Journal of African and Nile Basin Countries Research and Studies	**Volume 7, Issue 1 (82-94) January, 2024**
ISSN:2682-4450	**Website: https://mbddn.journals.ekb.eg/**
	E-mail: afr.journal@aswu.edu.eg

Efficacy of Pre-Sowing Treatments on Seeds of Some Acacia Species: The Effect on Germinability

A.F.A. Ebeid[1], and M.G. Khalil[2], Kassem A. S. Mohammed[2]

[1]*Research Woody Trees Department, Horticulture Institute, Agriculture Research Institute*

[2]*Institute of African and Nile Basin Countries Research and Studies, Aswan University*

[*]**Corresponding author:** Dr. K.A.S. Mohammed E-mail; kassem_said@aswu.edu.eg

Abstract

The present experiment was conducted during the two seasons of 2022 and 2023 at the Agricultural Research Station of Al-Marashda, Qena Governorate, ARC to overcome seed dormancy by different pre-germination treatments of three *Acacia* species. The three *Acacia* species were *A. albida*, *A. farnesiana* and *A. nilotica*. There were significant differences of pre-germination treatments, tested *Acacia* trees and their interaction on the different germination traits in the 1st and 2nd seasons. Soaking seeds in boiling water for 24 h gave the highest germination rate, followed by soaking in concentrated H_2SO_4 for 15 min and mechanical scarification. The highest value of germination rate in the two seasons was recorded with the seeds of *A. abida*, while the lowest value was recorded with *A. nilotica.* The highest values of germination rate were recorded with treated seeds of *A. albida* by boiling water for 24 h, and soaking seeds of *A. albida* in 2000 ppm GA_3 for 24 h. The shortest germination delay was recorded with the mechanical scarification, immersion in concentrated sulphuric acid and soaking seed in boiled water. The shortest germination delay was recorded with *A. farnesiana* seeds, followed by *A. nilotica* seeds. The least germination delay was recorded with *A. farnesiana* seeds plus mechanical scarification, followed by mechanical scarification of *A. albida*. The shortest germination latency was obtained with the *Acacia* seeds those treated by boiling water for 24 h, soaking in concentrated sulphuric acid for 15 min and mechanical scarification. The shortest germination latency was produced with *A. farnesiana* seeds treated by boiled water, and *A. nilotica* seeds treated by soaking in tap water for 24 h. It is evident that the fastest seeds from those treated by soaking in boiled water for 24 h, soaking in concentrated sulphuric acid for 15 min and mechanical scarification treatments. The fastest seeds were as result of soaking seeds of *A. farnesiana, A. albida* in boiled water for 24 h, and soaking seeds of *A. farnesiana* in concentrated sulphuric acid for 24 h. The shortest germination duration was due to scarify seeds of *A. farnesiana*, followed by the same species that treated by soaking in concentrated sulphuric acid for 15 min and soaking in boiled water for 24 h.

Keywords: *Acacia Species, Germination, Pre-Sowing Treatments*

Introduction

Acacia species belong to the Fabaceae family. The most advantages of these species are the ability of their roots to make symbiosis with soil microorganisms (Rhizobium and mycorrhizae) and therefore the capacity to survive in the marginal soils that characterized with very poor in the nutritional elements **(Boukhatem *et al.*, 2016).** *Acacia* species are honey-yielding plants with considerable sources of shade in the arid regions, and it also a site of nesting for several birds **(Zhang *et al.*, 2016).** The wood is hard, heavy, and could be also used for the reforestation of degraded lands to improve soil organic matter and its textures. Moreover, they have proven very hardy and tolerant for drought and salinity, so they are widely planted for windbreak and to control soil erosion **(Kheloufi *et al.*, 2017).**

Many of tree species are fast-growing, and classified as better producer of biomass, but most of these species have seeds which have difficulties for germinating by presenting water impermeability **(Liu *et al.*, 2011)**. These tree species cannot germinate in the normal conditions. The problems of the water imbibition phase are the vital problem of the establishment and growth of the leguminous tree species **(de Faria *et al*., 2010).** It is known under integumentary dormancy, which combined with the embryonic dormancy to make an ecological mechanism, which allows the seeds to germinate only in the favorable conditions. This phenomenon applies generally to the tree species and leguminous shrubs **(Vargas *et al.*, 2015).** Therefore, seeds require pre sowing treatments to obtain fast and uniform seed germination and a considerable rate **(Azad *et al.*, 2013). Kiani *et al.* (2012)** investigated pre germination treatments on *Acacia tortilis* and *A. oerfota* and found that treating seeds with sand paper scarification led to the highest germination percentage in both species. While, the lowest germination percentage resulted from soaking seeds in tap water for 48 or 24 h. **Satti *et al.* (2016)** proved that using sulphuric acid treatment for *Acacia nilotica* seeds is a better option for enhancement germination rate in initial 3 days of germination. Also, **Cartes-Rodríguez *et al*. (2022)** studied pre-germination treatments on some woody trees as *Acacia caven* indicated that among the most used treatments are soaking in water at room temperature and soaking in sulfuric acid. Soaking in tap water ranged between 2 and 72 h for most species, while exposure to sulfuric acid varies between 30 and 180 min depending on tree species. Therefore, the main objective of this work was to reduce seed coat thickening for decreasing seed germination period, improving germination parameters and increasing seedling quality by using different pre-sowing treatments of three Acacia species, namely *A. albida*, *A. farnesiana* and *A. nilotica.*

Material and methods

The present investigation was carried out at the Agricultural Research Station of Al-Marashda, Qena Governorate, Egypt during the two seasons of 2022 and 2023 to study the effect of some pre-germination treatments on breaking seed dormancy of three *Acacia* species.

