection, **Azad *et al*. (2010)** mentioned that hot water treatment (80 °C for 10 min) was the best for higher germination percentage of *Albizia richardiana* seeds and better growth of the seedlings. Likewise, **Khan (2013)** noted that hot water treatment (80 °C for 10 minutes) was very effective to enhance germination of *Cassia uriculata* and *C. tora* seeds and improving growth of the resulted seedlings.

Table (3). Effect of pre-germination treatments on growth traits of *Chrysalidocarpus lutescens* H. Wendl palm seedlings during 2014 and 2015 seasons.

Pre-germination treatments	Seedling length (cm)	Sheath length (cm)	Leaf length (cm)	Petiole length (cm)	No. leaves per seedling	No. leaflets per leaf	Root length (cm.)
First season: 2014							
Control	15.50d	2.79c	12.71d	5.83bc	1.00b	2a	6.33d
Soaking in tap water for 48 h.	27.24a	4.53a	22.71a	9.80a	3.00a	2a	11.20b
Soaking in hot water for 48 h.	23.80b	4.46a	19.34b	6.28b	3.00a	2a	14.80a
Clefting with a hacksaw	-	-	-	-	-	-	-
Rasping with a file	-	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	15.78d	2.58bc	13.20cd	5.50c	1.00b	2a	7.40cd
Soaking in concn. H_2SO_4 for 2 h	18.43c	2.97b	15.46c	6.10b	1.00b	2a	8.01c
Second season: 2015							
Control	15.41d	2.54c	12.87c	5.40b	1.00b	2a	7.25c
Soaking in tap water for 48 h.	27.03a	4.50a	22.53a	9.13a	3.00a	2a	13.72a
Soaking in hot water for 48 h.	23.50b	4.50a	19.00b	5.85b	2.76a	2a	12.10ab
Clefting with a hacksaw	-	-	-	-	-	-	-
Rasping with a file	-	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	18.33c	3.00bc	15.33c	5.51b	1.00b	2a	8.47b
Soaking in concn. H_2SO_4 for 2 h	18.50c	3.17b	15.33c	5.73b	1.00b	2a	8.30b

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

Table (4). Effect of pre-germination treatments on leaves and roots fresh and dry weights of *Chrysalidocarpus lutescens* H. Wendl seedlings during 2014 and 2015 seasons.

Pre-germination treatments	Leaves				Roots			
	Fresh weight (g)		Dry weight (g)		Fresh weight (g)		Dry weight (g)	
	2014	2015	2014	2015	2014	2015	2014	2015
Control	0.43c	0.40c	0.13b	0.12b	0.35c	0.41c	0.14c	0.17c
Soaking in tap water for 48 h.	0.78a	0.74a	0.25a	0.24a	0.75a	0.92a	0.31a	0.39a
Soaking in hot water for 48 h.	0.72a	0.70a	0.23a	0.23a	0.66ab	0.56b	0.24ab	0.21bc
Clefting with a hacksaw	-	-	-	-	-	-	-	-
Rasping with a file	-	-	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	0.52b	0.61b	0.14b	0.17ab	0.45b	0.52b	0.18bc	0.21bc
Soaking in concn. H_2SO_4 for 2 h	0.63ab	0.63ab	0.16b	0.17ab	0.49b	0.52b	0.21b	0.23b

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

3- Leaf content of pigments and sugars:

A similar trend to that obtained in case of germination and seedling growth traits, was also attained regarding pigments and sugars content in the leaves of seedlings originated from the treated seeds (**Table, 5**), where a marked increment was noticed in the leaf content of chlorophyll a, b and carotenoids (mg/g f.w.), as well as total soluble sugars (mg/100 g f.w.) relative to control content in the two seasons, except of the soaking in concentrated H_2SO_4 for 1 h treatment which slightly reduced total soluble sugars content in the first season only to 1.543 against 1.557 (mg/100 g f.w.) for control. The highest content in all previous constituents, however, was also found due to

soaking the depulped seeds in tap water treatment for 48 h. that gave contents surpassed those recorded by all other treatments. The second rank was also taken up by soaking in hot water treatment for 48 h.

These findings could be discussed and interpretted as indicated before in case of germination and seedling growth characters. On the same line, were those results observed by **Meerow (1991)** on golden cane palm, **Shahin *et al.* (2014)** on triangle palm and **Azad *et al.* (2012)** who postulated that immersion the seeds of *Albizia procera* in hot water (100 °C for 1 min) greatly improved germination % and leaf content of pigments, sugars, N, P and K of the seedlings originated from treated seeds. In this concern, **Shahin *et al.* (2015)** established that soaking *Dillenia indica* seeds either in concentrated sulphuric acid for 3 min. or in tap water for 72 h. pronouncedly improved the leaf content of chlorophyll a, b, carotenoids, total soluble sugars and indoles, but decreased total phenols content.

