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PRODUCTION OF VIGOROUS TRANSPLANTS IN *Swietenia mahogani* (L.) Jacq . BY USING GA_3

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ABSTRACT

The current investigation was carried out during the two successive seasons of 1998/1999 and 1999/2000 in order to enhancement seed germination and produce vigorous transplants in Spanish mahogany by different methods of application with GA_3. Therefore , seeds of Spanish mahogany were soaked in different concentrations of GA_3 (0.0, 50 , 100 , 200 and 400 ppm) or plants , three months old , were sprayed with 25 , 50 and 100 ppm GA_3.

The percentage of seed germination , vegetative growth characters , photosynthetic pigments , total sugars , endogenous phytohormones and stem anatomy of *Swietenia mahogani* (L.) Jacq.as affected by GA_3 treatments were investigated . The obtained results revealed that all seed soaking treatments increased the percentage of seed germination in both studied seasons and maximum significant increase was recorded at 400 ppm GA_3 which in turn being statistically indifferent with that of 200 ppm GA_3 . Also , it was found that different methods of GA_3 application had , in general , beneficial effects on all studied characters of vegetative growth (plant height , total leaf area/plant and fresh and dry weights of shoot / plant) . The maximum beneficial effect was obtained at foliar application with 50 ppm GA_3 which induced vigorous growth in both studied seasons . It is realized that seed soaking treatments as well as foliar application treatments with GA_3 increased chloroplast pigments , total sugars and endogenous IAA and GA_3 in leaves of Spanish mahogany , 10 months old ,. Whereas , endogenous ABA was decreased in this respect . Worthy to note that among seed soaking treatments , 400 ppm GA_3 was the promising concentration . While , among foliar application treatments , 50 ppm GA_3 was the best concentration in this concern . Moreover , it was found that foliar application with 50 ppm GA_3 caused considerable thickness of main stem by increasing the thickness of all included tissues. Thickness of periderm , cortex , phloem tissue and xylem tissue as well as pith diameter were increased in treated plants .

Keywords: GA_3, mahogany , vegetative growth , physiology ,anatomy.

INTRODUCTION

Gibberellins and other growth regulators are effectively used for controlling the size of plants , flowering and fruit set . Application of these substances are found useful and are extensively employed for promoting certain beneficial characters . So far 55 different gibberellins are known to occur in plants as native plant hormones . One of the most widespread gibberellins , and the most potent in numerous assays,is GA_3, gibberellic cutting, the first gibberellin to be discovered (Street and Opik, 1984). Many investigators refer to the stimulatory effect of soaking seeds of many species, especially those of woody plants , in GA_3 to enhance seed germination and produce vigorous seedling growth (El–Tarawy *et al* ., 1980; El – Banna *et al* ., 1981 ; Nofal *et al* ., 1981 ; Nofal *et al* ., 1983 ; El-Keiy *et al*., 1985 ; Singh and Murty , 1987 ; Singh , 1989 and Emam, 2000) .

Swietenia mahogani (L.) Jacq . , the West Indies or Spanish mahogany , the subject of the present investigation is the true mahogany which belongs to the family Meliaceae which might be termed the mahogany family (Cronquist , 1981) . Spanish mahogany , found in the Florida keys and the West Indies , was the first known and the first to be exploited . It has been introduced into Central America and other tropical countries . It is a scaly-barked tree of 25 m. The wood is reddish brown in colour with a crooked grain . It is very heavy , strong , hard enough to resist indentations , yet easy to work , and it polishes and glues well . It is one of the most highly esteemed in the world for cabinet making (Hill , 1952 and Metaclfe and Chalk , 1979) . *Swietenia mahogani* is an ornamental tree which may be planted successfully in Egypt to be used as wood source for the useful wood works and decrease our needs imported from the foreign countries (Abdel – Dayem ,1988).

Thus, the present research was designed to disclose the influence of GA_3 on seed germination and seedling growth of *Swietenia mahogani* (L.) Jacq. The effect on photosynthetic pigments, sugar content , phytohormones and stem anatomy was also investigated .

MATERIALS AND METHODS

The current investigation was carried out in plastic green – house of Agricultural Botany Department at the Agricultural Experiments and Researches Station , Faculty of Agriculture , Cairo University , Giza , Egypt, during the two successive seasons of 1998 / 1999 and 1999/2000 in order to enhancement seed germination and produce vigorous transplants in Spanish mahogany by different methods of application with GA_3 .

