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PHYSIOLOGICAL STUDIES ON GERMINATION AND FERTILIZATION OF SOPHORA PLANT.
1- ENHANCING GERMINATION OF MESCAL BEAN (*Sophora secundiflora*) SEEDS HARD–TO-GERMINATE.

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ABSTRACT

The seeds of Mescal-bean (*Sophora secundiflora*) have an extremely hard red shells and can take years to germinate. The current study was undertaken to break the physical dormancy of such seeds under semi-shade at the nursery of Al- Zohriya Garden, Hort. Res. Inst., ARC, Giza, Egypt, during 2017 and 2018 seasons by subjecting them to some pre-sowing treatments includeing untreated seeds (control), soaking in tap water for 48 h. at room temperature, soaking in hot water (60-70°C) for 48 h (thermal scarification), rasping with a file (mechanical scarification), rasping + soaking in tap water for 24 h. (combined treatment) and soaking in concentrated sulfuric acid (98.5 %) for 1, 2 or 3 h. (chemical scarification). The seeds were sown in 16-cm-diameter plastic pots (10 seeds/pot) filled with about 1.5 kg of an equal mixture of sand and clay (1:1, v : v).

The results indicated that the highest germination percentage (G%) and the least No. days to either 50 % germination or higher were achieved by soaking in hot water for 48 h treatment in both seasons, while control and all other treatments failed to increase G % to 50 % in both seasons. The best germination rate index, vigour index, seed viability and epicotyl length were also attained by hot water treatment. Soaking the seeds in tap water for 48 h. under room temperature did not affect the amount water uptake by the seeds, while other treatments greatly affected this parameter, as the greatest amount of water was taken up by the seeds rasped with a file or soaked in concen. H_2SO_4 for 3 h. treatments followed by soaking the seeds in hot water. However, the former treatments made the seeds absorb the maximum amount of water in the first 24 h., and this amount was steady afterwards, whereas the latter made water absorption continuous till the end of soaking time. A similar response occurred as well in respect of seedling vegetative and root growth measurements and the leaf content of pigments, total soluble sugars and indoles, as hot water treatment gave the utmost high means at all. In addition, the different treatments induced a marked decrement in the concentration of phenols , where the greatest decrement was also recorded by the hot water treatment. From the foregoing, it can be recommended to soak seeds of Mescal-bean *(Sophora secundiflora*) tree in hot water (60-70°C) for 48 h. to score the best germination and seedling growth.

Key words: *Mescal-bean (Sophora secundiflora), germination, pre-sowing treatments, scarification treatments .*

1. INTRODUCTION

Mescal-bean *(Sophora secundiflora* (Ort.) Lag ex. DC.), or Texas mountain laurel (Fam. Fabaceae) is a small tree with evergreen compound leaves that bear beautiful lavender-amethyst colored clusters of pea-like flowers smelling of "grape koolaid" with bright red seeds in a semi-woody pods Fig. (1). It is native to dry, rocky limestone soils and is drought-resistant after establishment. It makes a beautiful specimen plant in the landscape (Huxley *et al*., 1992).

Mescal-bean (*Sophora secundiflora)* is not propagated from cuttings and the seeds have an extremely hard red shell and can take years to germinate after they fall from the tree (Mueller, 2011). However, seeds of most fabaceous species respond well to various pre-sowing treatments, including thermal, mechanical and chemical scarification. In this regard, Ruter and Ingram

Fig. (1): Leaves and pods of *Sophora secundiflora*.

(1991) found that the germination rate of *S. secundiflora* increased as acid pretreatment time increased from 30 to 120 minutes. Soaking seeds in water at room temperature or in hot water (93 °C) for 24 h. had no effect on germination. Wang (1991) revealed that chemical scarification with undiluted H_2SO_4 (93 %) for 10 min. with fresh seeds or for 60 min. with 1year-old seeds enhanced germination to 80 and 70 %, respectively and reduced germination time to within 14 days. Mechanical scarification by drilling a small hole through the hard seed coat resulted in relatively quick and the highest rate of germination. Shao *et al*., (2010) and Aliloo and Mustafavi (2014) reported that immersion in diluted or concentrated H_2SO_4 (65 and 98 %. respectively) for 30 min. increased *Sophora davidii*, seed germination and seedling emergence most efficiently. In addition, Delgado *et al*. (2015) stated that beside the lens, the hilum and micropyle are involved in water absorption in seeds of *Sophora tomentosa* scarified with hot water .

