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EFFECT OF SOME PRE-SOWING TREATMENTS AND SEED AGE ON GERMINATION OF *Seaforthia elegans* L., PALM SEEDS

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ABSTRACT

This experiment was carried out during 2006 and 2007 seasons, at the glasshouse of the Experimental Area, Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. The objective was to study the effect of some pre-sowing treatments and seed age on germination of Seaforthia elegans L., Palm seeds. The results revealed that, all pre-sowing treatments improved germination, compared with the untreated seeds. Soaking scarified seeds in GA_3 solution at 1000 ppm/72 h, before warm stratification at 35°C/3 weeks, produced the best germination parameters, namely germination percentage, germination velocity and germination rate index (G.R.I.). Also, soaking unscarified seeds in GA_3 before warm stratification gave similar results. This treatment was followed by warm stratification or GA_3 treatments accompanied with scarification. Meanwhile, soaking unscarified seeds in GA_3 or stratifying them at warm temperature, gave satisfactory results, compared with mechanical scarification treatment. The improvement in germination was accompanying with an increasing in total soluble sugars, total soluble indoles and indole/ phenol ratio in the germinated seeds, whereas total soluble phenol was reduced.

The results show that, sowing freshly harvested seeds gave the highest germination percentage followed by 4-months old seeds, whereas 8-months old seeds produced the lowest germination percentage. Germinated freshly harvested seeds contain more soluble sugars and soluble indoles, compared with old seeds. On contrary, total soluble phenols was more in the old germinated seeds. It could be concluded that scarified freshly harvested seeds, which were soaked in GA_3 solution at 1000 ppm/72 h and stratified at 35°C/3 weeks could be recommended for improving the germination of Seaforthia elegans seeds.

Key words: Pre-sowing treatments, seed age, germination, *Seaforthia elegans* L., palm seeds.

INTRODUCTION

Seaforthia elegans L., sometimes called Ptycho*sperma elegans* L., is widely planted for decorative purposes throughout their native region, and elsewhere in the tropics and subtropics, It is considered by many to be the most beautiful palm in the world. In Egypt, it is in great demand for garden and street landscape and is also one of the most attractive and adaptable of foliage plants for indoor use under medium light conditions. However, slow seed germination and long production time lead to higher prices in the market place. Accelerating the germination rate and increasing total germination are of great concern to commercial nurseries. Many investigators tried to improve and hasten germination, using mechanical scarification; Elkiey *et al.* (1985) on *Seaforthia elegans*; El-Gendy *et al.* (1995) on *Cycas revoluta*; El-Kady (2001) on *Livistona chinensis*, and Jun and Ling (2004) on *Calligonum* species. They reported that, mechanical scarification increased germination percentage and accelerated germination. Other investigators studied the effect of soaking seeds in GA_3 solution; Elkiey *et al.* (1985) on *Seaforthia elegans*; El-Boraie (1991) on *Sabal palmetto*; Hassane *et al.* (1998) on *Hyphaene thebaica* and Yang *et al.* (2007) on *Areca* seeds. They reported that, the embryo development may be accelerated by the application of gibberellic acid (GA_3).

Warm stratification accelerated the germination of palm seeds; Blomme and Degeyter (1984) on *Cotonaster bullata*; Tipton *et al.* (1986) on *Crataegus tracyi*; Carpenter (1987) on *Sabal palmetto*; El-Tantawy (1992) on *Roystonea regia*; Darwish (1998) on *Caryota mitis* and El-Kady (2001) on *Sabal blackborniana*. The combination between scarification, GA_3 and stratification significantly increased germination percentage and germination velocity; Elkiey *et al.* (1985) on *Seaforthia elegans* and Hassane *et al.* (1998) on *Hyphaene thebaica*.

