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BOTANICAL STUDIES AND BREAKING SEED DORMANCY OF *Magnolia grandiflora* L.

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ABSTRACT

The present research was performed on *Magnolia grandiflora* L. which is considered as one of the most beautiful ornamental trees, belongs to the family Magnoliaceae, because of its showy, fragrant, ivory flowers and large evergreen leaves. It is aimed to throw light on more information about the botanical characteristics of magnolia trees grown in Egypt. Botanical studies include descriptions of height, trunk, bark, shoots, branches, leaves, flowers, fruits and seeds as well as anatomy of vegetative organs of this important tree. Seed germination and seedling growth were also considered. Moreover, breaking seed dormancy by cold stratification and / or GA_3 treatment and their influence on vegetative growth and photosynthetic pigments were investigated.

The results revealed that cold stratification of seeds at 4°C for three months during the winter before planting in spring is very necessary for breaking dormancy and enhancement of germination of magnolia seeds. Moreover, soaking stratified seeds in 150 ppm GA_3 for 24 hours just before sowing induced significant increase in the percentage of seed germination more than that recorded by cold stratification the alone. Such treatment also induced prominent increases in chloroplast pigments of leaves of magnolia plants aged six months.

***Key words**: anatomy, breaking dormancy, GA_3, Magnolia grandiflora L., phytography, seed germination, seedling growth, stand tree,*

1. INTRODUCTION

Magnolia is the largest genus in the family Magnoliaceae, comprised of 80 species of which *Magnolia grandiflora* L. (Southern magnolia or magnolia) is considered one of the most beautiful native American tree species occurs on the coastal plain from North Carolina, South to central Florida, and West to East Texas (Cronquist, 1981).

Magnolia grandiflora L., the subject of the present investigation, is widely planted as an ornamental tree because of its showy, fragrant, ivory flowers and large evergreen leaves. The flowers have a delicious and very powerful scent, possibly more powerful than any other flower. The bark is diaphoretic, stimulant, tonic. It is used in the treatment of malaria and rheumatism. The neoligran derivatives magnolol and honokiol, extracted from the bark and used in traditional medicine for neurosis and gastrostinol compliments (Watanable *et al.*, 1983). The wood is limited in its uses but may be made into furniture, paneling, veneer, crates and cabinets. The wood is white when first cut and turns brown on exposure to air. It is used in limited amounts for fuel.

This spectacular tree is beloved by gardeners and planted all over the world wherever it can be grown. One of the limiting factors that affects the spreading of *Magnolia grandiflora* L. is its difficult propagation by vegetative processes even that of micro-propagation in tissue culture techniques (Effat *et al.*, 1999).

Therefore, propagation of *Magnolia grandiflora* L. by seeds is considered the only method despite its difficulty regarding the dormancy phenomenon of its seeds and special requirements as needed to overcome these difficulties.

It is well known that woody plants (such as *Magnolia*) from temperate regions require a period of stratification before subjecting to germination or breaking that kind of dormancy by exposing seeds to growth regulators treatment to replace the chilling requirements (Mahmoud, 2001). In this respect, many investigators refer to the stimulatory effect of soaking seeds of different plant species, especially those of woody plants in

dormant case, in gibberellic state (GA_3) to enhance seed germination (increase the percentage and rate of seed germination) and stimulate seedling growth (El-Tarawy *et al.*, 1980; El-Banna *et al.*, 1981; Nofal *et al.*, 1981& 1983; El-Keiy *et al.*, 1985; Singh and Murty, 1987; Singh, 1989; Emam, 2000 and Reda, 2003 & 2006).

The present investigation is an attempt to bring to light more information about the botanical characteristics (morphology and anatomy) of *Magnolia grandiflora* L. stand trees grown in Egypt. Moreover, breaking seed dormancy by cold stratification and / or GA_3 treatments and their influence on vegetative growth and photosynthetic pigments were also considered.

2. MATERIALS AND METHODS

The current investigation was performed on *Magnolia grandiflora* L. (magnolia) stand trees grown in Zoological Garden at Giza, Egypt as well as on pot experiment including seed germination and seedling growth of magnolia carried out at the wire green-house of Agricultural Botany Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two growing seasons of 2007 and 2008.

The external morphology of stand trees located at Zoological Garden was investigated through keen observations and specimens collected during spring, summer and autumn seasons of the two successive years 2007 and 2008. Botanical description includes height, trunk, bark, shoots, branches and leaves as well as flowers, fruits and seeds of such important species of the genus *Magnolia*.

2.1. Source of seeds and the applied growth regulator GA_3

Seeds of *Magnolia grandiflora* L. were harvested from marked mother plus trees, about 80 years old, grown in Zoological Garden at Giza at the end of November in the two studied seasons 2006 and 2007.

Gibberellic acid (GA_3) was obtained commercially as granules in bags from the Syrgenta Corp. World Wide. Each bag contains one gramme active ingredient. Two concentrations; namely, 75 and 150 ppm were used as soaking treatments for 24 hours.

2.2. Experimental

At each season, after cleaning magnolia seeds from red pulp, the almost uniform seeds were divided into two groups, each of 300 seeds. The first group was stored at room temperature for three months before sowing. The second group was subjected to cold stratification where the seeds were mixed with moistened clean sand and put in polyethylene perforated bags and kept in the refrigerator at 4°C for three months. Seeds of each group were divided into three equal parts, each contained 100 seeds. The first part was soaked in distilled water for 24 hours. The second part was soaked in solution containing 75 ppm GA_3 for 24 hours. The third part was soaked in a solution containing 150 ppm GA_3 for 24 hours.

Stratified and nonstratified seeds which were soaked in a distilled water or in the solution containing GA_3 at concentration of 75 or 150 ppm were sown on the first March in both studied seasons (2007 and 2008) in plastic pots (15 cm diameter) filled with peatmoss, vermiculate and clean sand at the ratio of 1:1:1 by volume. Four seeds were sown in each pot.

The experiment was set in a complete randomized design with five replicates. The replicate contained 30 pots, each 5 pots were assigned for one treatment. The treatments were six as follows:

1-Control, seeds were stored at room temperature for three months and then soaked in distilled water for 24 hours just before sowing on the first March.