There were also several reports dealing with seed germination of other ornamental plants such as those reported by Agba *et al*. (2005) who mentioned that hot water treatment at 40-60°C significantly enhanced germination of *Mucuna flagellipes* seeds compared to hot water treatment at higher temperatures (80 and 100 °C). Soaking in water at room temperature for 36-48 h. resulted in higher cumulative germination over planting of seeds without pre-sowing treatment. Kak *et al*. (2007) postulated that hot water at 80 °C for 5 min. was most effective in breaking hardseededness in *Carotalaria laburnfolia*, while germination declined sharply in *C. retusa* when seeds were soaked in water at 70 °C for 15 min. Soaking *C. pallida*, seeds in hot water at 60 °C for 30 min. enhanced germination. Likewise, these observations were indicated by Sanyang *et al*. (2008) on *Acacia senegal*, Burrows *et al*. (2009) on *Acacia melanoxylon*, Azad *et al*. (2010) on *Albizia richardiana* and *Lagerstroemia speciosa*, Azad *et al*. (2012) on *Albizia procera*, Rodrigues Junior *et al*. (2014) on *Senna multijuga* , Imani *et al.* (2014) on Canna indica, Jaganathan *et al.* (2017) on *Delonix regia* and Jaganathan *et al.* (2018) who noticed that *Adenanthera pavonina* seeds treated with hot water and exposed to summer-autumn temperature regimes broke dormancy and gave the longest radicle .

The aim of the present study was to explore the most suitable pre-sowing treatment reliable to break the hardseededness of *Mescalbean sophora* seeds.

2. MATERIALS AND METHODS

The current work was conducted under semi-shade at the nursery of Al- Zohriya Garden, Hort. Res. Inst., ARC, Giza, Egypt, throughout the two successive seasons of 2017 and 2018 in order to overcome the physical dormancy of Mescal-bean sophora seeds due to their extremely hard red shells.

Thus,1-year-old semi-woody pods of Mescal-bean (*Sophora secundiflora*) were collected from a strong mature tree in Al- Zohriya Garden, Cairo on August, 12th for each season. The seeds were removed from the tough pods using a sharp knife, as they were shrinked and had deep red outer coats (the mean weight of 5 seeds was about 3.52 g, while diameter of the seed ranged between 10.50-13.35 mm) (Fig.2).

Fig. (2): Semi-woody pods (1) and seeds with hard red shell (2).

On August, 15th, the outer coats of the seeds were sterilized with 10 % of sodium hydrochloride solution for 10 minutes, then rinsed several times with sterile distillated water and directly subjected to the following pre-sowing treatments.

1. Untreated seeds, referred to as control.
2. Soaking in tap water for 48 hours at ambient conditions.

3. Soaking in hot water (60-70 °C) for 48 hours (as thermal scarification).
4. Rasping with a file (RWF) as the seeds were hold with a pliers and with a file rub one spot of the outer coat (at the larger cotyledon end) until the thin light-coloured inner coat is visible (as mechanical scarification treatment) .
5. Mechanical scarification (RWF) + soaking in tap water for 24 hours (as combined treatment).
6. Soaking in concentrated sulfuric acid (98.5 %) for 1, 2 or 3 hours (as chemical scarification treatments).

Immediately after treatment, the treated seeds and those of the control were sown in 16-cm-diameter plastic pots (10 seeds/ pot) filled with about 1.5 kg of sand and clay mixture at equal parts by volume (1:1, v/v). The physical and chemical properties of the sand and clay used in the two seasons are shown in Table (1).