Seed source:

Seeds of the three *Acacia* species i.e. *A. albida*, *A. farnesiana* and *A. nilotica* were collected from the Tropical Farm of Kom- Ombo, Aswan Botanical Garden, Agricultural Research Center, Egypt. The mature and dry pods were collected from healthy trees and manually crushed to free seeds. Seeds and pods of the three *Acacia* species were shown in Figure 1 a, b & c.

Pre-germination treatments:

Seeds of the three species underwent different pre-germination treatments i.e. untreated seeds (control), soaking in tap water for 24 h., soaking in tap water for 48 h., soaking in boiled water for 24 h., soaking in 2000 ppm GA_3 for 24 h., soaking in 4000 ppm GA_3 for 24 h., soaking in 6000 ppm GA_3 for 24 h., immersion in concentrated sulphuric acid for 15 min, followed by a good washing by distilled water, or mechanical scarification by steel file.

There were 9 treatments for each species, and each treatment was represented by 30 seeds. 10 seeds per pot (25 x 30 cm), filled with prepared medium of clay loamy soil, its chemical and physical properties was shown in Table (1) and irrigated daily. All other cultural practices were completed according to the requirements of nursery.

Fig. 1 (a). *Acacia albida* seeds and pods

Fig. 1 (b). *Acacia farnesiana* seeds and pods

Fig. 1 (c). *Acacia nilotica* seeds and pods

Table 1. Chemical and physical analysis of the experimental soil.

Physical properties					
Soil texture	**Sand**	**Silt**		**Clay**	
Clay loam	**16 %**	**36%**		**48%**	
Chemical properties					
Organic Matter	**Ca CO_3%**	**HCO_3^-**	**SO_4^{--2}**	**Soil pH**	**E.C.**
%		**meq/100 g soil)**			**(dSm^{-1})**
1.75	**2.21**	**0.72**	**3.76**	**7.81**	**1.32**

Experimental design:

This experiment was arranged in a split- plot in a randomized complete block design (RCBD) contained of 27 treatments. Nine pre-germination treatments were presented in the main-plots,

while the three *Acacia* species were assigned in sub-plots. The experiment was conducted from 1st February to 1st May for each season.

Collected data:

The data were collected for germination characteristics as follows:

1- Germination rate (%): the number of seeds sprouted divided by the number of total seeds, expressed as a percentage **(Akaffou *et al*., 2019).**
2- Germination delay (days) refers to the period between the sowing of each seed and the appearance of each seedling **(N'golo *et al*., 2018).**
3- Latency time (days) the time takes for the first seed to germinate from the sowing of all the seeds **(Amani *et al*., 2015).**
4- Germination speed (days): the average time after which 50% of the seeds have germinated **(Douma *et al*., 2019).**
5- Germination duration or spread time (days): the period between germination of the first seed and the last seed **(Adji *et al*., 2020).**

Statistical Analysis:

The obtained data from the two seasons were tabulated, pooled and subjected to the statistical analysis using Michigan Statistical Program Version C (MSTATC). The analysis of variance (ANOVA) was performed and the means were compared by using the least significant differences (LSD) test at 5% level **(Snedecor and Cochran, 1989).**

Results and discussion

The effect of pre-sowing treatments, *Acacia* species and their interaction on germination traits:

I- Germination rate (%):

The effect of pre-germination treatments, *Acacia* species and their interactions on germination rate percentages was presented in Table (2). There were significant differences of these factors on the germination rate in the 1st and 2nd seasons. As in Table (1), soaking seeds in boiling water for 24 h gave the highest germination rate (83.22 and 83.67%), followed by soaking in concentrated sulphuric for 15 min (75.78 and 77.56%) and mechanical scarification (70.22 and 70.67%). While the lowest values of germination rate were recorded with untreated seeds (41.33 and 44.89%) and soaking in tap water for 24 h (59.33 and 61.56%) in the 1st and 2nd seasons, respectively. Germination rate (%) was significantly different among the three *Acacia* species. The highest value of germination rate in the two seasons (76.81and 78.26 %) was noticed with the seeds of *A. abida*, while the lowest value (49.41% and 52.67 %) was recorded with *A. nilotica* in the first and second seasons, respectively.

The results recorded in the same table show the effect of the interaction between the pre-germination treatments and *Acacia* species on germination rate (%). The highest values of germination rate (95.00 and 93.67%), (94.33 and 95.67%), (93.33 and 92.67%) and (84.67 and 86.00%) were recorded with treated seeds of *A. albida* by boiling water for 24 h, soaking seeds of *A. albida* in 2000ppm GA3 for 24 h, soaking seeds of *A. farnesiana* in boiled water and soaking seeds of *A. albida* in concentrated sulphuric acid for 15 min in the 1st and 2nd seasons, respectively. Meanwhile, the less germination rate was as a result of untreated seeds of *A.*

nilotica (29.33 and 34.00%), followed by untreated seeds of *A. farnesiana* (41.33 and 45.33%) and soaking seeds of *A. nilotica* in tap water for 24 h (42.00 and 44.00%).

Table 2. The effect of pre-sowing treatments, *Acacia* species and their interactions on germination rate (%) of *A. albida*, *A. farnesiana* and *A. nilotica* seeds during the two seasons of 2022 and 2023.