2- Stored seeds at room temperature were soaked in 75 ppm GA_3 solution for 24 hours just before sowing on the first March.

3- Stored seeds at room temperature were soaked in a solution containing 150 ppm GA_3 for 24 hours just before sowing.

4- Seeds were subjected to cold stratification at 4°C for three months and then soaked in distilled water for 24 hours just before sowing on the first March.

5- Stratified seeds were soaked in a solution containing 75 ppm GA_3 for 24 hours just before sowing on the first March.

6- Stratified seeds were soaked in a solution containing 150 ppm GA_3 for 24 hours just before sowing.

All pots received adequate rates from NPK fertilizers as recommended.

2.3. Observations and data recording

Keen observations on germinated seeds and seedling growth were followed up to six months from sowing date.

After one month from sowing date, germinated seeds were counted and percentages of seed germination under different treatments were calculated. At the age of six months from sowing date, 15 randomly plants from each treatment (3 from each replicate) were lifted from pots for recording the characters of vegetative growth and thereafter for physiological studies. The

determined characters of vegetative growth include hypocotyl length (mm) and plant height (mm). For physiological studies, photosynthetic pigments were determined quantitatively in fresh leaves. Chlorophyll a, chlorophyll b and carotenoids were extracted by using dimethyl formamide and determined according to Nornai (1982) as mg/g fresh weight of magnolia leaves.

2.4. Statistical analysis

Data on seed germination percentage and on vegetative growth characters as well as on photosynthetic pigments were subjected, in each studied season, to conventional methods of analysis of variance according to Snedecor and Cochran (1982). The least significant difference (L.S.D.) at 0.05 level was calculated for each investigated character under different assigned treatments.

2.5. Anatomical studies

For anatomical investigations, specimens from branches and mature leaves, which were collected during summer season of 2008, were killed and fixed for one week in F.A.A. solution, dehydrated in a normal butyl alcohol series and embedded in paraffin wax. Transverse sections which were cut on a rotary microtome to a thickness of 20 micr-ometers were stained with crystal violet / erythr- osin before mounting in Canada balsam (Nassar and El-Sahhar, 1998). Slides were examined microscopically and photomicrographed.

3. RESULTS AND DISCUSSION

3.1. Germination of seeds and seedling growth

Magnolia seeds are gathered in the fall as soon as possible after the fruit is ripe, when the red seeds are visible all over the fruit. The red pulp on magnolia seed acts as an inhibitor to germination, so cleaning is very important. After cleaning, the seeds should be kept in sealed containers at 4°C for three months prior to spring planting. Allowing the seeds to dry out during storage seems to be harmful. Magnolia seeds lose their viability if stored through the winter at room temperature. Thus, seed stratification is necessary before subjecting to germination because of chilling requirements.

Seeds imbibe water as a first step in the sequence of events leading to germination. As a result, the seed coat is softened and swells then burst at the basal end of the seed. This lasted 8 to 10 days from sowing. As germination proceeds, the structure of the seedling soon becomes evident. The radicle emerges from the lower end where the seed has been bursted. This takes about 15 to 18 days from sowing. Seed germination of magnolia is epigeal (Fig. 1), the hypocotyl elongates and raises the two cotyledons above the ground accompanied by the partially enveloping remains of the seed. This almost takes place 25 to 30 days after sowing. The hypocotyl is some what bent in its growth before emergence above the soil, then becomes straight and the two cotyledons take an accumbent position towards the age of 45 days. The completely developed cotyledons are almost narrowly lanceolate each averaged 21 mm in length and 4 mm in width, green in colour and have pinnately netted venation and a complete margin. The whole length of the seedling averaged 10 cm. The radicle averages 6.5 cm long and the hypocotyl is some 3.5 cm. Worthy to note that the secondary roots developed at the age of three weeks.

By now, the plumule is also upward and starts a slow development to produce the shoot. It is clear that the growth habit of magnolia plant is very slow since the first foliage leaf is developed when plants aged two months. At the age of four months another two foliage leaves are developed (totalling three) and the two cotyledons still intact (Fig. 2). The internodes are easily detected, being three in number and averaged 9 mm in length. When plants aged six months (the end of the experiment), the number of developing leaves ranges from 4 to 5 and the two cotyledons still intact. The foliage leaf is simple and almost broadly ovate with smooth margin and have pinnately netted venation.

3.2. Botanical description of magnolia stand trees

The external morphology of stand trees was investigated through keen observations and specimen collection during late spring, summer and autumn seasons of the two years 2006 and 2007 from stand trees of magnolia located at the Zoological Garden (Fig. 3).

Magnolia grandiflora L. is considered one of the most beautiful evergreen trees with straight trunk, conical crown and very fragrant large white flowers. It is in leaf all year, in flower from late spring to all summer and the seeds ripen in autumn. Magnolia is a long – lived tree that will grow 18-21 m in height with a trunk up to 60-70 cm in diameter. The trunk is typically straight and erect with spreading branches that form a dense, broadly pyramidal crown, being 9-11 m wide. Twigs covered with rust coloured hairs when young, but become smooth and stay rusty with age. Bark is fragrant and bitter, gray to brown in colour, smooth when young but becomes lightly furrowed into close, flat plates or scales. Leaves are large, evergreen, alternate, simple and broadly ovate, 12-20 cm long and 6-12 cm broad, thick