Source of seeds and GA_3 :

Seeds of *Swietenia mahogani* (L.) Jacq . were collected from fully ripe fruits , during the last two weeks of April and the first two weeks of May in the two studied seasons (98/99 and 99/2000) , from marked mother plus trees , about 70 years old , grown in Zoological Garden at Giza .

GA_3 was obtained commercially as Berelex tablets from the Imperial Chemical Industries Ltd ., England (ICI) . Each tablet contain one –gram active ingredient . Four concentrations ; namely 50 , 100 , 200 and 400 ppm were used as seed soaking. Also , three concentrations (25,50 and 100 ppm) were used as spray application beside the control (0.0 , using tap water) .

Procedure of the experiment :

Seeds of Spanish mahogany were soaked in different concentrations of GA_3 (0.0 , 50 , 100 , 200 or 400 ppm) for 24 hours . Seeds of each treatment were then sown in plastic trays, 40 × 60 cm, filled with peatmoss and clean sand at the ratio of 1 : 1 by volume . Seeds were sown on 26th May , 1998 in the first season and replicated on 24th May , 1999 in the second one to provide the experimental plant materials .

Three weeks from sowing date , germinated seeds were counted and germination percentage of each treatment was estimated. At the age of two months , the emerged seedlings were transplanted to plastic pots , one

seedling per pot , (30 cm diameter) filled with clay and sand at the ratio of 1 : 1 by weight . Each pot was received NPK at the recommended rates . At the age of three months (one month from transplanting), seedlings obtained from seeds soaked in tap water were subjected to foliar application with GA_3 at concentrations of 0.0 (tap water) , 25 , 50 or 100 ppm . The experiment was made in a randomized complete block design with four replicates . The replicate contained 48 pots ,each 6 pots were assigned for one treatment . The treatments were:

1- Control (0.0) , using tap water in soaking seeds or in spraying seedlings .
2- Seeds were soaked in 50 ppm GA_3 .
3- Seeds were soaked in 100 ppm GA_3 .
4- Seeds were soaked in 200 ppm GA_3 .
5- Seeds were soaked in 400 ppm GA_3 .
6- Seeds were soaked in tap water and seedlings , three months old , were sprayed with 25 ppm GA_3 .
7- Seeds were soaked in tap water and seedlings , three months old, were sprayed with 50 ppm GA_3 .
8- Seeds were soaked in tap water and seedlings , three months old , were sprayed with 100 ppm GA_3 .

Recording of data :

At the age of ten months from sowing date , plants were lifted from pots for recording the characters of vegetative growth and for physiological studies. The determined characters of vegetative growth includes :

1- Plant height (cm.) .
2- Total leaf area (cm^2) per plant .
3- Fresh weight of shoot (g) per plant .
4- Dry weight of shoot (g) per plant .

For physiological studies , photosynthetic pigments,sugars and phytohormones were determined quantitatively in leaves of treated and untreated plants in the second season of 1999/2000 at the age of ten months from sowing date . Photosynthetic pigments (chlorophyll a , chlorophyll b and carotenoids) were extracted by using dimethyl formamide and determined accroding to Nornai (1982) as mg/g fresh weight of mahogany leaves . Total sugars was determined by using phenol – sulphoric method according to Dubois *et al* . (1956) as mg/g fresh weight of mahogany leaves . Phytohormones (IAA , GA_3 and ABA) were measured in methanol extract of mahogany leaves according to the method described by Vogel (1975) . Phytohormones were determined as µg/100g fresh weight .

Anatomical studies :

It was intended to carry out a comparative microscopical examination on plant material which showed the most prominent response of plant growth to investigated treatments . Specimens were taken from the median internode of the main stem throughout the second season of 1999/2000 at the age of six months from sowing date . Specimens were killed and fixed for one week in F.A.A. solution , washed in 50 % ethyl alcohol , dehydrated in normal butyl alcohol series and embedded in paraffin wax of melting point 56 °C , sectioned to a thick of 20 microns , double stained with crystal violet –

erythrosin, cleared in xylene and mounted in Canada balsam (Willey, 1971). Slides were examined microscopically and photomicrographed .

Statistical analysis :

Data on seed germination percentage and on vegetative growth characters were subjected 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 .

