# Effect of some pre-germination treatments on seed germination traits and seedling growth of *Calliandra haematocephala*, Benth.

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## ABSTRACT

This work was carried out during 2005 and 2006 seasons at the Experimental Farm of the Faculty of Agriculture, Kafr El-Sheikh University to study the effect of some pre-germination treatments (soaking seeds in tap water for 24 hrs; boiling water forl min.; $GA_3$ at 250, 500 and 1000 ppm for 24 hrs and concentrated $H_2SO_4$ 98.5% for 1 and 2 min.) on germination traits of seeds and seedling growth of *Calliandra haematocephala*, Benth. The results can be summarized as follows:

All pre-germination treatments increased germination percentage, germination velocity, germination rate index, chlorophyll a, b and total contents, plant height, roots length, leaf area, number of leaves /plant, stem diameter and fresh and dry weights of aerial parts and roots/plant but decreased mean germination rate, and total phenol compounds percentage compared to control. Soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 min. gave the best results in most cases when compared to other treatments.

It can be recommended to soaking *Calliandra haematocephala* seeds in $GA_3$ at 1000 for 24 hrs or concentrated $H_2SO_4$ for 1 min.,to obtain the best germination results.

**Key words:** *Calliandra hematocephala*, pere-germination treatments, $GA_3$, $H_2SO_4$.

## INTRODUCTION

One of the most important flowering shrubs is *Calliandra haematocephala* "Powder Puff" belongs to family Fabaceae. It is an exciting shrub, producing beautiful red flowers all the year round and is round used as a shrub border or in a mixed border, and forms attractive hedges, also is used in improving soil quality and

productivity by nitrogen fixation and litter production. Honey produced by bees foraging on Calliandra has a bittersweet flavor. The shrub grows very quickly so, its dense foliage provides ground cover, and its extensive and deep root system makes it particularly suitable for erosion control on slopes and for rejuvenating degraded soils.

The seeds of this shrub have impermeable coat, which prevents penetration of water and oxygen into the seeds. This may be modified by some treatments such as a soak in two times their volume of concentrated sulphuric acid; a water soak may be helpful in softening the seed coat or removing inhibitors. Gibberellins have been used to stimulate seed germination and seedling growth, either directly through activation of the enzyme amylase to hydrolyze complex carbohydrates to simpler sugars or indirectly through balancing the inhibitors in the seeds especially ABA.

Many investigators carried out experiments dealing with the response of ornamental shrubs and trees seeds to some pre-germination treatments, in this concern, Lee and Bin (1991) on Aralia seeds, found that, germination was highest when seeds were imbibed in $GA_3$ at 500 ppm and chilled around $4C^O$ for 2-5 weeks.

On Acacia, Srimathi *et al* (1991) demonstrated that, some species need just few minuets "2-10 min." of soaking in concentrated $H_2SO_4$ viz., *Acacia millifera*. Also, El-Mahrouk *et al.*(1998) mentioned that soaking *Acacia nilotica* seeds in a boiling water for 3 min. gave the best results in most cases and recommended it for improving germinability and obtaining healthy transplants. Germination of *Acacia polycantha* was increased to 89% by soaking in a boiling water for 80 seconds (Gondwe, 1999). However, germination of *Acacia retinodes* was increased from 3% to 81.5% by placing seeds in boiling water for 30 seconds (Magnani *et al.*, 1999). The highest germination percentage of *Acacia eburnea* seeds was obtained at $30C^O$ (Girase *et al.*, 2002).

Bhandari (1996) stated that, $GA_3$ is the most common growth regulator that has a positive effect on releasing dormancy of *Cinnamomum camphora* seeds. Likewise, Kandeel *et al* (1998)

found that, soaking *Terminalia arjuna* seeds in a tap water for 24 hrs gave significantly higher germination percentage and germination rate index and recorded less days for germination and attaining mean germination rate and gave taller transplants with longer roots and heavier fresh and dry weights of aerial parts and roots compared to the control. Also, Mahmoud (1999) reported that soaking *Brachychiton discolor* seeds in a tap water gave good results for seed germination.