1st season				
(A) Pre sowing treatments	**(B) *Acacia species***			**Mean (A)**
	A. albida	***A. farnesiana***	***A. nilotica***	
Control	53.33	41.33	**29.33**	41.33
Tap water for 24 h	65.33	70.67	42.00	59.33
Tap water for 48 h	74.33	60.67	**72.00**	69.00
Boiled water for 24 h	**95.00**	**93.33**	**61.33**	**83.22**
2000 ppm gibberellin for 24 h	**94.33**	60.67	43.33	66.11
4000 ppm gibberellin for 24 h	79.67	**72.00**	38.00	63.22
6000 ppm gibberellin for 24 h	**82.00**	56.00	34.67	57.56
Sulphuric acid for 15 min.	**84.67**	**82.00**	60.67	75.78
Scarification	62.67	**84.67**	**63.33**	70.22
Mean (B)	**76.81**	69.04	**49.41**	
LSD 5%	**A = 4.63 B= 2.55 AB= 7.77**			
2nd season				
Control	55.33	45.33	**34.00**	**44.89**
Tap water for 24 h	68.00	72.67	44.00	**61.56**
Tap water for 48 h	76.33	62.67	**75.33**	71.44
Boiled water for 24 h	**93.67**	**92.67**	**64.67**	**83.67**
2000 ppm gibberellin for 24 h	**95.67**	64.67	50.00	70.11
4000 ppm gibberellin for 24 h	81.33	**74.00**	41.33	65.56
6000 ppm gibberellin for 24 h	**84.00**	59.33	36.00	**59.78**
Sulphuric acid for 15 min.	**86.00**	**82.67**	**64.00**	**77.56**
Scarification	64.00	**83.33**	**64.67**	**70.67**
Mean (B)	**78.26**	70.81	**52.67**	
LSD 5%	**A = 3.92 B= 1.87 AB= 6.03**			

II- Germination delay (day):

The effect of pre-sowing treatments, *Acacia* species and their interactions on germination delay (days) were presented in Table (3). There were significant differences of these factors on the germination delay in the 1st and 2nd seasons. As shown in Table (3) the shortest germination delay (8.33 and 7.89) was recorded with the mechanical scarification of seeds, immersion in concentrated sulphuric acid (9.33 and 8.78 days) and soaking in boiled water (9.67 and 9.00 days) of the tested *Acacia* seeds. Meanwhile, the longest germination delay was noticed with untreated seeds (15.67 and 14.67days) and soaking seeds in tap water for 24 h (14.33 and 13.67 days) in the 1st and 2nd seasons, respectively. Germination delay (days) was significantly affected by the three *Acacia* species. The shortest germination delay (9.41 and 9.00 days) was recorded with *A. farnesiana* seeds, followed by *A. nilotica* seeds (13.11 and 12.11 days) in the first and second seasons, respectively. The interaction between the pre sowing treatments and *Acacia* species on germination delay proved that the least germination delay (6.0 days) was recorded with *A. farnesiana* seeds plus mechanical scarification, followed by mechanical scarification of *A. albida* (6.84 days) in the mean of seasons. Whereas, the longest germination delay of (16.0 and 15.0 days) and (16.0 and 15 days) was recorded with untreated seeds of *A. albida* or *A. nilotica* in the 1st and 2nd seasons, respectively.

Table 3. The effect of pre sowing treatments, *Acacia* species and their interactions on germination delay (days) of *A. albida*, *A. farnesiana* and *A. nilotica* seeds during the two seasons of 2022 and 2023.

1st season				
(A) Pre sowing treatments	**(B) *Acacia species***			**Mean (A)**
	A. albida	***A. farnesiana***	***A. nilotica***	
Control	**16.00**	15.00	**16.00**	**15.67**
Tap water for 24 h	15.00	13.00	15.00	**14.33**
Tap water for 48 h	14.00	11.00	9.00	11.33
Boiled water for 24 h	8.00	7.00	14.00	**9.67**
2000 ppm gibberellin for 24 h	10.00	9.33	15.00	11.44
4000 ppm gibberellin for 24 h	12.00	8.33	14.00	11.44
6000 ppm gibberellin for 24 h	13.00	8.00	13.00	11.33
Sulphuric acid for 15 min.	11.00	7.00	10.00	**9.33**
Scarification	**7.00**	**6.00**	12.00	**8.33**
Mean (B)	11.78	**9.41**	**13.11**	
LSD 5%	**A = 0.85 B= 0.63 AB= 1.76**			
2nd season				
Control	**15.00**	14.00	**15.00**	**14.67**
Tap water for 24 h	14.00	13.00	14.00	**13.67**
Tap water for 48 h	13.33	10.00	8.00	10.44
Boiled water for 24 h	7.00	7.00	13.00	**9.00**
2000 ppm gibberellin for 24 h	9.00	8.00	14.00	10.33
4000 ppm gibberellin for 24 h	11.00	8.00	13.00	10.67
6000 ppm gibberellin for 24 h	12.00	8.00	12.00	10.67
Sulphuric acid for 15 min.	10.33	7.00	9.00	**8.78**
Scarification	**6.67**	**6.00**	11.00	**7.89**
Mean (B)	10.93	**9.00**	**12.11**	
LSD 5%	**A = 1.26 B= 0.52 AB= 1.79**			

III-The effect on latency time (days):