Table(5). Effect of pre-germination treatments on some active constituents in the leaves of *Chrysalidocarpus lutescens* H. Wendl seedlings during 2014 and 2015 seasons.

Pre-germination treatments	Pigments content (mg/g. f.w.)						Total soluble sugars (mg/100 g. f.w.)	
	Chlorophyll (a)		Chlorophyll (b)		Carotenoids			
	2014	2015	2014	2015	2014	2015	2014	2015
Control	0.937	0.756	0.404	0.361	0.369	0.328	1.557	1.306
Soaking in tap water for 48 h.	2.522	2.143	1.068	0.969	0.913	0.965	2.967	2.497
Soaking in hot water for 48 h.	1.668	1.253	0.616	0.562	0.699	0.641	2.609	2.201
Clefting with a hacksaw	-	-	-	-	-	-	-	-
Rasping with a file	-	-	-	-	-	-	-	-
Soaking in concn. H_2SO_4 for 1 h	1.595	1.238	0.509	0.453	0.471	0.500	1.543	1.422
Soaking in concn. H_2SO_4 for 2 h	1.586	1.267	0.587	0.530	0.437	0.496	1.861	1.568

Accordingly, it is advised to soak the dopulped seeds of yellow areca palm (*Chrysalidocarpus lutescens* H. Wendl.) in either tap or hot water for 48 h. to improve germination characteristics and quality of the resulted seedlings.

REFERENCES

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

Al-Fredan, M. A. and Y.S.S. Ali. (2008). Seed scarification requirement in Doum (*Hyphaene thebaica* Mart). Scientific J. King Faisal Univ., 9 (2): 75-84.

Azad, M. S., R. K. Biswas, and M. Abdul Matin. (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., N. K. Paul, and M. Abdul Matin. (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.

Chikumba, N., C. Mapiye, and X. Poshiwa. (2006). Breaking seed coat dormancy in *Macrotyloma daltonii*. Rangeland J., 28 (2): 179-182.

Dubois, M., F. Smith, K. A. Illes, J. K. Hamilton and P. A. Rebers. (1966). Colorimetric mehod for determination of sugars and related substances. Ann. Chem., 28 (3): 350-356.

Hartmann, H.T. and D. E. Kester. (1983). Plant Propagation: Principles and Practices. Prentice-Hall Inc., Inglewood Cliffs, N. J., 662pp.

Huxley, A., ed. (1992). New RHS Dictionary of Gardening, Macmillan Pub. Co., Vol. 1, 665pp.

Kavita, S. R. and V. Kumar. (2014). Overcoming the hardseededness in *Stylosanthes guianensis* cv. Cook. Karnataka J. Agric. Sci., 27 (2): 135-138.

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.

Meerow, A. W. (1991). Palm seed germination. Gainsville: Florida Cooperative Extension Servia, Bulletin, 274, 10p.

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

SAS, Institute. (2009). SAS/STAT, User`s Guides: Statistics. Vers. 9, SAS. Institute Inc. Cary, N.C., USA.

Selvaraju, P. and J. A. Selvaraj. (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., Magda A. Ahmed, and T. M. Noor El-Deen. (2014). Germination of hard to germinate triangle palm (*Neodypsis decoryi* Jumelle) seeds. J. Biol. Chem. & Environ. Sci., 9 (4): 517-530.

Shahin, S.M., Amal S. El-Fouly, and Azza M. Abdel-Moniem. (2015). Seeds of Elephant apple (*Dillenia indica* L.) response to some pre-germination treatments. The 1st Conf. of SSFOP "Future of Ornam. Plants in Egypt", Feb. 22nd,Cairo, Scie. J. Flowers & Ornam. Plants 2 (1): 39-50.

Silva, F. de A.S. and C. A. V. de Azevedo. (2009). Principal Component Analysis in the Software Assistat Statistical Attendance. In: WORLDCONGRESS ON COMPUTERS IN AGRICULTURE, 7 RenoNV-USA, Amer. Soc. of Agric. and Bio. Engineers

Souza, T. V., C. H. Voltolini, Santos, M. and M. T. Paulilo. (2012). Water absorption and dormancy-braeaking requirements of physically dormant seeds of *Schizolobium parahyba* (Fabaceae -Caesalpiniodeae). Seed Sci. Res., 22 (3): 169-176.