Ebrahiem ( 2000) found that, the highest germination percentage and the minimum time for germination were obtained from soaking seeds in water for 72 hrs. The germination of *Parkinsonia aculeata* seeds ranged between 76-99% compared with control by soaking in $H_2SO_4$ for 60 min. (Ali, 2003). Hassan (2003) reported that the highest germination percentage resulted from soaking *Murraya exotica* seeds in $GA_3$ at 250 ppm for 4 hrs and 1000 ppm for 24 hrs for *Acokanthera spectabilis*.

This work aim to improve calliandra seed germination traits and seedling growth by some pre-germination treatments.

## Materials and Methods

The present investigation was carried out during two successive seasons of 2005 and 2006 at the Experimental Farm of the Faculty of Agriculture, Kafr El-Sheikh, Kafr El-Sheikh University to study the effect of some pre-germination treatments on some germination traits of seeds and seedling growth of *Calliandra hematocephala*, Benth. The seeds were collected from a certain mother shrub grown in the garden of Faculty of Agriculture Kafr El-Sheikh during the summer and Autumn months. Seeds of this shrub were subjected to 8 different treatments as follow:-

1- Control (untreated seeds).
2- Soaking seeds in a tap water for 24 hours.
3- Soaking seeds in a hot water (boiling water for one min.) then left in water for 24 hours.
4- Soaking seeds for 24 hours in an aqueous solution of $GA_3$ at the concentrations of 250,500 and 1000 ppm.

5- Soaking seeds in concentrated sulphuric acid (98.5%) for 1 and 2 min. then washed.

The seeds were sown in clay pots of 30 cm diameter filled with a mixed clay-sand-peat (1:1:1 v:v:v) medium on May 15th with three replicates in both seasons. Every pot was considered a replication. Each replicate contained 50 seeds. Therefore, every treatment consisted of 150 seed in the three replicates.

The experimental design was a completely randomized according to Snedecor and Cochran (1980).

The following data were recorded:-

1-Number of germinated seeds counted every day till germination became constant and seed germination percentage and rate were calculated using the following equation:

$$G\% = \frac{No.of.germimated\ seeds}{Total\ seed\ number} X100$$

2-Germination velocity (G.V) = Number of days from sowing until emergence of the plumule.

3-Mean germination rate (M.G.R) = Number of days to attain 50% of total germination (Odetola, 1987).

4-Germination rate index (G.R.I) according Hartmann and Kester (1983)

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

Where A, B and C = number of germinated seeds counted at different times.

N = number of times at which the germinated seeds were counted.

5-Percentage of total phenol compounds in seeds for the two seasons after seeds had been treated using the method of Snell and Snell (1953).

6-Chlorophyll a, b and total contents (mg/g fresh weight) in fresh leaves were determined according to Moran (1982).

At the end of the experiment after about 6 months from sowing, the following data were recorded on all the obtained transplants:

1- Plant height (cm).
2- Root length (cm).
3- Leaf area/plant ($cm^2$).
4- Number of leaves /plant.
5- Stem diameter (cm).
6- Fresh and dry weight of aerial parts and roots/ plant (g).

Means of all data were compared using Duncan's multiple range test according to Snedecor and Cochran (1980).

## Results and Discussion

### I-Effect on some germination traits:-

### I. A.-Germination percentage (G %):

It is obvious from Table (1) that all pre-germination treatments gave significantly higher germination percentage than control in both seasons. The highest germination percentage in both seasons resulted from the treatments of soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 and 2 min. as gave 85.26, 90.44 and 90.78% respectively against 47.51% for control in the first season and in the second one gave 95.17, 96.72 and 95.73%, respectively against 36.07% for the control. This was followed by the treatment of hot water in both seasons as gave 79.89 and 82.17%, respectively.

Table (1): Effect of some pre-germination treatments on germination percentage (%) and velocity (days) of *Calliandra hematocephala* seeds during 2005 and 2006 seasons.

| Treatments | G% | | G.V.(days) | |
|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 47.51g | 36.07d | 22.67a | 21.00a |
| Soaking in tap water for 24 hrs. | 56.52f | 66.42c | 13.67b | 14.00b |
| Soaking in boiling water for 1 min. | 79.89c | 82.17b | 11.00c | 11.00c |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 65.13e | 67.15c | 13.67b | 14.33b |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 73.03d | 78.35b | 11.67bc | 10.67c |
| Soaking in $GA_3$ at 1000 ppm for 24 hrs | 85.26b | 95.17a | 9.33cd | 9.00cd |
| Soaking in $H_2SO_4$ for 1 min. | 90.44a | 96.72a | 8.00d | 7.33d |
| Soaking in $H_2SO_4$ for 2 min | 90.78a | 95.73a | 7.33d | 6.33d |

G% = Germination percentage. G.V.= Germination velocity.
Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

There were significant differences among the treatments in the most cases. The least values resulted from the treatment of tap water comparing to the other treatments in both seasons although it has given yet significantly higher values than control.