2- Germination velocity (G.V.) in days, which equal average number of days from sowing till emergence of the last epicotyl .
3- Mean germination rate (M.G.R.) in days = mean No. days till 50 % germination (Odetola, 1987).
4- Germination rate index (G.R.I.), which was calculated from Bartled equation indicated by Hartmann and Kester (1983). GRI = A + (A + B) + (A + B + C) + … /N (A + B + C ….).

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

5- Vigour index (V.I.) = G % x mean length of epicotyl (Selvaraju and Selvaraj, 1994)
6- Seed viability (S.V.) = No. survived seedlings in each treatment after excluding the deteriorated and dead ones (Odetola, 1987).

Besides, the amount of water imbibed by treated seeds (g) were determined by fresh

Table (1):The physical and chemical analysis of the used sand and clay during 2017 and 2018 seasons.

Soil type	Seasons	Particle size distribution (%):				S.P.	pH	E.C. (dS /m)	Cations (meq /l)				Anions (meq/l)		
		Coarse sand	Fine sand	Silt	Clay				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
Sand	2017	89.03	2.05	0.40	8.52	23.00	7.92	3.72	7.50	1.63	33.60	0.50	3.20	22.00	18.03
	2018	90.10	1.95	0.50	7.45	22.86	7.89	3.70	19.42	8.33	7.20	0.75	1.60	7.00	27.10
Clay	2017	7.54	22.28	30.55	39.63	55.00	8.17	2.26	7.82	2.12	15.40	0.75	6.60	8.20	11.29
	2018	7.64	22.50	30.15	39.71	51.00	8.09	2.38	7.50	2.20	15.50	0.75	6.78	8.02	11.15

The layout of the experiment in both seasons was a completely randomized design, replicated thrice as each pot contained 10 seeds exemplifies one replicate (Mead *et al*., 1993). Clearly visible a protrusion of slender shoot (epicotyl) with the beginnings of the first true leaves was used as the first sign of germination (Ruter and Ingram, 1991). All agricultural practices required for care the seeds were carried out in time. Number of germinated seeds was counted daily and length of epicotyl (cm) was measured after a week from emergence to calculate germination traits as follows:

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

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

weight increase among 3 replications of 3 seeds each, as seeds were immersed in tap water under ambient temperature (35 -36 °C) and weighed every 12 h. for 60 h. (i.e. 5 times). Excess water was removed with filter paper before weighing. Result were expressed as water amount (g) uptook by seeds through the different times of immersing calculated by subtracting seed weight before soaking from seed weight after soaking **(** Brasil,1992) .

At the end of each season (on October, 15^{th}), data of the resulted seedlings from the different treatments were recorded as follows: seedling length (cm), number of leaves/seedling, root length (cm), number of roots/seedling as well as fresh and dry weights of top growth and roots (g).

In fresh leaf samples taken only in the second season, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g f. w.) were determined according to the method of Moran (1982). The percentage of total soluble sugars, and total indoles and total phenols (mg/100 g f. w.) were also evaluated by the methods described by Dubois *et al*. (1956), A.O.A.C (1990) and William *et al.* (1965), respectively.

Data were then tabulated and statistically analyzed according to program of SAS Institute (2009), followed by Duncan's New Multiple Range Test (Steel and Torrie,1980) for comparison among means.

3. RESULTS AND DISCUSSION

3.1. Effect of pre-sowing treatments on

3.1.1. Germination traits and epicotyl length

Data in Table (2) exhibit that germination % reached to the maximum value (65.76 % in the first season and 72.33 % in the second) by soaking in hot water for 48 h., while other treatments including the control recorded germination percentage ranged between 12.50 and 33.33% in the 1st season and 12.50 to 25 % in the 2nd season with non-significant differences among themselves in most cases of both seasons. However, the least percentage of germination (12.50 %) was achieved in both seasons by the control and rasping with a file treatments. This may indicate the role of hot water in softening the hard seed coat from all sides and cracking it in more than one position. In this concern, Hu *et al*. (2008) found that seed coats of *Sophora alopecuroides* seeds cracked in the hilum when pre-treated with sulfuric acid and after field exposure, but they cracked in both the hilum and extrahilar regions when treated with hot water, thus causing seeds to enter a fast imbibition stage. This finding was documented by Delgado *et al.* (2015) who mentioned that beside the lens, the hilum and micropyle are involved in water absorption in seeds of *Sophora tomentosa* scarified with hot water.