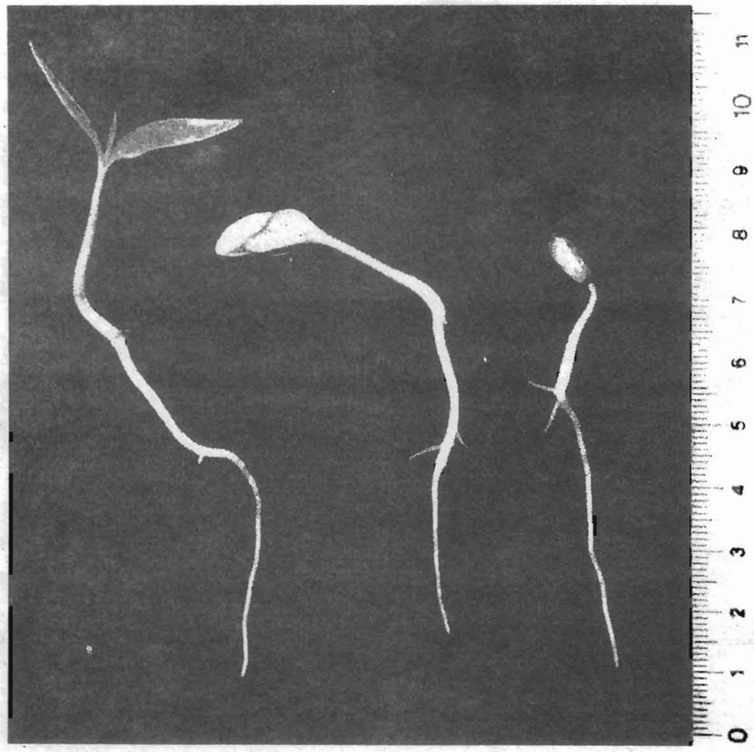

Fig. (1): A photograph representing different stages of seedling growth of *Magnolia grandiflora* L. showing its epigeous pattern of growth where the two cotyledons are brought above the soil and take an accumbent position towards the age of 45 days.

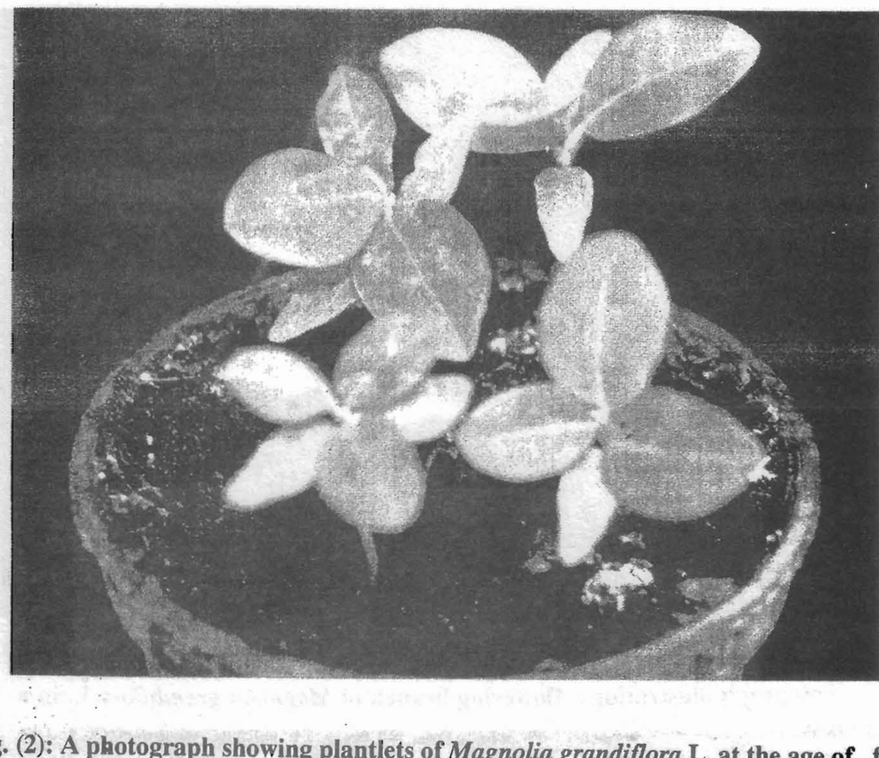

Fig. (2): A photograph showing plantlets of *Magnolia grandiflora* L. at the age of four months. At this age, three simple foliage leaves developed and the two cotyledons still intact.

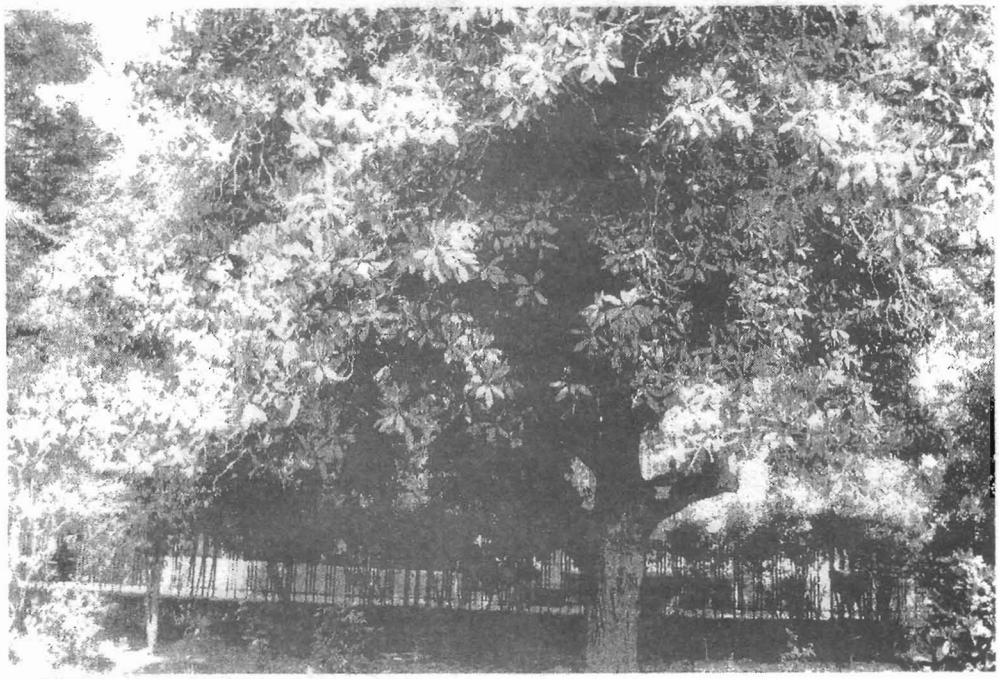

Fig. (3): A photograph showing the habit of *Magnolia grandiflora* L. stand tree, aged 80 years, grown in the Zoological Garden at Giza, Egypt.