It seems that the dormancy of these seeds is due mainly to the seed coat, and can be overcome by soaking in $H_2SO_4$ as it soften seed coat or $GA_3$ as it hasten seed germination through the stimulatory effect on hydrolytic enzymes, which resulted in increasing seed germination. These results are in agreement with those of Srimathi *et al.* (1991) and Girase *et al.*(2002) on *Acacia* spp and Magnani *et al.*, (1999) and Ali (2003) on *Parkinsonia aculeata.*

**I. B-Germination velocity (G.V):**

It is evident from Table (1) that all pre-germination treatments significantly hastened germination when compared to control for both seasons. The least days required for germination resulted from the treatment of $H_2SO_4$ for 2 min. followed by $H_2SO_4$ for 1 min. then $GA_3$ at 1000 ppm in both seasons as recorded 7.33, 8.00 and 9.33 days against 22.67 days for control in the first season and 6.33, 7.33 and 9.00 days against 21.00 days for control in the second one.

In the second rank lies the treatment of boiling water as recorded 11.00 and 11.00 days in both seasons, respectively as there were significant differences among the treatments in most cases. The primitive effect of $GA_3$ on decreasing the time required for germination would be a result of its effects on activating hydrolytic enzymes as well as increasing endogenous growth promoters to act on both the embryo and endosperm and raise the osmotic content of the seed, increasing water potential, thus giving the radicle the power to break through the mechanical contractions imposed by seed coat (Ikuma and Thimman, 1963; Warieng and Saunders, 1970 and Hartmann and Kester, 1983). Also, $H_2SO_4$ softens the seed coat to become penetrable by the radicle. These results are in conformity with those of EL-Mahrouk *et al* (1998) on *Acacia nilotica* and Ebrahiem (2000) on *Taxodium distichum.*

**I. C-Mean germination rate (M.G.R):**

The results presented in Table (2) indicated that, all pre-germination treatments significantly reduced the number of days to attain 50% of total germination (M.G.R.) compared to control in both seasons. The treatments of boiling water, $GA_3$ at 1000 ppm and sulphuric acid for 1 and 2 min. gave the least M.G.R. in the two seasons as recorded 15.33, 15.00, 15.67 and 13.33 days against 41.00

days for the control in the first season and 15.67, 15.33, 13.33 and 12.67 days against 40..67 days for the control in the second one.

Table (2): Effect of some pre-germination treatments on mean germination rate (M.G.R) and Germination rate index (G.R.I.) of *Calliandra haematocephala* seeds during 2005 and 2006 seasons.

| Treatments | M.G.R. | | G.R.I. | |
|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 41.00a | 40.67a | 0.29e | 0.34d |
| Soaking in tap water for 24 hrs. | 25.33b | 18.67bc | 0.40d | 0.41c |
| Soaking in boiling water for 1 min. | 15.33d | 15.67cd | 0.54c | 0.61a |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 21.00c | 22.33b | 0.43d | 0.40c |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 17.00d | 18.33bc | 0.51c | 0.52b |
| Soaking in $GA_3$ at 1000 ppm for 24 hrs | 15.00d | 15.33cd | 0.61b | 0.63a |
| Soaking in $H_2SO_4$ for 1 min. | 15.67d | 13.33d | 0.67a | 0.63a |
| Soaking in $H_2SO_4$ for 2 min. | 13.33d | 12.67d | 0.71a | 0.65a |

M.G.R.= Mean germination rate G.R.I= Germination rate index.
Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

These results are in accordance with those of Mahmoud (1999) on *Brachychiton discolor*, Ebrahiem (2000) on *Taxodium distichum* and Ali (2003) on some leguminous trees