The germination percentage of freshly harvested palm seeds is better than stored seeds; Barnett and Vozzo (1985) on pine seeds; Balvochyute and Dagite (1986) on *Hypericum perforatum*; Allen (1987) on *Nothofagus menziesii*; El-Tantawy (1992) on *Roystonea regia*; El-Shakhs (1993) and Reid (1997) on some ornamental palms; Hassane *et al.* (1998) on *Hyphaene thebaica* and El-Kady (2001) on *Livistona chinensis*.

The pre-sowing treatments, which improved germination, tended to increase total soluble sugars and total soluble indoles in the germinated seeds, particularly with freshly harvested seeds. On contrary, total soluble phenols was decreased, especially with old seeds; Kim and Kim (1984) on jujube seeds; Abdou and El-Banna (1989) on *Cocos romanzoffiana*; El-Tantawy

(1992) on *Roystonea regia*; Nofal *et al.* (2000) on some ornamental tree seeds and Samaan *et al.* (2000) on *Prunus armeniaca*.

MATERIALS AND METHODS

This investigation was carried out during 2006 and 2007 seasons, at the glasshouse of the Experimental Area, Ornamental Horticulture Department, Faculty of Agriculture, Cairo University. The objective was to study the effect of some pre-sowing treatments and seed age on germination of *Seaforthia* palm seeds. Seeds were collected from palm trees growing in Orman Botanical Garden in September every year.

Three different seeds age (freshly harvested seeds; 4-months old seeds and 8-months old seeds) were subjected to the following pre-sowing treatments after removing exocarps (fruit pulp): 1- Mechanical scarification was achieved by abrading the seeds between a revolving sand paper disks until part of the endosperm was visible. 2- Unscarified seeds were stratified for 3 weeks, before the planting date. Seeds were subjected to high temperature 35°C (warm stratification) under moist condition (peat moss and sand 2:1 v/v). 3- Soaking unscarified seeds in Gibberellic acid solution at 1000 ppm for 72 h. 4- Scarified seeds were stratified for 3 weeks. 5- Soaking scarified seeds in Gibberellic acid solution at 1000 ppm for 72 h. 6- Soaking unscarified seeds in Gibberellic acid solution at 1000 ppm/72 h, followed by warm stratification. 7- Soaking scarified seeds in Gibberellic acid solution at 1000 ppm/ 72 h, followed by warm stratification. 8- Untreated seeds (control).

Seeds were sown (in three different sowing dates, October 1st, February 1st and June 1st in plastic trays 40x60 cm filled with peat moss and sand (1:1 v/v), these trays were covered with white thinning polyethylene sheets, during winter months, to raise temperature around the sowing medium. Trays were watered regularly to keep the soil moist.

The layout of the experiment was a split plot design, the main plot was pre-sowing treatments and the sub-main plot was seed age. Each treatment was replicated four times and 25 seeds were used in each replicate. The following data were recorded; germination percentage, germination velocity (number of days from planting till germination) and germination rate index (GRI) as follow:

$$G.R.I. = \frac{A+ (A+B)+ (A+B+C)+\ldots\ldots}{N\ (A+B+C+\ldots\ldots)}$$

A, B and C: number of germinated seeds counted at different times.
N: number of counting times.

Also, total soluble sugars, total soluble indoles and total soluble phenols were determined in the germinated seeds according to Herbert *et al.* (1971), Larsen *et al.* (1962) and Daniel and Murten (1972), respectively.

The results were statistically analyzed using New L.S.D. test at 5% according to Steel and Torrie (1980).

RESULTS AND DISCUSSION

Germination percentage

Data presented in Table (1) show that, all pre-sowing treatments increased the average germination percentage, as compared to the control. Seeds which were soaked in GA_3 at 1000 ppm/ 72 h and stratified at 35°C for 3 weeks gave the highest values, particularly when they were scarified before soaking. This treatment resulted in 86 and 87% in both seasons, respectively, compared with 61.0 and 62.7% in the untreated seeds. Also, warm stratification or GA_3 treatments gave high values, especially with scarified seeds. These treatments resulted in 80.0 and 78.0 %, respectively in the first season, and 81.7 and 77.7% in the second one. The differences between these treatments were insignificant in the first season, also the differences between stratification or GA_3 treatments, were insignificant. These results agreed with those obtained by Hassane *et al.* (1998) on *Hyphaene thebaica*.