Results in Table (4) show the effect of pre-sowing treatments, *Acacia* species and the interaction between them on the germination latency (days) during the seasons of 2022 and 2023. There were significantly differences of the effect of the tested germination treatments on the germination latency during the two studied seasons. However, the shortest germination latency (3.33 and 3.43 days), (3.43 and 3.57 days) and (3.83 and 3.93days) was obtained with the *Acacia* seeds those treated by boiling water for 24 h, soaking in concentrated sulphuric acid for 15 min and mechanical scarification in the 1st and 2nd seasons, respectively. On the other side, the longest germination latency (6.21 and 6.17 days), (5.43 and 5.53 days) and (4.98 and 4.97 days) was detected with untreated seeds, soaking in GA_3 at 6000 ppm for 24 h and soaking in tap water for 24h in the 1st and 2nd seasons, respectively. Concerning the influence of *Acacia* species on germination latency regardless of pre-sowing treatments, the differences between these effects were significant. It is evident that the shortest germination latency (3.99 and 4.06 days) was due to *A. farnesiana* seeds. The longest germination latency (5.12 and 5.23 days) was recorded with *A. nilotica* seeds in the 1st and 2nd seasons, respectively. The effect of interaction between *Acacia* species and pre sowing treatments on germination latency was significant as shown in Table (4). The shortest germination latency (2.40 and 2.48 days), (2.80 and 2.80 days) and (2.90 and 3.08 days) was produced with *A. farnesiana* seeds treated by boiled water, *A. nilotica* seeds treated by soaking in tap water for 24 h and soaking seeds of *A. farnesiana* for 15 min in concentrated sulphuric acid in the 1st and 2nd seasons, respectively.

Table 4. The effect of pre sowing treatments, *Acacia* species and their interactions on latency time (days) of *A. albida*, *A. farnesiana* and *A. nilotica* seeds during the two seasons of 2022 and 2023.

1st season				
(A) Pre sowing treatments	**(B) *Acacia species***			**Mean (A)**
	A. albida	***A. farnesiana***	***A. nilotica***	
Control	4.83	6.53	7.27	**6.21**
Tap water for 24 h	4.93	3.70	6.30	**4.98**
Tap water for 48 h.	4.77	4.67	**2.80**	4.08
Boiled water for 24 h	3.07	**2.40**	4.53	**3.33**
2000 ppm gibberellin for 24 h	3.43	3.97	5.30	4.23
4000 ppm gibberellin for 24 h	4.53	3.13	5.80	4.49
6000 ppm gibberellin for 24 h	4.33	5.13	6.83	**5.43**
Sulphuric acid for 15 min	3.60	**2.90**	3.80	**3.43**
Scarification	4.57	3.50	3.43	**3.83**
Mean (B)	4.23	**3.99**	**5.12**	
LSD 5%	**A = 0.30 B= 0.19 AB= 0.55**			
2nd season				
Control	4.69	6.61	7.21	**6.17**
Tap water for 24 h	4.82	3.69	6.40	**4.97**
Tap water for 48 h	4.66	4.41	**2.80**	3.96
Boiled water for 24 h	3.06	**2.48**	4.74	**3.43**
2000 ppm gibberellin for 24 h	3.63	4.20	5.56	4.46
4000 ppm gibberellin for 24 h	4.72	3.38	5.85	4.65
6000 ppm gibberellin for 24 h	4.41	5.20	6.98	**5.53**
Sulphuric acid for 15 min	3.71	**3.08**	3.92	**3.57**
Scarification	4.65	3.53	3.60	**3.93**
Mean (B)	4.26	**4.06**	**5.23**	
LSD 5%	**A = 0.34 B= 0.20 AB= 0.59**			

IV- Germination speed (days):

The effects of the three *Acacia* species, pre-germination treatments and their interactions on the germination speed were statistically different as shown in Table (5). It is evident that the fastest seeds after (6.56 and 6.76 days), (7.10 and 7.24 days) and (7.28 and 7.38 days) from those treated by soaking in boiled water for 24h, soaking in concentrated sulphuric acid for 15 min and mechanical scarification treatments in the 1st and 2nd seasons, respectively. Meanwhile, the slowest seeds after (12.66 and 12.93), (10.77 and 10.90) and (10.76 and 10.82 days) were detected with untreated *Acacia* seeds, soaking in 6000 ppm GA_3 for 24 h and soaking in tap water for 24 h in the 1st and 2nd seasons, respectively. The effect of pre-sowing treatments on germination speed regardless the *Acacia* species pointed out that the fastest seeds after (8.99 and 9.05 days) were recorded with *A. albida*, while the slowest seeds after (9.29 and 9.32 days) were produced with *A. farnesiana* trees, in the 1st and 2nd seasons, respectively.

Concerning the effect of interaction between *Acacia* species and pre-sowing treatments, it is evident that the fastest seeds after (5.40 and 5.48 days), (6.40 and 6.32 days) and (6.57 and 6.65 days) were because of soaking seeds of *A. farnesiana, A. albida* in boiled water for 24 h, and soaking seeds of *A. farnesiana* in concentrated sulphuric acid for 24 h in the 1st and 2nd seasons, respectively. Meanwhile, the slowest seeds after (13.53 and 13.63 days) and (12.50 and 12.72 days) were recorded with untreated seeds of *A. farnesiana* and *A. albida* in the 1st and 2nd seasons, respectively.

Table 5. The effect of pre sowing treatments, *Acacia* species and their interactions on germination speed (days) of *A. albida*, *A. farnesiana* and *A. nilotica* seeds during the two seasons of 2022 and 2023.