RESULTS AND DISCUSSION

I – Percentage of seed germination :

Germination percentages of Spanish mahogany seeds as affected by seed soaking in different concentrations of GA_3 are given in Table(1).

Table (1) : The effect of soaking seeds in different concentrations of GA_3 on germination percentages of *Swietenia mahogani* (L.) Jacq. seeds

GA_3 concentration (ppm)	Germination %	
	First season	Second season
0.0	39.2	37.5
50	43.6	42.8
100	56.4	59.3
200	75.5	74.6
400	80.9	81.1
L.S.D. (0.05)	6.77 %	8.13 %

It is clear from Table (1) that all assigned concentrations of GA_3 increased the percentage of seed germination and the significant increase was detected at 100 ppm GA_3 in both studied seasons . The maximum increase was recorded at 400 ppm GA_3 being 106.4 and 116.3 % more than the control in the first and second season ; respectively . It is worthy to note that the difference between the treatment of 200 and that of 400 ppm GA_3 proved insignificant in both seasons .

In this respect , Singh (1989) soaking seeds of *Cassia glauca* Lamb . for 24 hours in GA_3 at concentrations of 0.0 , 50 , 100 , 200 or 500 ppm , found that seed germination tended to be greater at the lowest concentrations of 50 or 100 ppm GA_3 . Also , Emam (2000) found that seed germination of *Taxodium distichum* (L.) Rich . tended to be higher when seeds were soaked in 400 ppm GA_3 for 24 hours . Hastening seed germination with GA_3 may be due to the stimulating effect of this growth regulator upon enzyme activities which resulted in the increase in percentage of seed germination.The enhancement of seed germination by GA_3 could be attributed also to the stimulating effects of GA_3 which modified the relation between inhibitors and activators ; i.e., the addition of GA_3 caused the decrease of ABA and increased the endogenous production of GA_3 in germinated seeds(El-Keiy *et al.*,1985).

II – Vegetative growth characters :

Data on vegetative growth characters of Spanish mahogany seedlings are presented in Table (2) .

Table (2) : The effect of different concentrations of GA_3 with different methods of application on vegetative growth characters of *Swietenia mahogani* (L.) Jacq . plants , 10 months old , in two successive seasons

Methods of GA_3 application	Concentrations of GA_3 (ppm)	Characters of vegetative growth			
		Plant height (cm)	Total leaf area (cm)^2 / plant	Shoot fresh weight (g) / plant	Shoot dry weight (g) / plant
First season of 1998 / 1999					
Control	0.0	37.4	337.8	5.38	1.86
Seed soaking	50	38.6	341.2	5.44	1.87
	100	40.4	364.7	5.87	1.98
	200	47.2	412.2	6.68	2.27
	400	48.5	419.6	6.72	2.31
Foliar application	25	46.8	418.3	6.64	2.26
	50	54.9	486.2	7.28	2.57
	100	66.7	417.9	6.71	2.29
L.S.D. (0.05)		**5.6**	**44.8**	**0.51**	**0.23**
Second season of 1999 / 2000					
Control	0.0	41.7	395.7	6.31	2.05
Seed soaking	50	40.8	402.2	6.42	2.11
	100	44.3	437.4	6.84	2.22
	200	51.9	496.5	7.96	2.49
	400	52.4	514.8	7.91	2.52
Foliar application	25	51.2	520.3	7.83	2.51
	50	58.7	608.2	8.72	2.82
	100	69.6	501.9	7.86	2.49
L.S.D. (0.05)		**6.1**	**52.7**	**0.68**	**0.26**

1- Plant height :

Data presented in Table (2) clearly show that the control plants recorded a plant height of 37.4 cm in the first season and 41.7 cm in the second one which proved statistical difference with most of the studied treatments. It is obvious that seed soaking in GA_3 at 50 or 100 ppm had no significant effect on plant height of Spanish mahogany plants , 10 months old , in both studied seasons . On the other hand , plant height showed significant increase , in both seasons , when seeds were soaked in 200 or 400 ppm GA_3 . Also , it is realized that all sprayed concentrations of GA_3 promoted significantly plant height and the height was significantly increased with increasing the concentration of GA_3 . The maximum increase in plant height was detected at foliar application with 100 ppm GA_3, being 78.3 and 66.9 % more than the control in the first and second season ; respectively .