Moreover, the least number of days to either the highest percentage of germination velocity (G.V.) or to 50 % mean germination rate (M.G.R.) were also attained by hot water treatment that raised G % to 50 % in about 13.75 day and to 65.76 % in about 16.6 day in the first season, while in the second one these two parameters were scored after about 14.00 and 15.87 day from sowing the seeds, respectively. All the other treatments failed to elevate G % to 50 % in the two seasons. The best results of germination rate index (G.R.I.), as a real indicator for accelerating germination was also registered by hot water treatment that reduced

Table (2): Effect of pre-germination treatments on germination characteristics of *Sophora secundiflora* **seeds during 2017and 2018 seasons.**

Treatments	Germination (%)	Germination velocity (day)	Mean germination rate (day)	Germination rate index	Vigour index	Seed viability	Epicotyl length (cm)
	First season: 2017						
Control	12.50c	36.10a	0.00b	1.00a	16.25d	3.00c	1.30c
Soaking in T.W. for 48 h.	25.00bc	26.76b	0.00b	1.00a	33.25cd	6.00b	1.33c
Soaking in H.W. for 48 h.	65.76a	16.60d	13.75a	0.60c	131.52a	15.67a	2.00a
Rasping with a file (R.W.F.)	12.50c	30.00ab	0.00b	1.00a	16.63d	3.33c	1.33c
RWF + soaking in T.W. for 24 h.	33.33b	26.33b	0.00b	1.00a	47.33b	3.76c	1.42bc
Soaking in CSA for 1 h.	25.00bc	19.50c	0.00b	0.75b	37.50c	6.00b	1.50b
Soaking in CSA for 2 h.	25.00bc	19.50c	0.00b	1.00a	37.50c	6.00b	1.50b
Soaking in CSA for 3 h.	25.00bc	19.00c	0.00b	0.75b	37.50c	6.00b	1.50b
	Second season: 2018						
Control	12.50b	35.33a	0.00b	1.00a	15.38c	3.00c	1.23c
Soaking in T.W. for 48 h.	25.00b	27.00bc	0.00b	1.00a	32.50b	6.00b	1.30bc
Soaking in H.W. for 48 h.	72.33a	15.87d	14.00a	0.56c	151.89a	15.00a	2.10a
Rasping with a file (R.W.F.)	12.50b	30.33b	0.00b	1.00a	15.88c	3.00c	1.27c
RWF + soaking in T.W. for 24 h.	25.00b	25.76bc	0.00b	1.00a	33.50b	3.00c	1.34bc
Soaking in CSA for 1 h.	25.00b	21.50c	0.00b	1.00a	35.00b	6.00b	1.40b
Soaking in CSA for 2 h.	25.00b	21.33c	0.00b	0.75b	35.00b	6.00b	1.40b
Soaking in CSA for 3 h.	25.00b	21.33c	0.00b	0.75b	36.00b	6.33b	1.44b

-T.W.= Tap water,H.W.= Hot water,CSA= Concentrated sulfuric acid .

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

such parameter to 0.60 and 0.56 against 0.75 or 1.00 for other treatments in the first and second seasons, respectively. Similarly, were those results of vigour index, seed viability and epicotyl length (cm) traits, which also reached the maximum values by hot water treatment in the two seasons.