Sowing freshly harvested seeds in October 1st resulted in the highest values 80.3 and 81.5 % in both seasons, respectively, whereas, 8-months old seeds produced the lowest values 68.0 and 67.1 in the first and second seasons, respectively. The results show that germination percentage decreased when 4-months old seeds were used compared with fresh seeds. These results were in the agreement with the findings of El-Kady (2001) on *Livistona chinensis*.

Regarding the interaction between pre-sowing treatments and seed age, the results revealed that, soaking scarified fresh seeds in GA_3 at 1000 ppm/ 72 h before stratification at 35°C/3 weeks, gave the highest values being 90 and 92% in both seasons, respectively. Meanwhile, the untreated 8-months old seeds produced the lowest values 51 and 52 % in the first and second seasons, respectively. These results agreed with those obtained by El-Shakhs (1993) on some ornamental palms.

Germination velocity

Data presented in Table (2) show that pre-sowing treated seeds required from 29.6 to 50.5 days to germinate in the first season, and from 29.0 to 49.4 days in the second one, compared with 53.9 and 55.3 days in the untreated seeds. Soaking scarified seeds in GA_3 solution before stratification

Table 1. Effect of pre-sowing treatments and seed age on germination percentage of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	2006				2007			
Control	69	63	51	**61.0 a**	70	66	52	**62.7 a**
Mechanical scarification	72	67	59	**66.0 b**	73	67	58	**66.0 b**
Warm stratification	79	69	71	**73.0 c**	79	72	66	**72.3 c**
GA_3 at 1000 ppm/ 72 h.	74	68	63	**68.3 cd**	75	68	62	**68.3 b**
Scarification + Stratification	85	81	74	**80.0 d**	88	83	74	**81.7 e**
Scarification + GA_3	85	78	71	**78.0 d**	86	79	68	**77.7 d**
GA_3 + Stratification	88	86	76	**83.3 e**	89	88	77	84.7 f
Scar. + GA_3 + Str.	90	89	79	**86.0 e**	92	89	80	**87.0 g**
Mean	**80.3f**	**75.1g**	**68.0h**		**81.5h**	**76.5i**	**67.1j**	

Means sharing one or more letter(s) are insignificantly different at 5% level according to New LSD test.

Table 2. Effect of pre-sowing treatments and seed age on germination velocity of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh Seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	First season				Second season			
Control	63.4	53.0	45.2	**53.9**	63.7	55.6	46.6	**55.3**
Mechanical scarification	58.2	50.3	42.9	**50.5**	56.4	49.5	42.3	**49.4**
Warm stratification	48.5	43.2	38.5	**43.4**	48.4	44.5	35.4	**42.8**
GA_3 at 1000 ppm/72 h.	52.3	46.9	40.6	**46.6**	54.1	46.8	40.2	**47.0**
Scarification + Stratification	39.8	35.5	32.4	**35.6**	39.4	35.0	30.1	**34.8**
Scarification + GA_3	44.2	41.3	35.5	**40.3**	46.0	42.3	34.9	**41.1**
GA_3 + Stratification	35.8	32.5	28.1	**32.1**	39.7	33.5	29.4	**34.2**
Scar. + GA_3 + Str.	32.5	29.4	26.9	**29.6**	33.3	28.1	25.7	**29.0**
Mean	**46.8**	**41.5**	**36.3**		**47.6**	**41.9**	**35.6**	
New LSD at 5% for T				**4.8**				**5.2**
S				**3.2**				**3.5**
T x S				**5.7**				**5.8**

accelerated germination date, require 29.6 and 29.0 days to germinate in both seasons, respectively. This treatment was followed by unscarified seeds which were soaked in GA_3 before warm stratification, requiring 32.1 and 34.2 days in the first and second seasons, respectively. Treating unscarified seeds with stratification or GA_3 accelerated germination date, require 43.4 and 46.6 days, respectively (in the first season), and 42.8 and 47.0 days in the second one. These treatments were followed by mechanical scarification treatment, which required 50.5 and 49.4 days in both seasons, respectively. These results were in harmony with the finding of Yang *et al.* (2007) on *Areca* seeds, who reported that, the embryo development may be accelerated by the application of GA_3.