2- Total leaf area per plant :

It is realized from Table (2) that soaked seeds of Spanish mahogany in 50 or 100 ppm GA_3 showed no statistical effect on total leaf area per Spanish mahogany plant,10 months old , in both studied seasons. Whereas , seed soaking in 200 or 400 ppm GA_3 induced significant increase in this respect . At the same time , foliar application with GA_3 at any of the assigned

concentrations increased significanlty total leaf area per plant of Spanish mahogany , 10 months old , in both studied seasons . The maximum increase in total leaf area per plant was recorded when plants were sprayed with 50 ppm GA_3 , being 43.9 % more than the control in the first season and 53.7 % more than the control in the second one .

3- Shoot fresh weight :

Results in Table (2) clearly show that seed soaking in 50 or 100 ppm GA_3 showed no effect on shoot fresh weight per plant of Spanish mahogany in both studied seasons . While , seed soaking in 200 or 400 ppm GA_3 caused significant increase in shoot fresh weight of Spanish mahogany plant , 10 months old , in any of the two studied seasons . It is noted that all test concentrations of foliar application with GA_3 promoted significantly shoot fresh weight of mahogany plant , 10 months old , in both studied seasons . The highest fresh weight 7.28 g in the first season and 8.72 g in the second one was recorded when mahogany plants were sprayed with 50 ppm GA_3 , being 35.3 and 38.2% more than the control in the first and second season ; respectively.

4- Shoot dry weight :

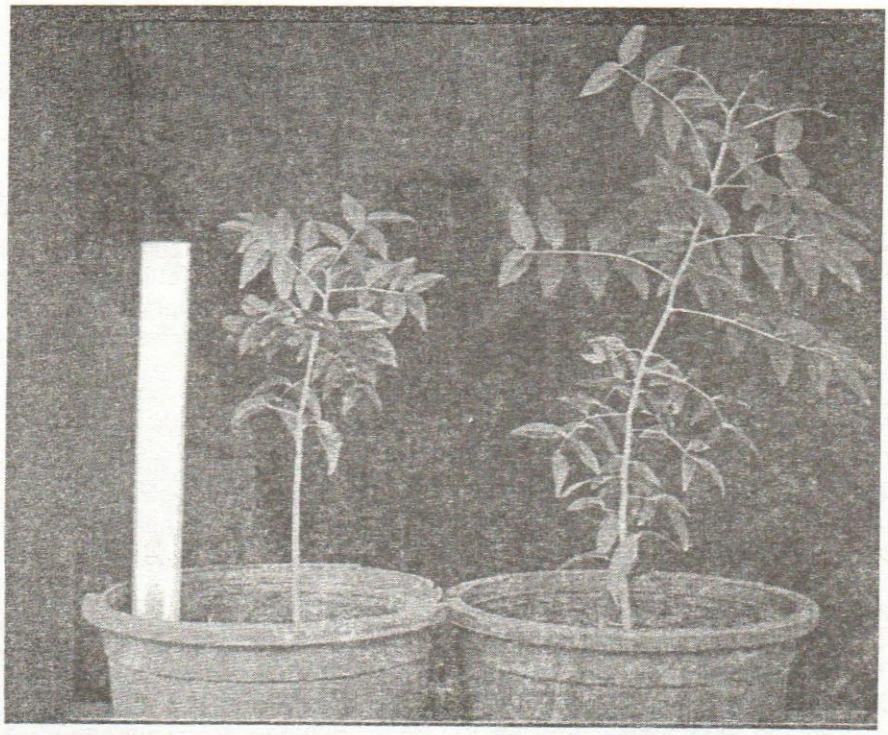
It is obvious that seed soaking in 50 or 100 ppm GA_3 had no statistical effect on shoot dry weight of mahogany plant in both studied seasons . Whereas , seed soaking in 200 or 400 ppm GA_3 increased significantly shoot dry weight in the two studied seasons . Also , all sprayed concentrations of GA_3 induced significant increases in this respect . The maximum increase in shoot dry weight was detected when plants were sprayed with 50 ppm GA_3 , being 38.2 % more than the control in the first season and 37.6 % more than the control in the second one .

From the aforementioned results concerning the effect of different concentrations of GA_3 with different methods of application (seed soaking or foliar application) on vegetative growth characters of *Swietenia mahogani* (L.) Jacq . , it could be stated that GA_3 , in general, had beneficial effect on characters of vegetative growth and the maximum beneficial effect was obtained at foliar application with 50 ppm GA_3 (Figure , 1) which induced vigorous growth in both studied seasons .