This may be ascribed to the role of hot water in reducing the hardseededness of the seed shell and cracking it to a level that permits the fast permeable of water and oxygen which activates enzymes to decay food reserve, producing sugars and energy required for embryo growth. These gains are in agreement with those revealed by Delgedo *et al.* (2015) on *Sophora tomentosa*, Agba *et al*. (2005) on *Mucuna flagellipes*, Kak *et al*. (2007) on *Carotalaria laburnfolia* and *C. pallida*, Burrows *et al*. (2009) on *Acacia melanoxylon* Rodrigues Junior *et al.* (2014) on *Senna multijuga*, Jaganathan *et al.* (2017) on *Delonix regia* and Jaganathan *et al.* (2018) on *Adenanthera pavonina* .

3.2. Water imbibition

It can be seen from the data in Table (3) that there was not any variable in fresh weight of seeds during the different stages of soaking in tap water under room temperature up to 60 h. So, germination % was the minimum and the seeds took the longest period to germinate in both seasons. The opposite was time regarding the other treatments, as the greatest water amount taken by the seeds rasped with a file or soaked in concentrated H_2SO_4 for 3 h. and directly followed by those soaked in the acid for 1 or 2 h. However, in these treatments, seeds absorbed the greatest amount of water in the first 24 h., while after that water absorption was to some extent stable or slightly reduced with elongating soaking periods. On the other hand, seeds soaked in hot water still absorb water till the end of soaking period. This means that the hard seed shell becomes more soften by hot water, so imbibition and seed swelling still occur, while coats of the seeds rasped with a file or soaked in acid did not soften enough, therefore the former treatment (hot water) recorded better germination characteristics than the latter ones (mechanical or acid scarification).

The results are supported by those indicated by Hu *et al*. (2008) on *Sophora alopecuroides*, Delgado *et al.* (2015) on *Sophora tomentosa*, Azad *et al*. (2010) on *Albizia richardiana* and *Lagerstroemia speciosa* and Azad *et al*. (2012) on *Albizia procera*.

3.3. Seedling growth traits

According to the data presented in Tables (4 and 5), it could be concluded that all pre-sowing treatments used in this work significantly improved length (cm), No. leaves and roots/seedling , root length (cm), as well as top growth and roots fresh and dry weights of the seedlings resulted from the treated seeds comparing with those of the control seedlings in the two seasons, except of rasping with a file treatment, alone or plus soaking in tap water for 24 h. that non-significantly improved length, No leaves and fresh and dry weights of top growth and roots parameters relative to control in most cases of both seasons. In addition, the differences among the various applied treatments concerning fresh and dry weights of top growth and roots were not significant in most instances of both seasons. However, the prevalence in all abovenamed characters was found due to hot water treatment which recorded the utmost high growth rates over the control and all other treatments in the two seasons (Fig.3).

Table (3): Effect of pre-germination treatments on water imbibition by *Sophora secundiflora* seeds after different periods from soaking in tap water under ambient conditions.

Pre-germination treatments	Seed weight before soaking (g)	Seed weight and water amount imbibed (g)									
		After 12 h.		After 24 h.		After 36 h.		After 48 h.		After 60 h.	
		Seed weight	Water amount	Seed weight	Water amount	Seed weight	Water amount	Seed weight	Water amount	Seed weight	Water amount
Soaking in T.W.	0.54	0.56c	0.02d	0.56c	0.02c	0.56c	0.02c	0.56c	0.02c	0.56c	0.02c
Soaking in H.W.	0.59	0.77bc	0.18c	1.05b	0.46b	1.10b	0.51b	1.12ab	0.53ab	1.14ab	0.55ab
Rasping with a file	0.57	0.79bc	0.22c	1.28ab	0.71a	1.29a	0.72a	1.28a	0.71a	1.26a	0.69a
Soaking in CSA for 1 h.	0.46	0.89b	0.43b	0.92b	0.46b	0.96b	0.50b	0.96b	0.50ab	0.95b	0.49b
Soaking in CSA for 2 h.	0.50	0.90b	0.40b	0.92b	0.42b	0.95b	0.45b	0.96b	0.46b	0.97b	0.47b
Soaking in CSA for 3 h.	0.61	1.35a	0.74a	1.40a	0.79a	1.39a	0.78a	1.38a	0.77a	1.33a	0.72a

- T.W. = Tap water, H.W. = Hot water and CSA = Concentrated sulfuric acid.
- Means within a column having the same letters are not significantly different according to Duncan's New Multiple Range t-Test (DMRT) at 5 % level.