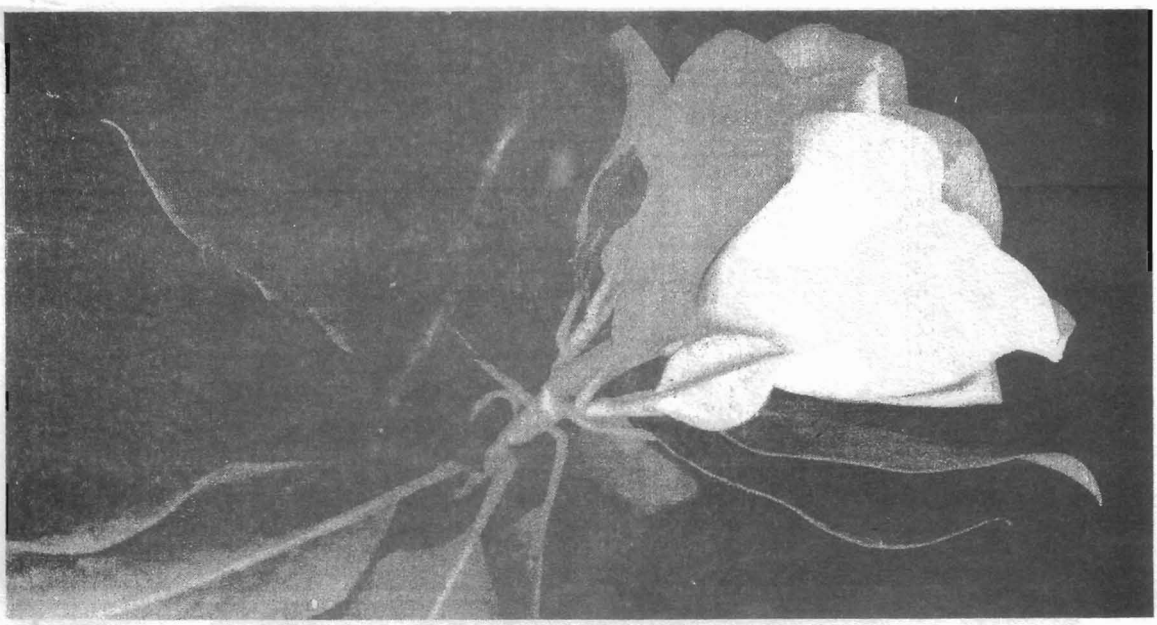

Fig. (4): A photograph illustrating a flowering branch of *Magnolia grandiflora* L. in a side view.

and firm with edges slightly turned under. Stiff, leathery, shiny-green above and rusty tomentose beneath. Stout leaf stalk with rust-coloured hairs.

Magnolia has large showy white flowers (Figs. 4 and 5) that are 20-25 cm in diameter, cup-shaped, possess 3 white sepals and 6-12 or more petals (18) which are creamy white in colour. The flowers are hermaphrodite and pollinated by beetles. Each flower is on a stout hairy stalk, solitary at end of twig. Magnolia flowers are very fragrant and appear in late spring and all summer (almost from May till August). The magnolia is a very primitive type of flower because all the floral parts are spirally arranged. In the center of magnolia blossom, numerous pistils spiral about a cone shaped receptacle, and below them a great many stamens are similarly arranged (Fig. 6). The pistils mature into a tight cluster of fruits and each individual fruit splits along one side; *i.e.,* each pistil will mature into a follicle. A follicle is a dry fruit that open along one side and develops from a single pistil. This releases one to two fleshy, scarlet-coated seeds (seeds with a sarcotesta) which dangle on slender threads.

The fruits are reddish-brown cone like structures, 5-10 cm long, with bright red kidney shaped seeds (Fig. 7) that hang from little threads when fully mature in autumn. The seeds are exposed September through November and the fruits fall in November and December.

3.3. Anatomy of vegetative organs

3.3.1. Anatomy of a branch

The anatomical structure of a branch was investigated in the form of transverse sections (Fig. 8). It is clear that the branch surface is nearly cylindrical in outline. The secondary growth increases the amount of vascular tissues although the epidermis is still intact. The epidermis consists of one layer, the epidermal cells are relatively small in size, nearly square in shape, often silicified, the outer walls are distinctly cutinized and possess relatively thick cuticle. Unicellular sclerified simple hairs are common in the epidermis.

The cortex is generally broad and composed of about 15 layers of which the outer 5 layers are compact collenchyma and the rest are parenchyma. Secretory cells are common in parenchymatous tissue. Nearly a complete circle of stone cells comprised of about 3 layers are present around the vascular cylinder abutting the phloem.

The xylem and phloem of adjacent vascular strands usually sufficiently separated by conspicuous medullary rays to appear as distinct vascular bundles in transverse sections. The branch is woody with typical secondary growth, the cambium producing xylem toward the inside and phloem toward the outside. Secondary growth takes place in nearly a continuous cylindrical form, especially the secondary xylem which consists of vessels arranged in radial rows. Medullary rays usually up to 3 cells wide.

The pith is generally broad and consists of thin-walled large polygonal parenchyma cells. Secretory cells with mucilaginous or oily contents are frequent in parenchymatous tissue of the pith. Also, calcium oxalate occurs as small octahedral or prismatic crystals.

3.3.2. Anatomy of leaf blade

Transverse sections through a leaf blade of *Magnolia grandiflora* L. were examined. Photomicrographs illustrating blade structure are shown in Figure (9). The upper epidermis is uniseriate, composed of a row of compactly – set tabular cells, often silicified, the outer walls are distinctly cutinized (sometimes suberized) and possess relatively thick cuticle. The lower epidermis is also uniseriate. Stomata are usually confined to the lower surface of the leaf. Also, unicellular sclerified simple hairs are present only on the abaxial surface. Hypoderm, often of one layer, occasionally present beneath the upper epidermis.

Leaves are distinctly dorsiventral where the mesophyll is differentiated into columnar palisade parenchyma on the adaxial side and irregular spongy parenchyma on the abaxial one. The palisade tissue consists of two to three layers of chlorenchyma cells which elongated perpendicular to the surface of the blade and occupies almost one-third of the whole thickness of the mesophyll. The spongy tissue is composed of four to five layers of chlorenchymatous loosely arranged cells with many wide intercellular spaces.

The midrib is slightly concave at adaxial surface and being strongly rounded at abaxial one. At the centre of the midrib region there is a circle of six separated collateral bundles embedded in parenchymatous tissue. Secretory cells with mucilaginous or oily contents are common in parenchymatous tissue.