**I. D- Germination rate index (G.R.I.):**

Data presented in Table (2) showed that all pre-germination treatments gave significantly higher G.R.I. than control in both seasons. The highest values resulted from soaking seeds in sulphuric acid for 1 and 2 min. in the first season as recorded 0.67 and 0.71, respectively against 0.29 for control. However, in the second season were the treatments of boiling water, $GA_3$ at 1000 ppm and $H_2SO_4$ for1 and 2 min., as recorded 0.61, 0.63,0.63 and 0.65, respectively against 0.34 for control. The lowest values resulted from soaking seeds in tap water and $GA_3$ at 250 ppm in both seasons as recorded 0.40 and 0.43, respectively in the first season and 0.41 and 0.40, respectively in the second one. These results are in agreement with those of Kandeel et al.(1998) on *Tipuana tipu* and *Terminalia arjuna* and Hassan (2003) on *Murraya exotica*

**II-Effect on some growth characters:-**
**II. A-Plant height (cm):**

It is clear from data in Table (3) that all pre-germination treatments gave significantly taller seedlings than control in both seasons. The tallest seedlings resulted from soaking seeds in the three concentrations of $GA_3$ and boiling water in both seasons plus $H_2SO_4$ for 1 min., in the second one as recorded 47.00, 51.67, 54.33 and 46.67 cm, respectively in the first season and 39.67, 43.33, 43.33, 40.00 and 42.67 cm, respectively in the second one. The shortest seedlings resulted from control plants in both seasons as recorded 21.00 and 17.67 cm, respectively. The stimulatory effect of $GA_3$ on plant height may be due to its activating effects on both cell division and enlargement. Similar results were obtained by Bhandari(1996) on *Cinnamomum camphora*, Ali (2003) on some leguminous trees and Hassan (2003) on *Enterlobium cyclocarpum*.

Table (3):Effect of some pre-germination treatments on plant height (cm), leaf area ($cm^2$) and leaves number of *Calliandra hematocephala* seedlings during 2005 and 2006 seasons.

| Treatments | Plant height (cm) | | Leaf area/plant ($cm^2$) | | Leaves number | |
|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 21.00c | 17.67d | 126.93f | 119.00e | 5.33f | 5.00f |
| Soaking in tap water for 24 hrs. | 35.33b | 31.33c | 238.00e | 222.13d | 10.00e | 9.33e |
| Soaking in boiling water for 1 min. | 46.67a | 40.00ab | 293.53cd | 253.87bc | 12.33cd | 10.67cd |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 47.00a | 39.67ab | 349.07ab | 238.00cd | 11.33de | 10.00de |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 51.67a | 43.33a | 372.87a | 285.60a | 13.33bc | 10.67cd |
| Soaking in $GA_3$ at 1000 ppm for 24hrs | 54.33a | 43.33a | 376.53a | 301.47a | 15.67a | 12.00ab |
| Soaking in $H_2SO_4$ for 1 min. | 36.67b | 42.67ab | 317.33bc | 283.87a | 15.67a | 12.67a |
| Soaking in $H_2SO_4$ for 2 min. | 36.67b | 35.00bc | 269.73de | 277.67ab | 14.67ab | 11.33bc |

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

**II. B-Leaf area and leaves number:**

It is evident from data in Table (3) that all pre-germination treatments significantly increased both leaf area and leaves number/ plant when compared to control in both seasons. The widest leaves resulted from soaking seeds in $GA_3$ at 250, 500 and 1000 ppm in the first season as recorded 349.07, 372.87 and 376.53 $cm^2$, respectively against 126.93 $cm^2$ for control and in the second one were the

treatments of $GA_3$ at 500 and 1000 ppm and $H_2SO_4$ for 1 and 2 min., as recorded 285.60, 301.47, 283.87 and 277.67 $cm^2$, respectively against 119.00 $cm^2$ for control. The narrowest leaves in both seasons resulted from soaking seeds in tap water for 24 hrs as recorded 238.00 and 222.13, $cm^2$, respectively.

As for leaves number, it is clear from the Table3) that all pre-germination treatments significantly increased leaves number/ plant when compared to control in both seasons. The highest number of leaves in the first season resulted from the treatments of $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 and 2 min. as recorded 15.67, 15.67 and 14.67, respectively against 5.33 for control, while in the second one were the treatments of $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 min. as recorded 12.00 and 12.67, respectively against 5.00 for control. The lowest number of leaves resulted from soaking seeds in tap water for 24 hrs as recorded 10.00 and 9.33, respectively in both seasons. The promotive effect of $GA_3$ on leaf area may be due to its stimulatory effect on cell division and elongation (Weaver, 1972).