Regarding the effect of seed age on germination velocity, the results show that sowing 8-months old seeds (in June 1st) accelerated germination date and seeds required 36.3 and 35.6 days to germinate in both seasons, respectively. Whereas, sowing freshly harvested seeds required 46.8 and 47.6 days to germinate. The accelerative effect of June sowing date might be due to high temperature during summer months (Darwish, 1991 on *Sabal palmetto*). Meanwhile medium results were obtained by 4-months old seeds.

Sowing scarified 8-months old seeds, which were soaked in GA_3 solution before stratification, gave the best results, but freshly harvested seeds produced the highest germination percentage, therefore it is recommended (El-Kady, 2001, on *Sabal blackborniana*).

Germination rate index (G.R.I.)

Data presented in Table (3) show that in the first season, the average GRI ranged from 0.60 to 0.79, compared with 0.48 in the control. Soaking scarified seeds in GA_3 solution before warm stratification gave the highest GRI value being 0.79. This treatment was followed by unscarified seeds which were soaked in GA_3 before stratification resulting in 0.76. Treating scarified seeds with stratification on GA_3 resulted in 0.73 and 0.70, respectively. Whereas unscarified seeds which were soaked in GA_3 or stratified resulted in 0.62 and 0.69, respectively. These treatments were followed by mechanical scarification which resulted in 0.60, compared with 0.48 in the untreated seeds. Similar results were obtained in the second season. These results were in good agreement with the findings of Blomme and Degeyter (1984), who accelerated the germination rate by treating seeds of *Cotoneaster bullata* with warm stratification at 20°C for 2 months.

Table 3. Effect of pre-sowing treatments and seed age on total germination rate index (G.R.I.) of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	First season				Second season			
Control	0.41	0.49	0.54	**0.48**	0.40	0.48	0.52	**0.47**
Mechanical scarification	0.54	0.60	0.65	**0.60**	0.55	0.59	0.66	**0.50**
Warm stratification	0.63	0.73	0.71	**0.69**	0.65	0.75	0.72	**0.71**
GA_3 at 1000 ppm/72 h.	0.57	0.61	0.67	**0.62**	0.58	0.63	0.69	**0.63**
Scarification + Stratification	0.65	0.75	0.79	**0.73**	0.66	0.75	0.80	**0.74**
Scarification + GA_3	0.61	0.73	0.75	**0.70**	0.63	0.65	0.77	**0.68**
GA_3 + Stratification	0.67	0.79	0.82	**0.76**	0.68	0.77	0.84	**0.76**
Scar. + GA_3 + Str.	0.70	0.82	0.85	**0.79**	0.72	0.81	0.86	**0.80**
Mean	**0.60**	**0.69**	**0.72**		**0.61**	**0.68**	**0.73**	
New LSD at 5% for T				**0.11**				**0.11**
S				**0.06**				**0.08**
T x S				**0.15**				**0.19**

Regarding the effect of seed age on GRI, the results show that the maximum values 0.72 and 0.73 (in both seasons, respectively) were obtained with 8-months old seeds, which were sown in June 1st. Whereas, freshly harvested seeds produced the lowest values 0.60 and 0.61 in both seasons, respectively. The differences between 4 and 8-months old seeds were insignificant in both seasons.