In this connection, other reviewers conformed these findings using GA_3 on other woody trees ; El – Tarawy *et al* . (1980) using *Phoenix canariensis* , Nofal *et al* . (1981) using *Pinus caribaea* , Singh and Murty (1987) using *Cassia fistula* L. , Singh (1989) using *Cassia glauca* and Emam (2000) using *Taxodium distichum* . All , being in accordance with the present findings .

III Physiological studies :

Photosynthetic pigments , total sugars and phytohormones were determined quantitatively in leaves of *Swietenia mahogani* (L.) Jacq . plants , 10 months old , as affected by different applications with GA_3 in the second season of 1999 / 2000 . Data on these constituents are given in Table (3) .



(A) (B)

Fig. (1): Habit of *Swietenia mahogani* (L.) Jacq. plants, ten months old , as affected by foliar application with GA_3.
A- Control plant .
B- Plant treated with 50 ppm GA_3.

Table (3) : The effect of different concentrations of GA_3 with different methods of application on photosynthetic pigments , total sugars and phytohormones of *Swietenia mahogani* (L.) Jacq. plants, 10 months old , in the second season of 1999/2000.

Methods of GA_3 application	GA_3 (ppm)	Photosynthetic pigments mg/g F.W.			Total sugars mg/g F.W.	Phytohormones µ g /100g F.W.		
		Chl.a	Chl.b	Carotenoids		IAA	GA_3	ABA
	0.0	2.416	0.837	1.105	7.331	14.317	19.707	12.770
Seed soaking	50	2.419	0.841	1.112	7.624	14.746	20.298	12.515
	100	2.427	0.846	1.118	7.881	15.176	20.692	12.259
	200	2.923	0.996	1.293	8.445	16.749	23.481	11.348
	400	3.021	1.029	1.348	8.392	16.894	23.845	10.855
Foliar application	25	2.803	0.945	1.268	7.994	19.328	28.772	9.152
	50	3.114	1.048	1.392	8.627	23.194	32.516	7.381
	100	2.819	0.939	1.315	7.893	26.673	36.114	4.926

1- Photosynthetic pigments :

Data shown in Table (3) indicate that soaking seeds of Spanish mahogany in 50 or 100 ppm GA_3 led to slight increases in chloroplast pigments (chlorophyll a , chlorophyll b and carotenoids) in leaves of mahogany plants , 10 months old , grown in the second season of 1999/2000. It is worthy to note that increasing GA_3 concentration from 100 to 200 or 400 ppm induced prominent increases in photosynthetic pigments , reaching its maximum with 400 ppm where chlorophyll a , chlorophyll b and carotenoids recorded 3.021 , 1.029 and 1.348 mg/g fresh weight in leaves of such treatment against 2.416 , 0.837 and 1.105 mg/g fresh weight in leaves of control plants ; respectively .

Data also indicated that all sprayed concentrations of GA_3 caused prominent increases in chloroplast pigments . The highest values (3.114 , 1.048 and 1.392 mg/g fresh weight for chlorophyll a , chlorophyll b and carotenoids ; respectively) were recorded at foliar application with 50 ppm GA_3. The present findings are generally in agreement with those obtained by Emam (2000) .

2- Total sugars :

It is realized from Table (3) that seed soaking treatments as well as foliar application treatments with GA_3 increased total sugars in leaves of Spanish mahogany plants 10 months old . It is obvious that , among all investigated treatments , foliar application with 50 ppm GA_3 gave the highest value of 8.627 mg total sugars per g leaves fresh weight followed by seed soaking treatment of 200 ppm GA_3 which recorded 8.445 mg total sugars per g leaves fresh weight against 7.331 mg total sugars per g leaves fresh weight of control plants. Similar results were also recorded by Emam (2000) .

3- Phytohormones :

Data presented in Table (3) clearly show that soaking seeds of Spanish mahogany in different concentrations of GA_3 (50 , 100 , 200 or 400 ppm) as well as spraying mahogany plants with different concentration of GA_3 (25 , 50 , or 100 ppm) increased endogenous IAA and GA_3 and decreased ABA concentrations in leaves of Spanish mahogany plants 10 months old . Worthy to note that , the rate of promotion as well as the rate of inhibition increased as the used concentration of GA_3 increased in both methods of application . The maximum promotion for endogenous IAA and GA_3 was recorded by foliar application with 100 ppm GA_3 followed by 50 ppm . Also , the maximum inhibition for endogenous ABA was detected at foliar application with 100 ppm GA_3 .