Fig. (3): Seedling produced from control (1), rasping treatment (2), soaking in acid for either 2h.(3),or 3h.(4) and soaking in hot water (5).

This may be reasonable because hot water treatment is the most one that accelerates germination velocity, so saving time for the seedlings to grow better than those resulted from other treatments. Analogous observations were also noticed by Kak *et al*. (2007) on *Carotalaria laburnfolia* and *C. pallida*, Sanyang *et al*. (2008) on *Acacia senegal* and Burrows *et al*. (2009) on *Acacia melanoxylon*. In this connection, Azad *et al*. (2012) stated that hot water at 100 °C for 1 min. gave highly quality of *Albizia procera* seedlings.

3.4. Chemical composition of the leaves

It is clear from data averaged in Table (6) that chlorophyll a and carotenoids concentrations (mg/g f. w.) were significantly increased in the leaves of seedlings raised from treated seeds with the superiority of hot water treatment that resulted the highest values of these two pigments and followed by acid treatment for any time, then soaking in tap water for 48 h. and rasping with a file treatments, which occupied the 3rd position as they caused the least improvement. In the matter of chlorophyll b concentration, the opposite was the right as it was non-significantly declined in response to the various used treatments except of acid treatment for 3 h. which slightly elevated such component to 0.210 mg/g f. w. and hot water treatment for 48h which significantly increased it to 0.311 mg/g f. w. versus 0.201 mg/g. f. w. for control.

A significant increment was also observed in the percentage of total soluble sugars and total indoles (mg/100 g f. w.) due to the pre-sowing treatments employed in this study compared to the control, except treatments of soaking in tap water (48 h.), rasping with a file and soaking in acid for 1 h. that caused a slight increase, but the mastery was also for hot water treatment which gave the utmost high means. On the other side, a marked decrement was attained concerning the total phenols concentration by the various used treatments with mostly significant differences relative to the control. However, the greatest decrement in such constituent was scored by hot water treatment which diminished it to 0.789 against 2.187 mg/100 g f. w. for the control. Thus, the best equilibrium between indoles and phenols suitable for enhancing germination and seedling growth was achieved by hot water treatment that raised indoles level to the maximum value plus decreasing phenols content to the minimum.

Table (4): Effect of pre-germination treatments on growth parameters of *Sophora secundiflora* **seedlings during 2017 and 2018 seasons.**

Treatments	Seedling length (cm)		No. leaves /seedling		Root length (cm)		No. roots/ Seedling	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	2.80c	2.93c	3.33c	4.00c	3.10d	4.26d	2.33e	3.00e
Soaking in T.W. for 48 h.	4.43b	4.60ab	5.00b	5.00b	7.33bc	8.00b	4.51d	5.63bc
Soaking in H.W. for 48 h.	5.67a	5.38a	6.10a	6.50a	12.70a	10.83a	8.55a	7.68a
Rasping with a file (R.W.F.)	4.00bc	3.51c	4.00c	4.00c	6.17c	6.00c	4.70d	4.25d
RWF + soaking in T.W. for 24 h.	4.16bc	4.39ab	4.10bc	4.23bc	7.00c	7.46bc	5.26c	5.30c
Soaking in CSA for 1 h.	4.50b	4.36b	5.00b	5.00b	8.00b	7.91bc	6.00b	5.56c
Soaking in CSA for 2 h.	4.46b	4.50ab	5.00b	5.00b	7.63bc	8.00b	5.76bc	5.61bc
Soaking in CSA for 3 h.	4.50b	4.67ab	5.00b	5.00b	8.50b	9.40ab	6.40b	6.62b

- T.W. = Tap water, H.W. = Hot water and CSA = Concentrated sulfuric acid.
- Means within a column having the same letters are not significantly different according to Duncan's New Multiple Range t-Test (DMRT) at 5 % level.