Scarified 8-months old seeds which were soaked in GA_3 solution before stratification produced the highest interaction values being 0.85 and 0.86 in the first and second seasons, respectively. Whereas, unscarified freshly harvested seeds gave the lowest GRI values (0.41 and 0.40). These results were explained by Mayer and Mayber (1982) who reported that GA_3 and warm temperature stimulate the synthesis of hydrolytic enzymes which hydrolysis complex compounds in the seeds as starch and proteins to simpler substance valid to be absorbed by the embryo.

Total soluble sugars

Data presented in Table (4) show that the improvement in germination percentage was accompanied with an increasing in soluble sugars in the germinated seeds. In the first season, total soluble sugars ranged from 95.9 to 122.5 mg/g DW, compared with 74.2 mg/g DW in the untreated seeds.

Table 4: Effect of pre-sowing treatments and seed age on total soluble sugars (mg/g DW) of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh Seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	First season				Second season			
Control	79.7	76.1	66.7	**74.2**	81.4	74.1	65.6	**73.7**
Mechanical scarification	100.3	98.7	89.1	**95.9**	101.9	96.4	88.1	**95.5**
Warm stratification	114.6	109.2	101.7	**108.5**	113.3	108.9	99.9	**107.4**
GA_3 at 1000 ppm/72 h.	109.5	105.8	95.0	**103.4**	108.8	102.1	102.4	**104.1**
Scarification + Stratification	118.7	115.2	101.3	**111.7**	116.5	112.3	100.6	**109.8**
Scarification + GA_3	114.3	110.1	97.6	**107.3**	113.9	109.5	98.8	**107.4**
GA_3 + Stratification	121.8	118.6	107.2	**115.9**	119.4	116.4	105.7	**113.8**
Scar. + GA_3 + Str.	127.5	125.0	114.9	**122.5**	123.8	120.2	113.6	**119.2**
Mean	**110.8**	**107.3**	**97.7**		**109.9**	**105.0**	**96.8**	
New LSD at 5% for T				**10.8**				**12.9**
S				**6.7**				**6.5**
T x S				**14.6**				**15.4**

Soaking scarified seeds in GA_3 solution before stratification, produced the highest values (122.5 mg/g DW) compared with 74.2 mg/g DW in the control. This treatment was followed by unscarified seeds which soaked in GA_3 before stratification, resulting in 115.9 mg/g DW. Treating scarified seeds with warm stratification or GA_3 increased also total soluble sugars resulting in 111.7 and 107.3 mg/g DW, respectively. Whereas, soaking unscarified seeds in GA_3 solution or treating them with warm stratification relatively increased total soluble sugars in the germinated seeds, resulting in 103.4 and 108.5, respectively. These treatments were followed by mechanical scarification which resulted in 95.9 mg/g DW, as compared with 74.2 mg/g DW in the untreated seeds. Similar results were obtained in the second season. These results agreed with those obtained by Samaan *et al.* (2000) on *Prunus armeniaca*.

Total soluble sugars tended to be reduced in the old germinated seeds. 8-months old seeds produced the lowest values 97.7 and 96.8 mg/g WD in both seasons, respectively, whereas the highest values 10.8 and 109.7 mg/g DW were obtained with the freshly harvested seeds. Medium values were recorded with 4-months old seeds 107.3 and 105.0 mg/g DW in both seasons, respectively.

Scarified freshly harvested seeds, which were soaked in GA_3 before stratification, produced the highest interaction values 127.5 and 123.8 mg/g DW in both seasons, respectively. Meanwhile, the untreated 8-months old seeds gave the lowest values 66.7 and 65.6 mg/g DW. The increase in total soluble sugars may be due to the more activity of hydrolytic enzymes mainly amylase enzyme which hydrolysis starch to soluble sugars especially under warm stratification (Mayer and Mayber, 1982).