**II. C-Stem diameter:**

Data presented in Table (4) show that all pre-germination treatments significantly increased stem diameter over control in both seasons. The thickest stems in both seasons resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 and 2 min. as recorded 0.38, 0.39 and 0.37 cm, respectively against 0.19 cm for control in the first season and in the second one gave 0.29, 0.29 and 0.32 cm, respectively against 0.14 cm for control. The thinnest stems in both seasons resulted from soaking seeds in tap water for 24 hrs as recorded 0.27 and 0.21 cm, respectively. These results are in agreement with the findings of Ebrahiem (2000) on *Taxodium distichum* and Hassan (2003) on *Enterlobium cyclocarpum*.

**II. D-Fresh and dry weights of aerial parts:**

It is clear from data in Table (4) that all pre-germination treatments gave significantly heavier fresh and dry weights of the aerial parts than control in both seasons. The heaviest fresh and dry weights in both seasons resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 min. as recorded 13.05 and 13.83 g fresh

weight against 9.46 for control and 6.58 and 6.49g dry weight, respectively against 4.22g for control in the first season. Whereas, in the second one the corresponding values were 11.36 and 11.64gfresh weight against 8.469 for control and 5.19 and 5.27g dry weight against 3.71g for control.

Table (4): Effect of some pre-germination treatments on stem diameter (cm),fresh and dry weights of aerial parts (g) of *Calliandra haematocephala* transplants during 2005 and 2006 seasons.

| Treatments | Stem diameter (cm) | | Aerial parts fresh weight/ plant (g) | | Aerial parts dry weight/ plant (g) | |
|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 0.19d | 0.14d | 9.46h | 8.46e | 4.22e | 3.71f |
| Soaking in tap water for 24 hrs. | 0.27c | 0.21c | 10.11g | 9.91d | 4.25e | 4.09e |
| Soaking in boiling water for 1 min. | 0.33bc | 0.29ab | 11.49e | 10.78c | 5.34c | 4.49d |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 0.31c | 0.26bc | 10.72f | 10.11d | 4.73d | 4.16e |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 0.33bc | 0.26bc | 12.18d | 10.85c | 5.94b | 4.74c |
| Soaking in $GA_3$ at 1000 ppm for 24hrs | 0.38ab | 0.29ab | 13.05b | 11.36b | 6.58a | 5.19ab |
| Soaking in $H_2SO_4$ for 1 min. | 0.39a | 0.29a | 13.83a | 11.64a | 6.49a | 5.27a |
| Soaking in $H_2SO_4$ for 2 min. | 0.37ab | 0.32a | 12.79c | 11.34b | 5.15c | 5.10b |

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

The lightest fresh and dry weights resulted from soaking seeds in tap water for 24 hrs in both seasons as recorded 10.11g fresh weight and 4.25g dry weight in the first season and 9.91g fresh weight and 4.09 g dry weight in the second one. These results are in accordance with those of Kandeel *et al* (1998) on *Tipuana tipua*, Ebrahiem (2000) on *Grevillea robusta* and Hassan (2003) on *Acokanthera spectabilis*.

**II. E-Root length (cm):**

Data presented in Table (5) showed that all pre-germination treatments significantly increased root length more than control in both seasons. The tallest roots resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 and 2 min. in the first season as recorded

29.00, 28.00 and 27.00 cm, respectively against 11.00 cm and $GA_3$ at 1000 ppm in the second one as recorded 31.67 cm against 10 cm for control. The differences among the used treatments reached the significancy level in the most cases in both seasons.

The favorite results of $GA_3$ and $H_2SO_4$ on root length was observed by many investigators as El-Mahrouk *et al.*(1998) on *Cassia didymobotrya*, Ebrahiem (2000) on *Grevillea robusta* and Hassan (2003) on *Acokanthera spectabilis*.