As far as the authors are aware no detailed study dealing with the anatomical structure of vegetative organs of *Magnolia grandiflora* L. was carried out. However, Metcalfe and Chalk (1979) stated that the stem is woody with typical secondary growth and vessels tending to be in radial groups. Secretory cells with mucilaginous

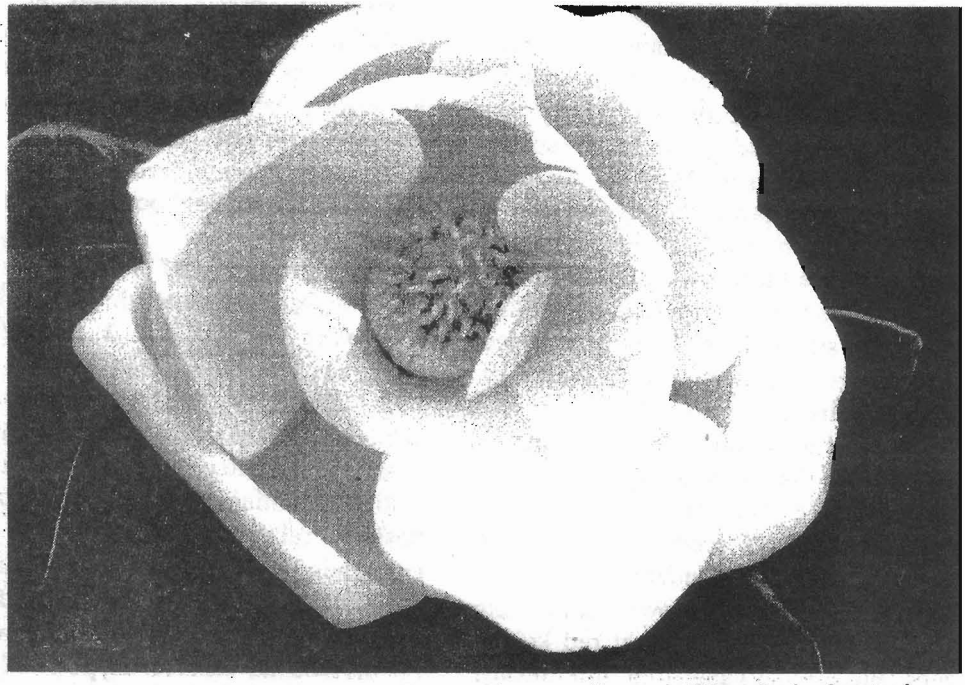

Fig. (5): **Fig. (5): A photograph showing a flower of *Magnolia grandiflora* L. in front view (from (from above).**

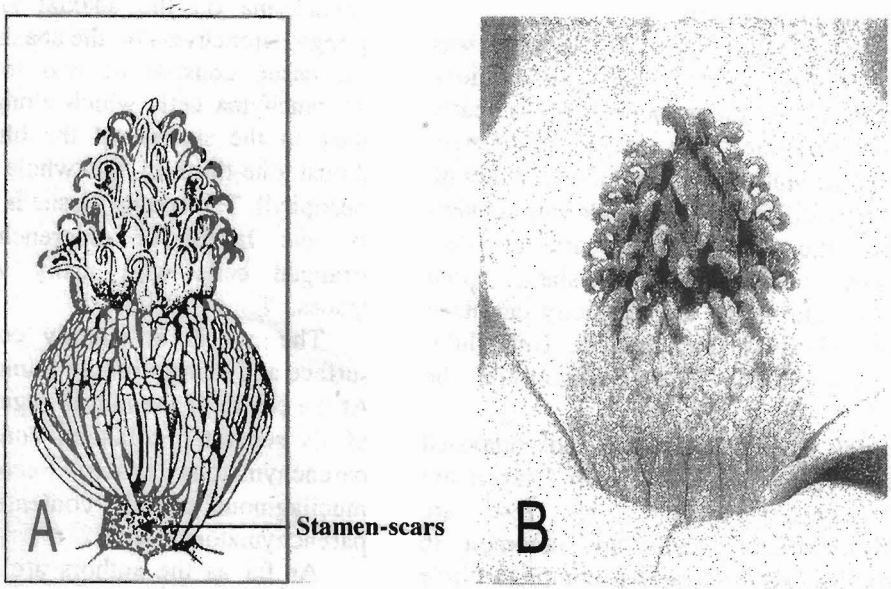

Fig. (6): Diagramatic (A) and photograph (B) illustrating sexual organs, stamens and carples of *Magnolia grandiflora* L. flower, spirally arranged.