Total soluble indoles

Data presented in Table (5) show that there were positive relationship between germination percentage and total soluble indoles in the germinated seeds. Soaking scarified seeds in GA_3 solution before stratification, produced the highest values 50.5 and 52.5 mg/g FW in both seasons, respectively, and **as** compared with 31.5 and 32.8 mg/g FW in the untreated seeds. Unscarified seeds which were soaked in GA_3 before warm stratification resulted in 45.6 and 49.3 mg/g FW in the first and second seasons, respectively. This treatment was followed by the treatments of either stratification or GA_3 which pre-treated with scarification, resulting in 42.8 and 42.6 mg/g FW respectively (in the first season); 46.7 and 44.5 mg/g FW in the second one. Meanwhile, unscarified seeds which stratified resulted in 39.3 and 41.9 mg/g FW in both seasons, respectively followed by GA_3 without scarification which recorded 36.5 and 38.9 mg/g FW in the first and second seasons, respectively. The scarified seeds contained more soluble indoles (35.0 and 36.6 mg/g FW in both seasons, respectively), compared with the untreated seeds. These results agreed with those obtained by Abdou and El-Banna (1989) on *Cocos romanzoffiana*.

Sowing freshly harvested seeds in October 1st produced the highest value 43.8 and 45.4 mg/g FW in both seasons, respectively. Whereas, 8-months old seeds produced the lowest values 37.0 and 40.0 mg/g FW in both seasons, respectively.

Freshly harvested seeds which were scarified and soaked in GA_3 solution before stratification produced the highest interaction values being 53.4 and 55.9 mg/g FW in both seasons, respectively. Whereas, the unscarified 8-months old seeds gave the lowest interaction values (28.3 and 30.2 mg / g FW) in the first and second seasons, respectively.

Total soluble phenols

Data presented in Table (6) show that, treatments which improved the germination reduced total soluble phenols in the germinated seeds. Soaking scarified seeds in GA_3 solution before warm stratification, produced the lowest values 13.8 and 12.3 mg/g FW in both seasons, respectively. Whereas,

Table 5. Effect of pre-sowing treatments and seed age on total soluble indoles (mg/g FW) of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh seeds	4-months old seeds	8-months old seeds	Mean	Fresh seeds	4-months old seeds	8-months old seeds	Mean
	First season				Second season			
Control	34.2	31.9	28.3	**31.5**	35.7	32.4	30.2	**32.8**
Mechanical scarification	38.6	34.9	31.4	**35.0**	39.1	36.4	34.4	**36.6**
Warm stratification	43.3	39.8	34.8	**39.3**	45.0	42.8	37.9	**41.9**
GA_3 at 1000 ppm/72 h.	40.3	37.5	31.7	**36.5**	41.3	39.6	35.7	**38.9**
Scarification + Stratification	46.2	43.0	39.1	**42.8**	47.9	47.3	45.0	**46.7**
Scarification + GA_3	45.8	41.4	40.5	**42.6**	46.5	45.4	41.6	**44.5**
GA_3 + Stratification	48.4	46.3	42.1	**45.6**	51.5	49.2	47.3	**49.3**
Scar. + GA_3 + Str.	53.4	50.6	47.9	**50.5**	55.9	52.2	49.5	**52.5**
Mean	**43.8**	**40.7**	**37.0**		**45.4**	**43.2**	**40.2**	
New LSD at 5% for T				**4.5**				**4.8**
S				**2.1**				**2.4**
T x S				**5.8**				**5.6**

Table 6. Effect of pre-sowing treatments and seed age on total soluble phenols (mg/g FW) of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	First season				Second season			
Control	20.3	22.3	24.6	**22.4**	19.2	19.1	22.4	**20.2**
Mechanical scarification	18.9	21.4	22.1	**20.8**	17.9	18.4	20.3	**18.9**
Warm stratification	16.8	18.0	21.5	**18.8**	15.5	16.2	19.4	**17.0**
GA_3 at 1000 ppm/72 h.	17.6	20.0	19.7	**19.1**	16.1	16.2	18.2	**16.8**
Scarification + Stratification	13.1	16.5	18.4	**16.0**	12.3	13.3	20.8	**15.5**
Scarification + GA_3	14.2	17.7	16.2	**16.0**	13.6	14.1	15.5	**14.4**
GA_3 + Stratification	13.2	15.5	16.3	**15.0**	11.2	12.9	14.7	**12.9**
Scar. + GA_3 + Str.	12.0	14.3	15.1	**13.8**	11.7	11.6	13.6	**12.3**
Mean	**15.8**	**18.2**	**19.2**		**14.7**	**15.2**	**18.1**	
New LSD at 5% forT				**2.1**				**2.2**
S				**0.9**				**0.8**
T x S				**2.9**				**2.6**