1st season				
(A) Pre sowing treatments	**(B) *Acacia species***			**Mean (A)**
	A. albida	***A. farnesiana***	***A. nilotica***	
Control	**12.50**	**13.53**	11.93	**12.66**
Tap water for 24 h	11.93	9.37	10.97	**10.76**
Tap water for 48 h	10.10	11.33	6.47	9.30
Boiled water for 24 h	**6.40**	**5.40**	7.87	**6.56**
2000 ppm gibberellin for 24 h	6.63	10.63	8.97	8.74
4000 ppm gibberellin for 24 h	9.53	8.13	9.80	9.16
6000 ppm gibberellin for 24 h	8.67	11.80	11.83	**10.77**
Sulphuric acid for 15 min	7.27	**6.57**	7.47	**7.10**
Scarification	7.90	6.83	7.10	**7.28**
Mean (B)	**8.99**	**9.29**	9.16	
LSD 5%	**A = 0.50 B= 0.36 AB= 1.01**			
2nd season				
Control	**12.72**	**13.63**	12.43	**12.93**
Tap water for 24 h	12.15	9.26	11.04	**10.82**
Tap water for 48 h	10.24	11.13	6.47	9.28
Boiled water for 24 h	**6.32**	**5.48**	8.47	**6.76**
2000 ppm gibberellin for 24 h	6.36	10.78	9.01	8.72
4000 ppm gibberellin for 24 h	9.42	8.05	9.96	9.14
6000 ppm gibberellin for 24 h	8.85	11.91	11.93	**10.90**
Sulphuric acid for 15 min	7.30	**6.65**	7.76	**7.24**
Scarification	8.05	6.98	7.11	**7.38**
Mean (B)	**9.05**	**9.32**	9.35	
LSD 5%	**A = 0.44 B= 0.28 AB= 0.81**			

V- Germination duration (days):

The influence of the three *Acacia* species and pre-germination treatments as well as their interaction on the germination duration was significantly different as shown in Table (6). It is proved that the shortest germination duration of (9.33 and 9.70 days), (10.00 and 10.42 days) and (10.67 and 11.25 days) was observed in the seeds those treated by mechanical scarification, soaking in concentrated sulphuric acid for 15 min and soaking in boiled water for 24 h in the 1st and 2nd seasons, respectively. On the other hand, the longest germination duration of (16.67 and 17.11 days) and (15.33 and 15.71 days) was recorded with untreated seeds and soaking in tap water for 24 h in the 1st and 2nd seasons, respectively. The effect of *Acacia* species on germination duration regardless the *Acacia* species pointed out that the shortest germination duration of (10.52 and 10.95 days) was recorded with *A. farnesiana*, while the longest duration (14.00 and 14.38 days) was registered with *A. nilotica* trees in the 1st and 2nd seasons, respectively. Concerning the effect of interaction between *Acacia* species and pre-germination treatments, it is evident that the shortest germination duration of (7.00 and 7.46 days) was due to scarify seeds of *A. farnesiana* by steel file, followed by (8.00 and 8.46 days) and (8.00 and 8.53 days) for the same species that treated by soaking in concentrated sulphuric acid for 15 min and soaking in boiled water for 24 h in the 1st and 2nd seasons, respectively. Also, the germination duration of (8.00 and 8.43 days) was due to mechanical scarification on *A. albida*. Meanwhile, the longest germination duration of (17.00 and 17.46 days) and (17.00 and 17.42 days) was recorded with untreated seeds of *A. albida* and *A. nilotica* in the 1st and 2nd seasons, respectively.

Table 6. The effect of pre sowing treatments, *Acacia* species and their interactions on germination duration (days) of *A. albida*, *A. farnesiana* and *A. nilotica* seeds during the two seasons of 2022 and 2023.

1st season				
(A) Pre sowing treatments	**(B) *Acacia species***			**Mean (A)**
	A. albida	***A. farnesiana***	***A. nilotica***	
Control	**17.00**	16.00	**17.00**	**16.67**
Tap water for 24 h	16.00	14.00	16.00	**15.33**
Tap water for 48 h	15.00	12.00	10.00	12.33
Boiled water for 24 h	9.00	**8.00**	15.00	**10.67**
2000 ppm gibberellin for 24 h	11.00	10.33	16.00	12.44
4000 ppm gibberellin for 24 h	13.00	9.33	15.00	12.44
6000 ppm gibberellin for 24 h	14.00	10.00	14.00	12.67
Sulphuric acid for 15 min	12.00	**8.00**	10.00	**10.00**
Scarification	**8.00**	**7.00**	13.00	**9.33**
Mean (B)	12.78	**10.52**	**14.00**	
LSD 5%	**A = 0.85 B= 0.63 AB= 1.76**			
2nd season				
Control	**17.46**	16.46	**17.42**	**17.11**
Tap water for 24 h	16.50	14.35	16.27	**15.71**
Tap water for 48 h	15.33	12.41	10.50	12.74
Boiled water for 24 h	9.60	**8.53**	15.62	**11.25**
2000 ppm gibberellin for 24 h	11.46	10.91	16.40	12.92
4000 ppm gibberellin for 24 h	13.42	9.58	15.20	12.73
6000 ppm gibberellin for 24 h	14.47	10.42	14.42	13.10
Sulphuric acid for 15 min	12.45	**8.46**	10.34	**10.42**
Scarification	**8.43**	**7.46**	13.21	**9.70**
Mean (B)	13.23	**10.95**	**14.38**	
LSD 5%	A = 0.86 B= 0.61 AB= 1.73			

Discussion

This investigation was conducted to study the effect of pre-sowing treatments on breaking seed dormancy of three *Acacia* species namely, *A. albida*, *A. farnesiana* and *A. nilotica*. Concerning this study, the estimated characteristics were broadly divided for the discussion into:

I-The effects of pre-germination treatments.