IV – Anatomical studies :

As inferred earlier throughout the investigation on vegetative growth , it was found that foliar application with GA_3 at 50 ppm showed prominent promotive effect on vegetative growth characters and induced vigorous transplants in Spanish mahogany . This may justify a further study on the

internal structure of the main stem of mahogany plants sprayed with 50 ppm GA_3 .

Microscopical measurments of certain characters in transverse sections through the median internode of the main stem of Spanish mahogany , six months old , as affected by foliar application with 50 ppm GA_3 in the second season of 1999/ 2000 are given in Table (4) . Likewise , microphotographs illustrating such treatment as well as the control are shown in Figure (2) .

Table (4) : Measurements in micron of some histological characters in transverse sections through the median internode of the main s tem , s ix m onths o ld , o f n ormal m ahogany p lants and of those sprayed with 50 ppm GA_3 .

(Means of three sections from three specimens)

Characters	Control plants	Plants sprayed with 50 ppm GA_3	± % to control
Stem diameter	3240	4078	+ 25.9
Thickness of periderm	276	340	+ 23.2
Thickness of cortex	194	219	+ 12.9
Thickness of phloem tissue	189	223	+ 18.0
Thickness of xylem tissue	592	754	+ 27.4
Pith diameter	738	1006	+ 36.3

It is clear from Table (4) and Figure (2) that GA_3 treatment caused considerable thickness of the main stem by increasing the internode diameter by 25.9 % more than the control . The increase in stem diameter due to GA_3 treatment could be attributed to the considerable increase in thickness of all included tissues . Thickness of periderm , cortex , phloem tissue and xylem tissue were increased in treated plants by 23.2 , 12.9 , 18.0 and 27.4 % more than the control ; respectively . Also , pith diameter was increased in treated plants by 36.3 % more than the control .

As far as the authoress is aware , information concerning anatomical structure of the main stem of Spanish mahogany plants as affected by foliar application with GA_3 are not available in the literature.