Table (5): Effect of some pre-germination treatments on root length (cm) and root fresh and dry weights (g) of *Calliandra hematocephala* transplants during 2005 and 2006 seasons.

| Treatments | Root length (cm) | | Roots fresh weight/ plant (g) | | Roots dry Weight/ plant (g) | |
|---|---|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 11.00e | 10.00e | 3.59e | 2.95f | 1.27d | 0.93f |
| Soaking in tap water for 24 hrs. | 15.33d | 14.33d | 4.05d | 3.65d | 1.74c | 1.59e |
| Soaking in boiling water for 1 min. | 20.33c | 17.67cd | 5.51b | 4.34b | 2.33b | 2.00b |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 18.00cd | 15.00d | 4.11d | 3.94e | 1.92c | 1.62e |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 24.00b | 19.67c | 4.78c | 4.12c | 2.10bc | 1.76d |
| Soaking in $GA_3$ at 1000 ppm for 24hrs | 29.00a | 31.67a | 6.87a | 4.98a | 2.97a | 2.15a |
| Soaking in $H_2SO_4$ for 1 min. | 28.00a | 26.67b | 7.05a | 4.98a | 3.08a | 2.16a |
| Soaking in $H_2SO_4$ for 2 min. | 27.00a | 25.33b | 5.65b | 4.22bc | 2.42b | 1.88c |

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

## II. F-Fresh and dry weights of roots:

Data in Table (5) reveal that all pre-germination treatments gave significantly heavier fresh and dry weights of roots than control in both seasons. The heaviest fresh and dry roots resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 min. in both seasons as gave 6.87 and 7.05g fresh weight against 3.59g for control and, 2.97 and 3.08g dry weight against 1.27g for control in the first season. Whereas, in the second season the corresponding values were 4.98 and 4.98g fresh weight against 2.95 for control and, 2.15 and 2.16g dry weight against 0.93g for control.

The other treatments gave intermediate values with significancy among them in the most cases in both seasons. This may be due to the increase in water uptake, which evaporated with drying plants. These results are in accordance with those of Kandeel *et al* (1998) on *Tipuana tipua* and Hassan (2003) on *Murraya exotica* and *Acokanthera spectabilis.*

**III-Effect on chlorophyll contents:-**

Data presented in Table (6) and (7) showed that all pre-germination treatments significantly increased chlorophyll contents more than control in both seasons. The highest chlorophyll a, b and total contents resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1. min. in both seasons as recorded 1.877 and 1.883 mg/g fresh weight for chlorophyll a, 0.732 and 0.749 mg/g fresh weight for chlorophyll b and 2.609 and 2.633 mg/g fresh weight for total chlorophyll against 1.597, 0.542 and 2.139 mg/g fresh weight, respectively for control in the first season and, 1.710 and 1.710 mg/g fresh weight for chlorophyll a, 0.732 and 0.739 mg/g fresh weight for chlorophyll b and 2.435 and 2.460 mg/g fresh weight for total chlorophyll against 1.387, 0.543 and 1.929 mg/g fresh weight, respectively for control in the second season.

Table (6): Effect of some pre-germination treatments on chlorophyll a & b contents (mg/g fresh weight) in *Calliandra hematocephala* leaves during 2005 and 2006 seasons.

| Treatments | Chlorophyll a (mg/g fresh weight) | | Chlorophyll b (mg/g fresh weight) | |
|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 1.597d | 1.387d | 0.542e | 0.543e |
| Soaking in tap water for 24 hrs. | 1.700c | 1.550c | 0.610d | 0.605d |
| Soaking in boiling water for 1 min. | 1.733c | 1.594bc | 0.661cd | 0.701bc |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 1.737c | 1.560c | 0.662cd | 0.663bcd |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 1.800b | 1.623b | 0.681bc | 0.652cd |
| Soaking in $GA_3$ at 1000 ppm for 24 hrs | 1.877a | 1.710a | 0.732ab | 0.732a |
| Soaking in $H_2SO_4$ for 1 min. | 1.883a | 1.710a | 0.749a | 0.739a |
| Soaking in $H_2SO_4$ for 2 min. | 1.807b | 1.640b | 0.675bc | 0.721ab |

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

The least chlorophyll a, b and total contents resulted from soaking seeds in tap water for 24 hrs in both seasons as recorded 1.700, 0.610 and 2.310 mg/g fresh weight, respectively in the first season and 1.550, 0.605 and 2.155 mg/g fresh weight, respectively in the second one. These results are in agreement with those of Hassan (2003) on *Murraya exotica* and *Acokanthera spectabilis*

Table (7): Effect of some pre-germination treatments on total chlorophyll contents in the leaves (mg/g fresh weight) and total phenols contents (mg/g dry weight) in the seeds of *Calliandra haematocephala* during 2005 and 2006 seasons.