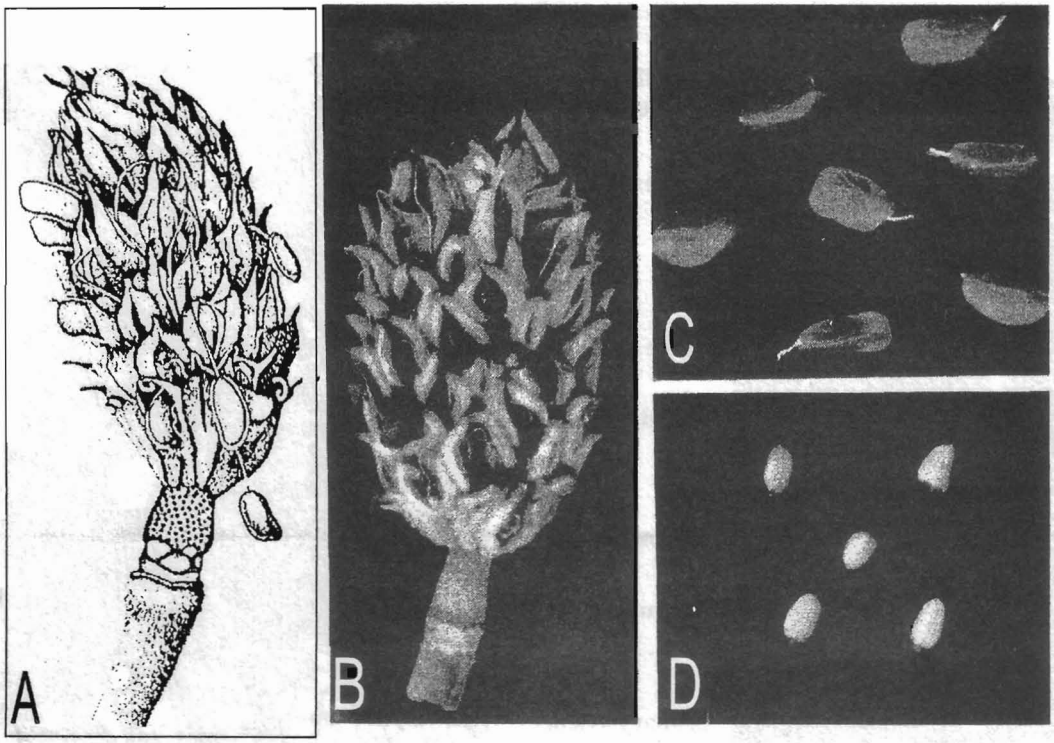

Fig. (7): Diagramatic and photographs illustrating a fruit and seeds of *Magnolia grandiflora* L.

A- Diagramatic fruiting head of carples.

B- A photograph showing multi-fruited conelike structure (aggregate of follicles).

C- A photograph showing mature fleshy scarlet-coated seeds.

D- A photograph showing seeds after removing red pulp (sarcotesta).

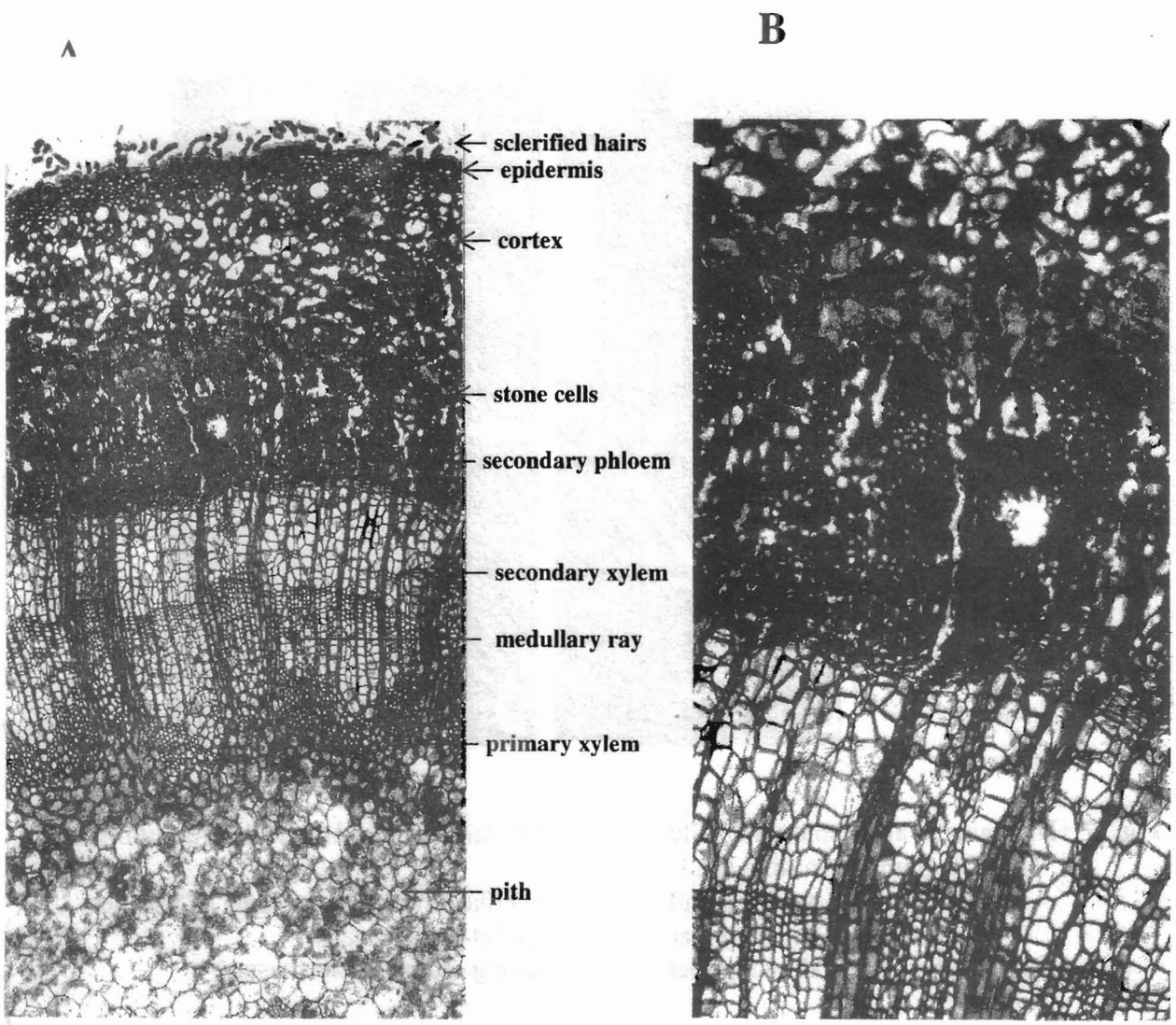

Fig. (8): Transverse sections of a branch of *Magnolia grandiflora* L.
A- Sector of a section. **(X 52)**
B- Magnified portion of (A). (X 144)