Steel, R. G. D. and J. H. Torrie. (1980). Principles and procedures of statistics. McGrow Hill Book Co., Inc., New York, P: 377-400.

Viana, F. A., F. V. Moro, G.S. Batista, G. de N. Romani, R. B. Mazzini and K. F. Pivetta. (2013). Maturity, pulp removal and storage effects on the germination of *Livistna rotundifolia* seeds. Acta Hort., 1003: 197-201.

Yadava, Y. L. (1986). Rapid and non-destructive methods to determine chlorophyll in intact leaves. HortScience, 21: 1449-1450.

Zarchini, M., D. Hashemabadi, B. Kaviani, P. R. Fallahabadi and N. Nagahdar. (2011). Improved germination conditions in *Cycas revoluta* L. by using sulphuric acid and hot water. Plant Omics, J., 4 (7): 350-353.

الملخص العربى

تأثير بعض معاملات ما قبل الإنبات على إنبات بذور وجودة شتلات نوعين من نخيل الزينة المتداول فى مصر

١- نخيل الأريكا الصفراء (*Chrysalidocarpus lutescens* H. Wendl.)

سيد محمد شاهين وهشام فخري الطيب

قسم بحوث الحدائق النباتية- معهد بحوث البساتين- مركز البحوث الزراعية- الجيزة، مصر.

أجريت تجربة أصص تحت الظل بمشتل حديقة أنطونيادس النباتية، معهد بحوث البساتين، الإسكندرية، مصر خلال موسمي ٢٠١٤، ٢٠١٥ بقصد التغلب على صلابة بذور نخيل الأريكا الصفراء وذلك بتعريضها، بعد إزالة الجزء اللحمي الخارجي للمعاملات الآتية: بذور منزوعة اللحم بدون معاملة (كمقارنة)، النقع إما في ماء الصنبور أو الماء الدافئ (٦٠-٧٠ °م) لمدة ٤٨ ساعة على درجة حرارة الغرفة، خدش الإندوسبرم الصلب ميكانيكياً إما بشقه بالمنشار عند أحد الأجناب أو كشطه بالمبرد عند الطرف البعيد المستدير المقابل للطرف المشيمى المدبب وكذلك النقع في حمض الكبريتيك المركز (٩٨,٥ %) إما لمدة ساعة أو ساعتين في تصميم عشوائي كامل، به ثلاث مكررات/معاملة وبكل مكررة عشرة بذور.

أوضحت النتائج المتحصل عليها أن معاملتي النقع إما في ماء الصنبور أو الماء الدافئ لمدة ٤٨ ساعة أعطيتا أعلى نسبة مئوية للإنبات (٨٧,٣٣، ٨٥,٠٠ % في الموسم الأول، ٩٠,٠٠، ٨٧,٥٠ % في الموسم الثاني، على الترتيب) مقارنة بالكنترول والمعاملات الأخرى فى كلا الموسمين. أما أقل نسبة مئوية للإنبات فقد سجلتها معاملتي النقع في حمض الكبريتيك المركز لمدة ساعة أو ساعتين، بينما فشلت البذور المخدوشة ميكانيكياً إما بالشق أو الكشط في الإنبات بكلا الموسمين. أيضاً، فإن أقل عدد للأيام لتحقيق أعلى نسبة للإنبات (سرعة الإنبات) أو تحقيق ٥٠ % إنبات (معدل متوسط الإنبات) فقد أحرزته معاملتي النقع إما في ماء الصنبور أو في الماء الدافئ. أوضحت النتائج كذلك أن متوسطات دليل معدل الإنبات، دليل قوة الإنبات، حيوية البذور وطول الريشة كأدلة حقيقية على قوة الإنبات، أطوال الشتلة، الغمد، الورقة، عنق الورقة والجذر وعدد الأوراق/شتلة، وأيضاً محتوى أوراق الشتلات الناتجة من كلوروفيل أ، ب، الكاروتينويدات والسكريات الكلية الذائبة قد تحسنت بمختلف المعاملات المطبقة بهذه الدراسة عدا معاملات حمض الكبرتيك، لكن السيادة في معظم القياسات السابقة كانت

لمعاملة النقع في ماء الصنبور (٤٨ ساعة) والتي أعطت أعلى القيم على الإطلاق في معظم الحالات بكلا الموسمين وتلتها معاملة النقع في الماء الدافئ (٤٨ ساعة).

وعليه، يمكن التوصية بنقع البذور منزوعة اللحم لنخيل الأريكا الصفراء إما في ماء الصنبور أو في الماء الدافئ لمدة ٤٨ ساعة للحصول على أفضل صفات للإنبات وعلى جودة للشتلات الناتجة.