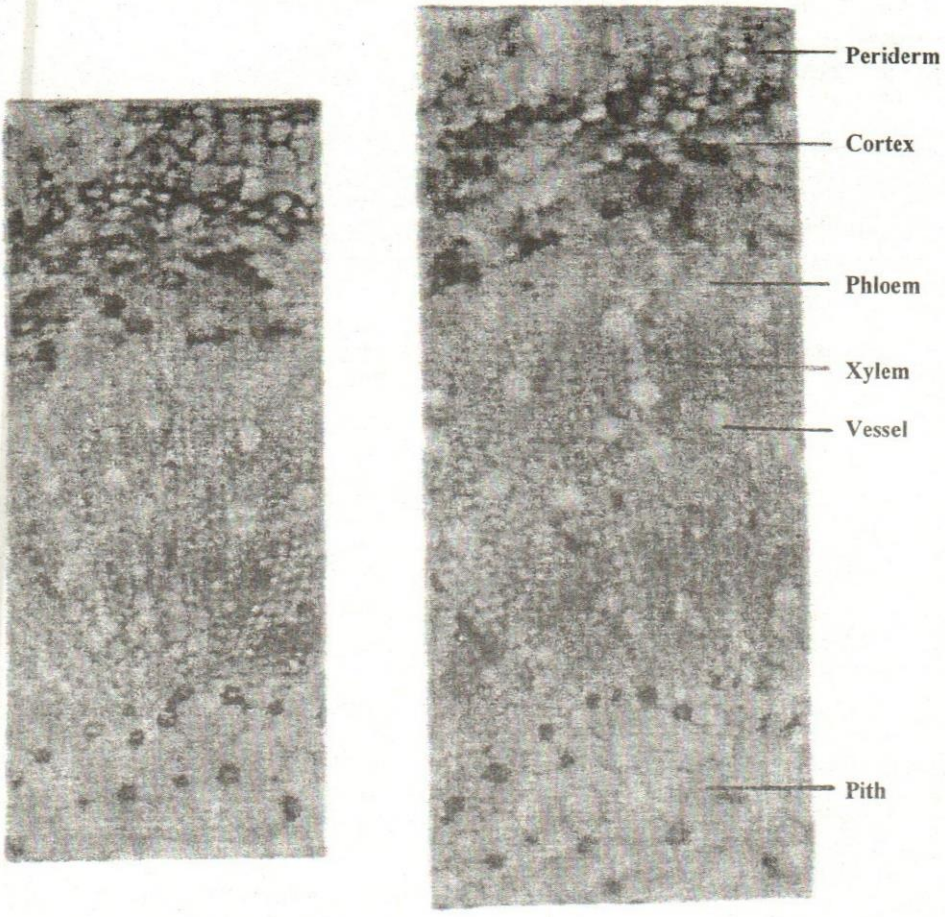


Fig.(2) : Transverse sections through the median internode of the main stem of *Swietenia mahogani* (L.) Jacq ., six months old , as affected by foliar application with GA_3.
A- Untreated plant .
B- Plant treated with 50 ppm GA_3 .

(X 144)

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إنتاج شتلات قوية من الماهوجنى الإسبانى بإستخدام حمض الجبريلليك

فاتن محمد رضا

قسم الغابات والأشجار الخشبية – معهد بحوث البساتين – مركز البحوث الزراعية– الجيزة – مصر

أجرى هذا البحث خلال موسمين متتاليين هما ١٩٩٨ /١٩٩٩ و ١٩٩٩ / ٢٠٠٠ بهدف تنشيط إنبات البذور وإنتاج شتلات قوية النمو من الماهوجنى الإسبانى بإستخدام طرق مختلفة لإضافة حمض الجبريلليك . ولتحقيق ذلك تم نقع بذور الماهوجنى فى تركيزات مختلفة من حمض الجبريلليك (صفر ، ٥٠ ، ١٠٠ ، ٢٠٠ و ٤٠٠ جزء فى المليون) ، كما تم رش نباتات الماهوجنى (عمر ثلاثة شهور) بتركيزات مختلفة من حمض الجبريلليك (٢٥ ، ٥٠ و ١٠٠ جزء فى المليون). تم دراسة تأثير المعاملات المختلفة من حمض الجبريلليك على نسبة إنبات البذور وصفات النمو الخضرى وأيضاً على صبغات البناء الضوئى والسكريات الكلية والهرمونات الداخلية فى أوراق النباتات المعاملة والغير معاملة ، كما تم دراسة تأثير الرش بتركيز ٥٠ جزء فى المليون من حمض الجبريلليك على التركيب التشريحى للساق الرئيسية .

أوضحت النتائج المتحصل عليها أن معاملات نقع البذور فى حمض الجبريلليك أدت إلى زيادة فى نسبة الإنبات ، وسجلت أقصى زيادة معنوية فى نسبة الإنبات عند معاملة نقع البذور فى تركيز ٤٠٠ جزء فى المليون من حمض الجبريلليك فى كلا موسمى الدراسة . كذلك كان هناك تأثير مرغوب على جميع صفات النمو الخضرى (إرتفاع النبات ، المساحة الكلية للأوراق على النبات ، الوزن الرطب والجاف للمجموع الخضرى للنبات) وكان أقصى تأثير مرغوب تم الحصول عليه بإستخدام حامض الجبريلليك رشاً على النباتات بتركيز ٥٠ جزء فى المليون والذى سبب زيادة فى قوة نمو النباتات فى كلا موسمى الدراسة . كما أوضحت النتائج أيضاً أن معاملات نقع البذور وكذلك معاملات رش النباتات بحمض الجبريلليك أدت إلى زيادة فى محتوى الأوراق من صبغات البناء الضوئى والسكريات الكلية وهرمونات النمو الداخلية من إندول حامض الخليك وحامض الجبريلليك وعلى العكس من ذلك سببت نقص فى محتوى الأوراق من حمض الأبسيسيك. ومما هو جدير بالذكر أن أفضل معاملات نقع البذور هى معاملة النقع فى تركيز ٤٠٠ جزء فى المليون من حمض الجبريلليك ، كذلك أفضل معاملات الرش هى معاملة رش النباتات بتركيز ٥٠ جزء فى المليون من حمض الجبريلليك والتى أدت أيضاً إلى زيادة فى سمك الساق الرئيسية نتيجة الزيادة الحادثة فى سمك جميع أنسجته (البريدرم – القشرة – اللحاء – الخشب) بالإضافة إلى زيادة فى قطر النخاع البارنشيمى مقارنة بالنباتات الغير معاملة .