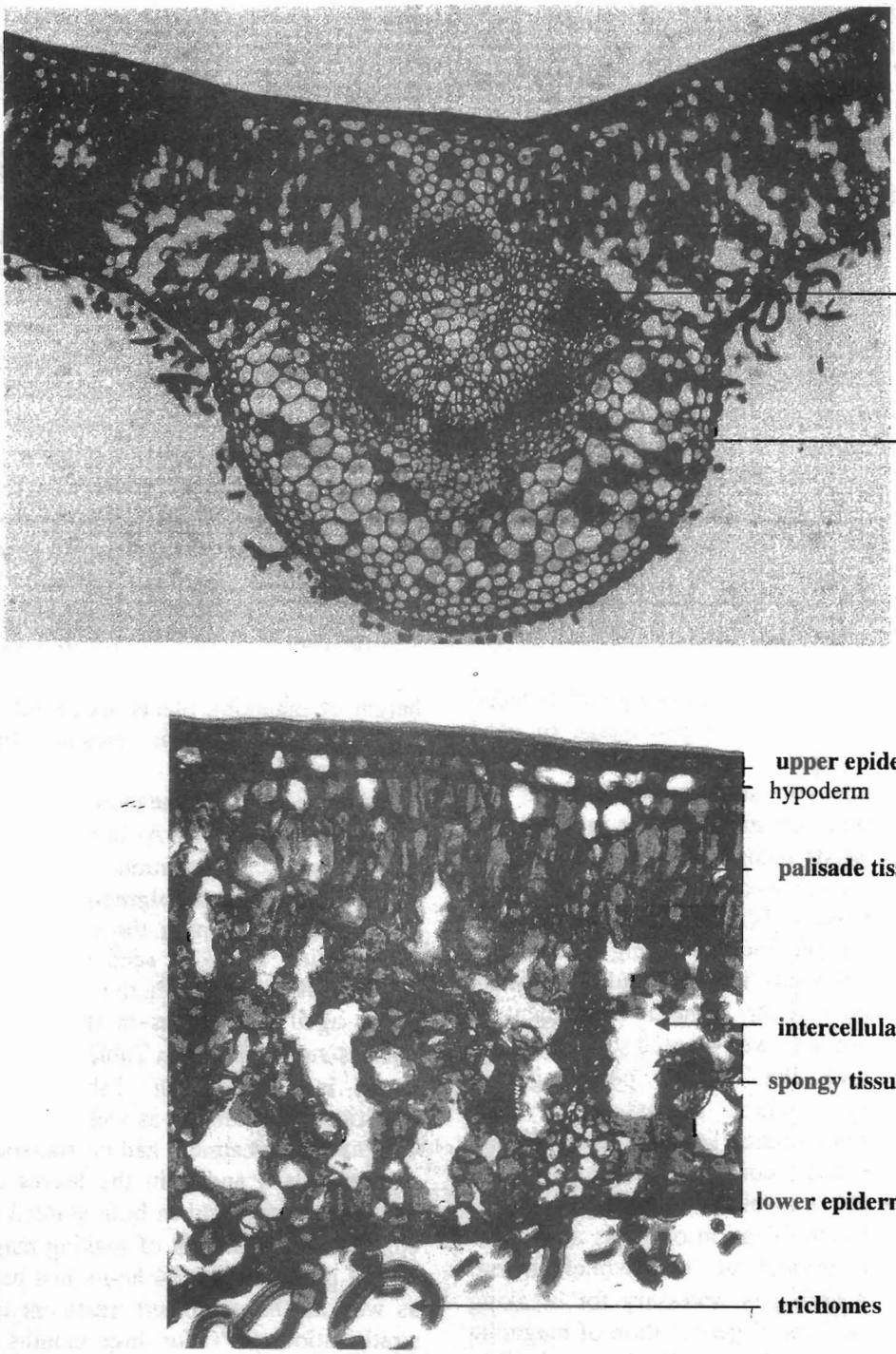

Fig. (9): Transverse sections through a leaf blade of *Magnolia grandiflora* L.
A- Whole section (X 52)
B- Magnified portion of A. (X 144)

or oily contents are very frequent especially in arenchymatous tissues. Leaves are usually dorsiventral. Epidermis silicified with unicellular hairs. Hypoderm is present below the upper epidermis and stomata confined to the lower surface. These results are generally in agreement with the present findings.

3.4. Effect of seed cold stratification and / or seed soaking in GA_3 on germination percentage, vegetative growth and photosynthetic pigments

3.4.1. Percentage of seed germination

The effects of seed cold stratification and / or seed soaking in GA_3 on the percentages of seed germination of *Magnolia grandiflora* L. are presented in Table (1).

Data given in Table (1) clearly show that seeds stored at room temperature for three months through the winter before germination in spring (control treatment) recorded the lowest percentage of seed germination in both studied seasons, being 18 and 19% in the first and second seasons, respectively. At the same time, all adopted treatments [cold stratification of seeds at 4°C for three months prior to spring planting and / or soaking seeds in various concentrations of GA_3 (75 or 150 ppm) for 24 hours just before germination] enhanced germination of magnolia seeds; *i.e.,* breaking seed dormancy and induced significant increases in the percentage of seed germination. Comparing individual treatments, it was observed that cold stratification of seeds was the best treatment than soaking seeds in GA_3.

Stratified seeds recorded a percentage of 65 and 68% germinated seeds in the first and second seasons, respectively. Whereas, soaking seeds in GA_3 recorded a percentage ranging from 36 to 43% germinated seeds in both studied seasons. Worthy to note that the combined treatment of seed stratification followed by seed soaking in 150 ppm GA_3 gave the highest percentage of germinated seeds which surpassed all other treatments in both studied seasons, being 73 and 76% in the first and second seasons, respectively.

From the above mentioned results, it could be stated that cold stratification of seeds at 4°C for three months throughout the winter before germination in spring is necessary for breaking dormancy and enhanced germination of magnolia seeds. Moreover, soaking stratified seeds in GA_3 at a concentration of 150 ppm for 24 hours just before sowing induced significant increase in the percentage of seed germination more than that recorded by cold stratification treatment alone. Similar results were reported by Yong *et al.* (1991) and by Mahmoud (2001). These results could be explained by the fact that cold stratification treatment could minimize, or in some cases prevent, the formation of abscisic acid (ABA) which inhibited seed germination. At the same time, cold stratification increased the concentration of endogenous gibberellins which opposed the inhibitory effect of ABA (Davies, 1987). Thus, exogenous applications of gibberellins can replace at least a part of the chilling requirement for such kind of seed dormancy.

3.4.2. Vegetative growth characters

Data pertaining to the effects of seed cold stratification and / or seed soaking in GA_3 on the length of hypocotyl and plant height of magnolia plants six months old are given in Table (2).