the untreated seeds gave the highest values 22.4 and 20.2 mg/g FW. Unscarified seeds which were soaked in GA_3 before stratification resulted in 15.0 and 12.9 mg/g FW in the first and second seasons, respectively. Also, stratification or GA_3 treatments reduced total soluble phenols, particularly with scarified seeds, compared with mechanical scarification. These results agreed with those obtained by El-Tantatwy (1992) on *Roystonea regia*.

Regarding the effect of seed age on total soluble phenols, the results show that 8-months old seeds produced the highest values, whereas freshly harvested seeds gave the lowest values. Meanwhile, 4-months old seeds produced medium results.

The unscarified 8-months old seeds gave the highest interaction values, whereas scarified freshly harvested seeds which soaked in GA_3 before stratification produced the lowest values in both seasons. These results agreed with those obtained by Abdou and E-Banna (1989) on *Cocos romanzoffiana*.

Indol /Phenol ratio

Data presented in Table (7) show that, in the first season, indol/phenol ratio ranged from 1.7 to 3.7 compared to 1.4 in control. Soaking scarified seeds in GA_3 solution before stratification produced the highest value (3.7). This treatment was followed by unscarified seeds which were soaked in GA_3 before stratification resulting in 3.1. Treating scarified seeds with stratification or GA_3 resulted in 2.7. Meanwhile, unscarified seeds which were stratified or soaked in GA_3 recorded 2.1 and 1.9, respectively. Mechanical scarification treatment relatively increased indol/phenol ratio, as compared to the untreated seeds. Similar results were obtained in the second season.

Freshly harvested seeds produced the highest values 2.9 and 3.2 in first and second seasons, respectively, whereas, 8-months old seeds gave the lowest values being 2.0 and 2.3 in both seasons, respectively. Medium results were obtained with 4-months old seeds, resulting in 2.3 and 3.0 in the first and second seasons, respectively. These results were in line with those obtained by El-Kady (2001) on *Sabal blackborniana*, who found that pre-sowing treatments increased total soluble indol, but total soluble phenol was reduced, therefore idol/phenol ratio increased.

Conclusively, scarified freshly harvested seeds, which were soaked in GA_3 solution at 1000 ppm/72 h and stratified at 35°C/3 weeks could be recommended for improving the germination of *Seaforthia elegans* seeds.

Table 7. Effect of pre-sowing treatments and seed age on indol/phenol ratio of *Seaforthia elegans* seeds, during 2006 and 2007 seasons.

Treatment	Seed age (S)				Seed age (S)			
	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean	Fresh seeds	4-Months old seeds	8-Months old seeds	Mean
	First season				Second season			
Control	1.7	1.4	1.2	**1.4**	1.9	1.7	1.3	**1.6**
Mechanical scarification	2.0	1.6	1.4	**1.7**	2.2	2.0	1.7	**2.0**
Warm stratification	2.6	2.2	1.6	**2.1**	2.9	2.6	2.0	**2.5**
GA_3 at 1000 ppm/72 h.	2.3	1.9	1.6	**1.9**	2.6	2.4	2.0	**2.3**
Scarification + Stratification	3.5	2.6	2.1	**2.7**	3.9	3.6	2.2	**3.2**
Scarification + GA_3	3.2	2.3	2.5	**2.7**	3.4	3.2	2.7	**3.1**
GA_3 + Stratification	3.7	3.0	2.6	**3.1**	4.6	3.8	3.2	**3.9**
Scar. + GA_3 + Str.	4.5	3.5	3.2	**3.7**	4.8	4.5	3.6	**4.3**
Mean	**2.9**	**2.3**	**2.0**		**3.2**	**3.0**	**2.3**	