II-The effects of *Acacia* species.

III-The effects of interaction between pre-germination treatments and *Acacia* species.

I-The effects of pre-germination treatments.

Results of our study indicated that the hard seed coat of *Acacia* species showed a positive response to the different pre-germination treatments. However, the highest germination rate, the shortest germination delay, the shortest germination latency, the fastest germination and the shortest germination duration were recorded with mechanical scarification, immersion in concentrated H_2SO_4 for 15 min and soaking in boiling water of *Acacia* seeds. On the other side, the lowest values of germination rate were resulted from the untreated seeds. This result suggests that the presence of hard seed coat and the impermeability to water and gases may be resulted in poor seed germination. The pre-sowing treatments break dormancy in *Acacia* seeds by disrupting and softening the seed coat or by fracturing specialized tissues in seed coat to allow water penetration **(Bosman *et al*. 1995).** These findings are generally in accordance with the reports of **Missanjo *et al.* (2014)**; **Abdelrhman *et al.* (2014); Shahin *et al.* (2015); Kheloufi1 *et al.* (2017 a); Mozumder *et al.* (2018); Iralu and Upadhaya (2018)**; **Gomes *et***

***al.* (2019)**; **Oyebamiji and Ogo (2019)**; **Nourmohammadi *et al*. (2019)**; **Maiguru *et al.* (2020)** and **Ebeid *et al*. (2022).**

II-The effects of Acacia species.

The obtained results in this study revealed differences between the three *Acacia* species on germination parameters. It is evident that the highest values of these traits were produced with *A. albida* and *A. farnesiana*, while the lowest ones were manifested with *A. nilotica*. These results may be due to the genetic differences among the three species and thus the differences in seed germination and seedling vigor and quality. The different responses of the tested *Acacia* species to the pre-germination may be due to the variation on proportion of hard seed on the seeds according to **(FAO, 1983).** They revealed that, within any Acacia seed lot no all the seeds are equally hard. Also, variation in hard seed coat will occur within a sample, among samples of the same species and among species **(Willan, 1985).** The findings derived from this study were in agreed with those of **El-Keltawy *et al*. (2010),** who reported that there were significant differences between seed germination of certain legume tree species. These results were also reported by **Ahmed (2014)** on three *Acacia* species namely**,** *A. senegal*, *A. mellifera* and *A. laeta*.

III-The effects of interactions:

The effect of interaction between the two factors i.e. pre-sowing treatments and *Acacia* species was significant for the different germination traits. In most cases, the best germination measurements were manifested by *A. farnesiana* seeds those treated with physical scarification either by mechanical one or soaking in boiled water. Whereas, the highest value of germination rate was induced by soaking seeds of *A. albida* in boiling water for 24 h. The difference in the response to the tested pre-germination treatments and *Acacia* species may be due to variation in the effect of these treatments and variation in the three species. Meanwhile, *A. farnesiana* with mechanical scarification produced the highest value of stem diameter. The highest value of shoot dry weight was manifested by soaking seeds of *A. albida* in boiling water for 24 h compared to the other interactions. However, mechanical scarification and boiling water treatments were effective on removing and/ or cracking of the testa surface of seeds, then increasing the permeability of seeds to water and improving germination parameters **(Teketay, 1996).** These results were in accordance with those of **EL-Khalifa (2004); El-Keltawy *et al*. (2010)** and **Ebeid *et al*. (2022)**.

References:

Abdel-Aal, M.A.M., and Kayad, G.R. (2007). Effect of thinning on chemical composition of some trees grown in Egypt. Egyptian Journal of Applied Sciences 22 (11): 167-178.

Anonymous (1959c): Alcohol-benzene solubility of wood. Official standard. T6m-59. Technical Association of Pulp and Paper Industry, New York, 29-30.

Anonymous (1959b): Lignin in wood. Official standard. T12m-59. Technical Association of Pulp and Paper Industry, New York, 36-37.

Anonymous (1959a): Holocellulose of wood official standard. T9m-59. Technical Association of Pulp and Paper Industry, New York, 43-45.

Armstrong, A., Johns, C., and Tubby, I. (1999). Effects of Spacing and Cutting Cycle on the Yield of Poplar Grown as an Energy Crop," Biomass and Bioenergy, 17 (4): 305-314.

ASTM American Society of Testing and Materials (1989): Standard test method for specific gravity of wood and wood- based materials. ANSI/ ASTM vol. 4.09; D 2395.

Beldt, V.D., Brewker, R.J., Andhu, J.L., and Boontawee B. (1982). International leucaena population trials. Leucaena Research Reports, 3: 96-99.

Bernando, A., Maria Reis, L., Geraldo Reis, G. F., Harrison, G.R., and Deuseles Firme, B. J. (1998). Effect of spacing on growth and biomass distribution in Eucalyptus camaldulensis, E. pellita, E. europhylla plantations in south- eastern Brazil," Forest Ecology and Management 104 (1-3): 1-13.

Brewbaker, J.L. (1997): Leucaena leucocephala-a versatile nitrogen fixing tree. Fact Sheet 97-06 Winrock International, Morrilton, AK. 5 p.