| Treatments | Total chlorophyll (mg/g fresh weight) | | Total phenols (mg/g dry weight) | |
|---|---|---|---|---|
| | 2005 | 2006 | 2005 | 2006 |
| Control (untreated seeds) | 2.139e | 1.929bc | 1.07a | 0.68a |
| Soaking in tap water for 24 hrs. | 2.310d | 2.155c | 0.68b | 0.53cd |
| Soaking in boiling water for 1 min. | 2.395c | 2.311ab | 0.71b | 0.63b |
| Soaking in $GA_3$ at 250 ppm for 24 hrs | 2.399c | 2.189abc | 0.59c | 0.58bc |
| Soaking in $GA_3$ at 500 ppm for 24 hrs | 2.481b | 2.277ab | 0.56c | 0.53cd |
| Soaking in $GA_3$ at 1000 ppm for 24 hrs | 2.609a | 2.435a | 0.45d | 0.48de |
| Soaking in $H_2SO_4$ for 1 min. | 2.633a | 2.460a | 0.45d | 0.45e |
| Soaking in $H_2SO_4$ for 2 min. | 2.482b | 2.361a | 0.44d | 0.42e |

Means within a column having the same letters are not significantly different according to Duncan's multiple range test.

**IV-Effect on total phenols contents:-**

It is clear from Table (7) that all pre-germination treatments significantly reduced total phenols contents when compared to control in both seasons. The lowest phenol contents resulted from soaking seeds in $GA_3$ at 1000 ppm and $H_2SO_4$ for 1 and 2 min., in the first season as recorded 0.45, 0.44 and 0.45 mg/g dry weight, respectively against 1.07 mg/g dry weight for control. Whereas in the second season such treatments recorded 0.48, 0.45 and 0.42 mg/g dry weight, respectively against 0.68 mg/g fresh weight for control. Soaking seeds in tap water gave the highest phenols contents compared to other treatments in both seasons as recorded 0.71 and 0.63 mg/g fresh weight, respectively. So phenols are main contributors for growth inhibiting and decreasing of phenol compounds in seeds encouraged seeds to germinate (Wareing and Saunders,1970). Similar results were obtained by Mahmoud (1999)

on *Brachychiton discolor* and Hassan (2003) on *Enterlobium cyclocarpum.*

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## الملخص العربي

## تأثير بعض معاملات ما قبل الإنبات على صفات الإنبات ونمو شتلات الكليندرا

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اجري هذا البحث خلال موسمي ٢٠٠٥، ٢٠٠٦ بالمزرعة التجريبية بكلية الزراعة جامعه كفرا لشيخ لدراسة تأثير بعض معاملات ما قبل الإنبات (نقع البذور في ماء الصنبور لمدة ٢٤ ساعة، الماء المغلي لمدة دقيقة، حمض الجبر يلك بتركيز ٢٥٠، ٥٠٠، ١٠٠٠ جزء في المليون ، حمض الكبريتيك المركز ٩٨,٥% لمدة ١ ،٢ دقيقه) علي صفات الإنبات و نمو الشتلات لنبات الكليندرا ويمكن تلخيص النتائج كما يلي:-

١- أدت جميع معاملات ما قبل الإنبات إلي زيادة كل من نسبه الإنبات، سرعة الإنبات، معدل سرعه الإنبات ، كلوروفيل ا ، ب والكلوروفيل الكلي، ارتفاع النبات، طول الجذور، المساحة الورقية للنبات، عدد الأوراق علي النبات، قطر الساق، الوزن الطازج والجاف للأجزاء الهوائية والجذور للنبات مقارنة بالكنترول.

٢- أدت جميع معاملات ما قبل الإنبات إلي خفض كل من الوقت اللازم للإنبات، متوسط سرعة الإنبات، نسبة الفينولات الكلية في البذور مقارنة بالكنترول.

٣-أعطت المعاملة بكل من حمض الجبريللك بتركيز ١٠٠٠ جزء في المليون، حمض الكبريتيك المركز لمدة دقيقة واحدة أفضل النتائج مقارنة بالمعاملات الأخرى.

يوصى بنقع بذور الكليندرا في حمض الجبر يلك بتركيز ١٠٠٠ جزء فى المليون لمدة ٢٤ ساعة للحصول على أفضل النتائج للإنبات ونمو الشتلات.