It is realized from Table (2) that seed cold stratification at 4°C for three months prior to spring planting as well as seed soaking in 75 ppm GA_3 for 24 hours just before sowing showed no significant effect on hypocotyl length and height of magnolia plant aged six months in both studied seasons. Whereas, seed soaking in 150 ppm GA_3 for 24 hours just before sowing as well as the combined treatment of seed cold stratification at 4°C for three months followed by soaking stratified seeds in GA_3 at concentration of 75 or 150 ppm for 24 hours just before sowing induced significant increases in hypocotyl length and height of magnolia plants six month old in both studied seasons. The present findings are generally in harmony with those obtained by Mahmoud (2001). These increments in length may be due to the role of GA_3 in stimulating both cell division and cell elongation.

3.4.3. Photosynthetic pigments

Results concerning the effects of seed cold stratification and / or seed soaking in GA_3 on chloroplast pigments in the leaves of magnolia plants aged six months in the two investigated seasons are presented in Table (2).

It is noted from Table (2) that seed stratification treatment as well as seed soaking in 75 ppm GA_3 treatment had no statistical effect on chlorophylls a and b in the leaves of magnolia plants six month old in both studied seasons. By contrast, the treatment of soaking magnolia seeds in 150 ppm GA_3 for 24 hours just before sowing as well as the combined treatment of seed cold stratification at 4°C for three months followed by soaking stratified seeds in GA_3 at concentration of 75 or 150 ppm for 24 hours just before sowing induced significant increases in chlorophylls a and b of leaves of magnolia plant aged six months in both the seasons.

As to the effect on carotenoids, it is obvious that, in the first season, the combined treatment of eed cold stratification at 4°C for three months followed by soaking stratified seeds in GA_3 at

Table (1): Percentages of seed germination of *Magnolia grandiflora* L. as affected by seed cold stratification and / or seed soaking in GA_3 in two successive seasons

Treatments	Germination %	
	First season	Second season
Control	18	19
Soaking in 75 ppm GA_3	39	36
Soaking in 150 ppm GA_3	43	41
Cold stratification	65	68
Stratification + soaking in 75 ppm GA_3	64	69
Stratification + soaking in 150 ppm GA_3	73	76
L.S.D. $_{(0.05)}$	**4.87**	**5.26**

Table (2): The effect of seed cold stratification and / or seed soaking in GA_3 on vegetative growth characters and photosynthetic pigments in the leaves of *Magnolia grandiflora* L. plants aged six months in two successive seasons

Treatments	Vegetative growth characters		Photosynthetic pigments (mg/g. F. W.)		
	Hypocotyl length (mm)	Plant height (mm)	Chl. a	Chl. b	Carotenoids
First season					
Control	32	43	1.216	0.425	0.591
Soaking in 75 ppm GA_3	34	46	1.258	0.424	0.606
Soaking in 150 ppm GA_3	38	51	1.437	0.488	0.599
Cold stratification	33	45	1.291	0.437	0.608
Stratification + soaking in 75 ppm GA_3	40	54	1.496	0.506	0.648
Stratification + soaking in 150 ppm GA_3	41	55	1.498	0.497	0.652
L.S.D. (0.05)	**3.7**	**4.8**	**0.126**	**0.043**	**0.049**
Second season					
Control	35	48	1.167	0.416	0.578
Soaking in 75 ppm GA_3	38	51	1.211	0.421	0.593
Soaking in 150 ppm GA_3	42	56	1.368	0.482	0.576
Cold stratification	36	49	1.235	0.429	0.582
Stratification + soaking in 75 ppm GA_3	44	58	1.441	0.499	0.605
Stratification + soaking in 150 ppm GA_3	43	59	1.429	0.505	0.611
L.S.D. (0.05)	**3.4**	**5.1**	**0.121**	**0.048**	**N.S.**

concentration of 75 or 150 ppm for 24 hours caused a significant increase in carotenoid concentration in leaves of magnolia plants six month old. Whereas, in the second season all adopted treatments showed no significant effect on carotenoids concentration in leaves of magnolia plants six month old.

The present findings are generally in accordance with those recorded by Mahmoud (2001). These findings could be attributed to the role of GA_3 in enhancement of growth rate as a result of an increase in effective leaf area as well as to the role of GA_3 in enhancement of ultrastructural morphogenesis of plastids and to the increases induced in concentration of photosynthetic pigments (Arteca, 1996).

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دراسات نباتية وكسر كمون البذرة للماجنوليا

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ملخص

أجرى هذا البحث على الماجنوليا التى تعد واحدة من أجمل أشجار الزينة، التابعة للفصيلة الماجنولية، بسبب أزهارها الرائعة العاجية اللون ذات الرائحة العطرية وأوراقها الكبيرة الدائمة الخضرة. لذلك ولأهميتها الطبية أيضا هدفت هذه الدراسة إلى إلقاء الضوء على المزيد من المعلومات عن الصفات النباتية للأشجار البالغة النامية فى مصر حيث اشتملت الدراسة على وصف دقيق لأشجار الماجنوليا من حيث الارتفاع والجذع والقلف والافرع وانتشارها والاوراق والازهار والثمار والبذور وإنباتها وتطور تكوين البادرة، هذا بالإضافة إلى دراسة التركيب التشريحى للأوراق البالغة والأفرع . كما أشتملت الدراسة أيضا على كسر كمون البذور بواسطة التنضيد البارد أو النقع فى محاليل تحتوى على تركيزات مختلفة من حمض الجبريلليك، هذا بالإضافة إلى تأثير هذه المعاملات على النمو الخضرى ومحتوى الاوراق من صبغات البناء الضوئى.

أوضحت النتائج المتحصل عليها أن تخزين البذور بعد جمعها لمدة ثلاثة شهور على درجة حرارة منخفضة (٤° م) خلال فصل الشتاء قبل إنباتها فى بداية الربيع كان ضروريا وفعالا فى كسر كمون البذور وزيادة نسبة الإنبات. كما ثبت أن نقع البذور السابق تنضيدها على البارد فى محلول يحتوى على ١٥٠ جزء فى المليون من حمض الجبريلليك لمدة ٢٤ ساعة قبل الزراعة مباشرة أدى إلى حدوث زيادة معنوية فى نسبة إنبات البذور مقارنة بمعاملة التنضيد على البارد فقط، كما أدت هذه المعاملة أيضا إلى حدوث زيادة ملموسة فى محتوى أوراق النباتات عند عمر ٦ شهور من صبغات البناء الضوئى.

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