Chotchutima, S., Kangvansaichol, K., Tudsri, S., and Sripichitt, P. (2013). Effect of spacing on growth, biomass yield and quality of leucaena (Leucaena leucocephala (Lam.) de Wit.) for renewable energy in Thailand. Journal of Sustainable Bioenergy Systems 3: 48-56.

Condit, R. (1998). Tropical Forest Census Plots. Springer-Verlag and R. G. LandesCompany , Berlin, Germany, and Georgetown, Texas.

DeBell, D.S., Keyes, C.R. and Gartner, B.L. (2001). Wood density of Eucalyptus saligna grown in Hawaiian plantations: Effects of silvicultural practices and relation to growth rate. Australian Forestry 64 (2): 106-110.

El-Baha, A. M. A., Abu – Gazia, H. A. El – Settawy, A. A. A., and Zayed, M. Z. A. (2009). Leucaena leucocephala: Effect of spacing and age on growth, biomass and some physical and anatomical characteristics of wood. J. Agric. Sci. Mansoura Univ., 34 (7): 8093 – 8109.

Fang, J., and Wang, Z. (2001). Forest biomass estimation at regional and global levels, with special reference to China's forest biomass. Ecol. Res. 16, 587–592.

Gathaara, G.N., Glumac E.L., and P. Felker, P. (1991). Three-year growth studies of Leucaena leucocephala (1094) and L. pulverulenta (1001) at two spacings in Texas. Forest Ecology and Management 40 (3-4): 189-198.

Hapla, F. (1997). How to bring into accord the silvicultural management and the end-users' interests in case of the Douglas-fir. Pp 3–8 in Proceedings of the CTIA/IUFRO International Wood Quality Workshop. 18–22 August 1997, Québec City.

Haygreen, J.G., and Bowyer, J.L. (1996): Forest Products and Wood Science.3rd ed. Iowa State Univ. Press/ Ames 232pp.

Hébert, F., Krause, C., Plourde, P-Y., Achim, A., Prégent , G., and Ménétrier, J. (2016).Effect of tree spacing on tree level volume growth, morphology, and wood properties in a 25-year-old Pinus banksiana plantation in the boreal forest of Quebec. Forests 7 (276): 1-16.

Jeeban, P., and Sea, C. O. (2012). Degradation characteristics of wood using supercritical alcohols. Energies 5: 5038-5052.

Kennedy, R.W. (1995). Coniferous wood quality in the future: concerns and strategies. Wood Science and Technology 29: 323–338.

Little, I.M. and F.J. Hills (1978): Agricultural Experimentation, Design and Analysis. Johan Wiely and Sons Inc. New York 320 pp.

Miller, R.B. (1999). Structure of Wood. Wood Handbook—Wood as an Engineering Material. General Technical Report FPL–GTR–113. USDA, Forest Product Laboratory, Madison.

Mitchell, C.P. (1995). New Cultural Treatments and Yield Optimization," Biomass and Bioenergy 9 (1-5): 11-34.

Moulin, J.C., Arantes, M.D.C., Vidaurre, G.B., Paes, J.B., and Carneiro, A.C.O. (2015). Efeito do espaçamento, da idade e da irrigação nos componentes químicos da madeira de eucalipto. Revista Árvore 39: 199–208.

Naji, H.R., Bakar, E.S., Soltani, M., Ebadi, S.E., Abdul-Hamid, H., Javad, S.K.S., and Sahri, M.H. (2014). Effect of initial planting density and tree features on growth, wood density, and anatomical properties from a Hevea brasiliensis trial plantation. Forest Products Journal 64 (1/2): 41- 47.

Nasser, R.A. (2008). Specific gravity, fiber length and chemical components of Conocarpus erectus as affected by tree spacing. J. Agric. & Env. Sci. Alex. Univ. Egypt 7 (3): 49-68.

Nazri, W.M., Jamaludin, K., Rudaini, M.N., Rahim, S., and Nor Yuziah, M.Y. (2009). Effects of chemical components on properties of oriented strand board from Leucaena leucocephala wood. Journal of Tropical Forest Science 21(4): 353–360.

Parrotta, J.A. (2000): Leucaena leucocephala (Lam.) de Wit Leucaena, tantan. International Institute of Tropical Forestry, Río Piedras, PR. p. 308-316.

Poo, C., Gary, L.R., and William. K.M. (1995). Chemical compositions of five 3-year-old hardwood trees. Wood and Fiber Science 27(3): 319-326.

Prasad, J. V. N. S., Korwar, G. R., Rao, K.V., Man- dal, U.K., Rao, G. R., Srinivas, I., Venkateswarlu, B., Rao, S.N., and Kulkarni, H. D. (2011). Optimum stand density of Leucaena leucocephala for wood production in Andhra Pradesh, Southern India. Biomass and Bioenergy (35) 1: 227-235.

Proe, M., Craig, J., and Griffiths, J. (2002). Effects of Spacing, Species and Coppicing on Leaf Area, Light Interception and Photosynthesis in Short Rotation Forestry," Biomass and Bioenergy 23 (5): 315-326.

Ragab, M. (1998): Adaptability of nitrogen fixing trees. Leucaena leucocephala in Egyptian soils: 1. Effect of inoculation and phosphate fertilization. Cairo University Publication ISBN, 89-96.

Rocha, M.F.V., Vital, B.R., Carneiro, A.C.O., Carvalho, A.M.M.L., Cardoso, M.T., and Hein, P.R.G. (2016). Effects of plant spacing on the physical, chemical and energy properties of Eucalyptus wood and bark. Journal of Tropical Forest Science 28(3): 243–248.