Table (5): Effect of pre-germination treatments on top growth and roots fresh and dry weights of *Sophora secundiflora* **seedlings during 2017 and 2018 seasons.**

Treatments	Fresh weight (g)				Dry weight (g)			
	Top growth		Roots		Top growth		Roots	
	2017	2018	2017	2018	2017	2018	2017	2018
Control	0.26c	0.32b	0.10c	0.12b	0.05c	0.06c	0.02c	0.03c
Soaking in T.W. for 48 h.	0.41ab	0.46a	0.14b	0.15ab	0.12b	0.14b	0.09b	0.10ab
Soaking in H.W. for 48 h.	0.58a	0.50a	0.23a	0.21a	0.21a	0.19a	0.15a	0.13a
Rasping with a file (R.W.F.)	0.35b	0.34b	0.12bc	0.12b	0.10b	0.10bc	0.05bc	0.06bc
RWF + soaking in T.W. for 24 h.	0.38b	0.40ab	0.14b	0.14ab	0.11b	0.12b	0.08b	0.08b
Soaking in CSA for 1 h.	0.42ab	0.46a	0.16ab	0.17ab	0.18ab	0.20a	0.10ab	0.11ab
Soaking in CSA for 2 h.	0.46ab	0.47a	0.17ab	0.17ab	0.19ab	0.20a	0.11ab	0.11ab
Soaking in CSA for 3 h.	0.39b	0.45a	0.14b	0.16ab	0.11b	0.13b	0.08b	0.09b

- T.W. = Tap water, H.W. = Hot water and CSA = Concentrated sulfuric acid .
- Means within a column having the same letters are not significantly different according to Duncan's New Multiple Range t-Test (DMRT) at 5 % level.

Table (6): Effect of pregermination treatments on some constituents in the leaves of *Sophora secundiflora* **seedlings during 2018 season .**

Treatments	Pigments (mg/g f.w.)			Total soluble sugars (%)	Total indoles (mg/100 g.f.w.)	Total phenols (mg/100 g.f.w.)
	Chlorophyll a	Chlorophyll b	Carotenoids			
Control	0.508d	0.201b	0.227d	0.742d	0.612d	2.187a
Soaking in T.W. for 48 h.	0.693c	0.176c	0.322c	0.769d	1.770c	1.379b
Soaking in H.W. for 48 h.	0.989a	0.311a	0.491a	1.476a	2.779a	0.789d
Rasping with a file (R.W.F.)	0.701c	0.168c	0.347bc	0.778cd	1.741c	2.137a
RWF + soaking in T.W. for 24 h.	0.716bc	0.192b	0.369b	0.817c	1.967bc	1.289b
Soaking in CSA for 1 h.	0.740b	0.195b	0.377b	0.787cd	2.097b	1.213bc
Soaking in CSA for 2 h.	0.736b	0.187bc	0.365b	0.798c	2.106b	1.200bc
Soaking in CSA for 3 h.	0.749b	0.210b	0.381b	1.035b	2.138b	1.186c

- T.W. = Tap water, H.W. = Hot water and CSA = Concentrated sulfuric acid .
- Means within a column having the same letters are not significantly different according to Duncan's New Multiple Range t-Test (DMRT) at 5 % level.

In this regard, Kenneth (1979) indicated that the inhibitory effect of phenols due to modify the activity of IAA- oxidase and might therefore be acting on plant activities through changes endogenous auxins activity. On the same line, were those results postulated by Sanyang *et al*., (2008) on *Acacia senegal*, Azad *et al*. (2012) on *Albizia procera* and Rodrigues Junior *et al*. (2014) on *Senna multijuga*.

From the previous results, it can be advised to soak seeds of Mescal bean (*Sophora secundiflora*) in hot water (60-70 °C) for 48 h. to obtain the best germination and seedling growth.