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تأثير بعض المعاملات وعمر البذور على إنبات بذور نخيل السفورثيا

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أجرى هذا البحث خلال موسمي ٢٠٠٦ و٢٠٠٧ داخل الصوبة الزجاجية بمشتل قسم بساتين الزينة، كلية الزراعة، جامعة القاهرة. يهدف هذا البحث إلى تحسين كفاءة الإنبات لبذور نخيل السفورثيا. تم جمع البذور في أول سبتمبر من حديقة الأورمان بالجيزة وتم معاملة البذور الحديثة الجمع عمر أربعة وثمانية شهور بالمعاملات الآتية قبل الزراعة: الخدش الميكانيكي، نقع البذور المخدوشة وغير المخدوشة في حمض الجبرليلك بتركيز ١٠٠٠ جزء في المليون لمدة ٧٢ ساعة ، الكمر الدافئ للبذور المخدوشة وغير المخدوشة لمدة ٣ أسابيع وكذلك معاملة البذور المخدوشة وغير المخدوشة بحمض الجبراليك بالإضافة إلى الكمر الدافئ. زرعت البذور في صواني بلاستيك مقاس ٤٠ × ٦٠ سم مملوءة بمخلوط من البيت والرمل وذلك في أول أكتوبر وفبراير ويونيه من كل موسم. قدرت نسبة وسرعة ومعدل إنبات البذور، كما قدر محتوى البذور النابتة من السكريات الذائبة الكلية والإندولات والفينولات الذائبة الكلية. وفيما يلي ملخصاً لأهم النتائج المتحصل عليها:

أدت جميع المعاملات إلى تحسين الإنبات مقارنة بالبذور الغير معاملة حيث أدى نقع البذور في محلول الجبرالين بتركيز ١٠٠٠ جزء في المليون لمدة ٧٢ ساعة قبل تعريضها للكمر الدافئ على درجة ٣٥°م لمدة ٣ أسابيع إلى الحصول على أفضل النتائج وخاصة مع البذور المخدوشة ميكانيكياً ، حيث أنتجت هذه المعاملة أكثر قيم لقياسات الإنبات.

أدى معاملة البذور بالكمر الدافئ أو النقع في محلول الجبرالين إلى تحسين الإنبات وخاصة مع البذور المخدوشة حيث أدت إلى زيادة نسبة وسرعة ومعدل الإنبات.

كان التحسن في الإنبات مصحوباً بزيادة في السكريات الذائبة الكلية والأندولات الذائبة الكلية وكذلك النسبة بين الأندولات / الفينولات في البذور النابتة وعلى العكس كان هناك نقصاً في محتوى هذه البذور من الفينولات الذائبة الكلية.

زراعة البذور الحديثة الجمع أعطى أفضل النتائج بالمقارنة بالبذور التي خزنت لمدة أربعة أو ثمانية شهور حيث حدث نقص تدريجي في نسبة الإنبات رغم زيادة سرعة ومعدل الإنبات مصحوباً بنقص في محتوى البذور النابتة من السكريات الذائبة الكلية والإندولات الذائبة الكلية وكذلك النسبة بين الأندولات / الفينولات وعلى العكس حدث زيادة في الفينولات الذائبة الكلية. مما سبق يمكن التوصية بضرورة زراعة بذور نخيل السفوريثا بعد جمعها مباشرة للحصول على أفضل إنبات وخاصة إذا نقعت البذور المخدوشة في محلول الجبرالين بتركيز ١٠٠٠ جزء في المليون/٧٢ ساعة قبل تعريضها للكمر الدافئ.