Sadasivam, S., and Maanickam, A. (2005). Biochemical methods. 2nd Edition, New age International, New Delhi.

Sayed, R.M.M., Ebeid, A.F.A., Ali, E.F., Mostafa, Mona M.A. (2015). Effectiveness of planting intervals on the growth, above-ground biomass and some wood properties of two Sesbania Species. International Journal of Advanced Research 3 (9): 146 – 153.

Shupe, T.F., Choong, E.T., and Yang, C.H. (1996). The effect of cultural treatments on chemical composition of plantation-grown loblolly pine wood. Wood and Fiber Science, 28(3), 295-300.

Singh, N. and A. Rani (2013): Extraction and processing of fiber from Sesbania for preparation of needle punched nonwoven fabric. Natl. Acad. Sci. Lett. 36: 489-492.

Singh, N. and A. Rani. A. (2014): Needle punched non-woven of Sesbania fiber. Int. J. Text. Fash. Tech. 4: 7-12.

Snedecor, G.W. (1956): Statistical Methods 5st ed. Iowa State College Press, Ames, Iowa 270 p.

Van den Beldt, R.J. (1983). Effect of spacing on growth of leucaena, proceedings of leucaena research in the asian- pacific region. International Development Research Centre, Ottawa 103-108.

Verma, S.C., and Misra, P.N. (1989). Biomass and energy production in coppice stands of Vitex negundo L. in high density plantations on marginal lands. Biomass 19 (3): 189-194.

Washusen, R., Baker, T.G., Menz, D., and Morrow, A. (2005). Effect of thinning and fertilizer on the cellulose crystallite width of Eucalyptus globulus. Wood Science and Technology 39 (7): 569-578.

Yu, Y., Pan, Y., Yang, X.G., and Fan, W.Y. (2022). Spatial Scale Effect and Correction of Forest Aboveground Biomass Estimation Using Remote Sensing. Remote Sens. 14, 2828.

Zhang, J., Ritchie, M.W., Maguire, D.A., and Oliver, W.W. (2013). Thinning ponderosa pine (Pinus ponderosa) stands reduces mortality while maintaining stand productivity. Can. J. For. Res. 43: 311–320.

Zhu, Y., Feng, Z., Lu, J., and Liu, J. (2020). Estimation of Forest Biomass in Beijing (China) Using Multisource Remote Sensing and Forest Inventory Data. Forests 11, 163.

الملخص:

التجربة الحالية خلال موسمي ٢٠٢٢ و٢٠٢٣ بمحطة البحوث الزراعية بالمراشدة بمحافظة قنا مركز البحوث الزراعية للتغلب على سكون البذور بمعاملات ما قبل الإنبات المختلفة لثلاثة أنواع من السنط. وكانت أنواع السنط الثلاثة هي A. albida وA.farnesiana وA. nilotica. كانت هناك فروق معنوية في معاملات ما قبل الإنبات وأشجار السنط المختبرة وتفاعلها في صفات الإنبات المختلفة في الموسمين الأول والثاني. أعطى نقع البذور في الماء المغلي لمدة ٢٤ ساعة أعلى معدل إنبات، يليه النقع في ماء مغلي مركز لمدة ١٥ دقيقة ثم الخدش الميكانيكي. سجلت أعلى قيمة لمعدل الإنبات في الموسمين لبذور نبات A. nilotica. ، بينما سجلت أقل قيمة لبذور A. abida نبات بالماء المغلي لمدة ٢٤ ساعة، A. albida سجلت أعلى قيم معدل الإنبات مع معاملة بذور GA3 في ٢٠٠٠ جزء في المليون A. albida ونقع بذور لمدة ٢٤ ساعة. تم تسجيل أقصر تأخير للإنبات من خلال الخدش الميكانيكي والغمر في حامض الكبريتيك المركز ونقع البذور في الماء المغلي. تم تسجيل أقصر تأخير للإنبات مع بذور A. nilotica. ، تليها بذور A. Farnesiana تم تسجيل أقل تأخير في الإنبات مع بذور A. albida. بالإضافة إلى الخدش الميكانيكي، يليه الخدش الميكانيكي لبذور A. Farnesiana على أقصر زمن إنبات مع بذور السنط التي تمت معالجتها بالماء المغلي لمدة ٢٤ ساعة، والنقع في حامض الكبريتيك المركز لمدة ١٥ دقيقة والخدش الميكانيكي. تم إنتاج أقصر زمن إنبات باستخدام بذور A. Farnesiana المعالجة بالنقع في ماء الصنبور لمدة ٢٤ ساعة. ومن الواضح أن A. nilotica المعالجة بالماء المغلي، وبذور أسرع البذور من تلك المعاملة هي النقع في الماء المغلي لمدة ٢٤ ساعة والنقع في حامض الكبريتيك المركز لمدة ١٥ دقيقة ومعاملة الخدش الميكانيكي. أسرع البذور كانت نتيجة نقع بذور A. albida، A. Farnesiana في حامض الكبريتيك المركز لمدة ٢٤ ساعة. أقصر A. Farnesiana الماء المغلي لمدة ٢٤ ساعة، ونقع بذور A. Farnesiana ، تليها نفس الأنواع التي تمت معاملتها بالنقع في حامض الكبريتيك المركز لمدة ١٥ دقيقة والنقع في الماء المغلي لمدة ٢٤ ساعة. مدة إنبات كانت بسبب خدش بذور

الكلمات المفتاحية: أنواع السنط، الإنبات، معاملات ما قبل الزراعة.