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دراسات فسيولوجية على إنبات وتسميد نبات السوفورا
1. إنبات بذور السوفورا (*Sophora secundiflora*) صعبة الإنبات

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ملخص

تعاني بذور شجرة السوفورا (*Sophora secundiflora*) من سكون طبيعي بسبب الصلابة العالية لأغلفتها الخارجية. لذا، أجريت هذه الدراسة التي تهدف إلى كسر سكون هذه البذور بمكان نصف مظلل بمشتل حـــديقة الزهـرية، معهد بحوث البساتين، مركز البحوث الزراعية، الجيزة، مصر خلال موسمي 2017، 2018 وذلك بتعريضها لبعض معاملات ما قبل الإنبات والتي تضمنت: بذور غير معاملة (مقارنة)، النقع في ماء الصنبور لمدة 48 ساعة تحت حرارة الغرفة العادية، النقع في ماء دافئ (60-70 °م) لمدة 48 ساعة (خدش حراري)، الكشط بالمبرد (خدش ميكانيكي)، الكشط بالمبرد + النقع في ماء الصنبور لمدة 24 ساعة (معاملة مشتركة) والنقع في حمض الكبريتيك المركز (98.5 %) لمدة 1، 2، 3 ساعة (خدش كيماوي). زرعت البذور بعد المعاملات مباشرة في أصص بلاستيكيه قطرها 16 سم (10 بذور/أصيص) ملأت بحوالي 1,5 كجم من مخلوط متساوي من الرمل والطين (1 : 1 بالحجم). أوضحت النتائج أن أعلى نسبة إنبات وأقل عدد للأيام حتى حدوث 50 % إنبات أو أكثر قد حققته معاملة النقع في ماء دافئ لمدة 48 ساعة فى كلا الموسمين، بينما فشلت المعاملات الأخرى والمقارنة في رفع نسبة الإنبات إلى 50 % فى كلا الموسمين. أيضاً. حققت أفضل نتائج لدليل معدل الإنبات، دليل قوة الإنبات، حيوية البذور وطول السويقة الجنينية السفلى معاملة النقع في الماء الدافئ. لم يؤثر نقع البذور في ماء الصنبور فى درجة حرارة الغرفة العادية على كمية المياه الممتصة بواسطة البذور، بينما أثرت المعاملات الأخرى بدرجة كبيرة على هذا القياس حيث لوحظ أن أكبر كمية مياه قد أمتصت بواسطة البذور التي خدشت ميكانيكيا (كشط بالمبرد) أو كيماوياً بالنقع في حمض الكبريتيك المركز لمدة 3 ساعات)، ثم تلتها معاملة النقع في الماء الدافئ لمدة 48 ساعة. إلا أن المعاملتان الأولتان جعلتا البذور تمتص أكبر كمية من المياه خلال الـ 24 ساعة الأولى من النقع في الماء، ثم بقيت هذه الكمية ثابتة بعد ذلك. بينما أدت المعاملة الأخيرة (النقع في الماء الدافئ) إلى أستمرار البذور في إمتصاص الماء بشكل متزايد كلما زادت مدة النقع. تم الحصول أيضاً على إتجاه مشابه فيما يتعلق بصفات النمو الخضري والجذري للشتلات الناتجة ومحتوى أوراقها من الصبغات، السكريات الكلية الذائبة والإندولات، حيث أعطت معاملة النقع في الماء الدافئ أعلى المتوسطات على الإطلاق. إضافة إلى ذلك، أحدثت المعاملات المختلفة المطبقة بهذه الدراسة إنخفاضاً ملحوظاً في محتوى أوراق الشتلات من الفينولات الكلية، إلا أن أكبر معدل للإنخفاض أيضاً، كان لمعاملة النقع في الماء الدافئ **وعليه، يمكن التوصية** بنقع بذور شجرة السوفورا (*Sophora secundiflora*) ذات القشرة شديدة الصلابة بالنقع في ماء دافئ (60-70 °م) لمدة 48 ساعة لتحقيق أفضل إنبات وأعلى جودة للشتلات الناتجة.

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