RESPONSE OF *Ficus binnendykii* (Miq.) Miq. cv. "AMSTEL QUEEN" TRANSPLANTS TO SOME BIOFERTILIZERS

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ABSTRACT

This investigation was carried out in the open field at the nursery of Antoniades Res. Branch, Hort. Res. Inst., Alexandria, Egypt during 2009 and 2010 seasons to study the effect of soil dressing with rhizobacterien, nitrobien and biogien commercial biofertilizers on growth and chemical composition of 6-months-old transplants of *Ficus binnendykii* (Miq.) Miq. cv. "Amstel Queen" cultivated in 20-cm-diameter clay pots filled with about 2.5 kg of sand + clay mixture (1:1, v/v), when added at the rates of 0, 3 and 6 g/pot, five times with one month interval, and to detect how far these biofertilizers can replace the chemical fertilization with NPK compound fertilizer at the rate of 2 g/pot. The obtained results indicated that all fertilization treatments examined in this study significantly improved all vegetative and root growth parameters (plant height (cm), stem diameter (mm), No. branches and leaves/plant, leaf area (cm^2) and fresh and dry weights (g) of leaves, stem and roots), as well as the active constituents in the leaves of the treated plants (chlorophyll a, b and carotenoids (mg/g F.W.) and the percentages of total carbohydrates, N, P and K). the dominance in all previous measurments was for the dressing with biogien at 6 g/pot treatment, which gave the utmost high means compared to those of control, NPK and all other biofertilization treatments in the two seasons. It was also noticed that biofertilizers treatments, especially at the high rate (6 g/pot) recorded better results than NPK treatment in most cases of both seasons. So, in order to get the best growth and higher content of active constituents of 6-months-old transplants of *F. binnendykii* cv. "Amstel Queen" grown in 20-cm-diameter clay pots, it is preferable to fertilize them with biogien at the rate of 6 g/pot, proved to added as soil dressing, five times with one month interval.

INTRODUCTION

Ficus binnendykii (Miq.) Miq. cv. "Amstel Queen", Narrow leaf fig, that belongs Fam. Moraceae is a glabrous shrub or tree up to 6-8 m high, with dense branches full of green narrow leaves. Native to SE Asia to Java, Sulawesi and the Philippines. It is widely used as lawn specimens due to its huge and attractive vegetative growth, and as pot-plant in great container for decoration of sunny places. Propagated by cuttings (Huxley *et al.,* 1992). Nowadays, using of biofertilizers, as natural preparations containing one or more of beneficial microorganisms that can release nutrients from rocks and organic matter in the soil to become available for plants, has become one of the most important requirements to protect environments from pollution, besides getting a safe and clean product. Some of microorganisms can fix atmospheric nitrogen in a free living state,

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e.g. *Azotobacter* and *Azospirillum* (Darwish, 2002). Moreover, *Azotobacter* bacteria secrete some growth promoting factors, e.g. gibberellin, cytokinin-like substances, auxins, as well as some vitamins such as thiamine, riboflavin, pyridoxine, nicotinic and pantothenic acids (Darwish, 2002). Subba Rao (1993) indicated that *Azotobacter chroococcum* bacteria synthesize antifungal anti-biotics, which gave it additional advantage for the use in field of production.Many efforts, however have been done in this respect, as Quoreshi (2003) who stated that inoculation with mycorrhizal fungi raised growth and nutrients uptake by *Picea mariana* seedlings. Likewise, Martin *et al.* (2003) mentioned that height and trunk diameter of *Quercus palustris* and *Q. coccinea* seedlings colonized with ectomycorrhizae were better that those of uncolonized ones. Abdel-Wahid *et al.* (2006) reported that using yeast twice at 4 g/L + 6 g NPK/plant significantly increased height, fresh and dry weights of shoots and N% in roots of *Euonymus japonicus* plant, while yeast alone led to an increment in No. branches, stem diameter, root length, fresh and dry weights of roots, carotenoids content in the leaves and K% in the roots. Sarhan *et al.* (2006) found that inoculation of vesicular arbuscular mycorrhize (VAM, *Glomus sp.*) at 100 or 200 ml/pot significantly improved survival (%), stem height and diameter and root length of *Khaya senegalensis* under salinity stress. Giri *et al.* (2007) postulated that mycorrhizal *Acacia nilotica* plants maintained greater root and shoot biomass than non-mycorrhizal ones. AM-inoculated plants had higher P, Zn, Mn and Cu concentrations than uninoculated plants. Similar observations were also revealed by Attia and Abdel-Azeem (2005) on *Populus nigra,* Sarhan *et al.* (2007) on jojoba, El-sayed *et al.* (2009) on *Nephrolepis exaltata,* Abdel-Fattah *et al.* (2009) on Dracaena and Ruscus and Abdel-Fattah *et al.,* (2009) who pointed out that spraying the aqueous solution of active dry yeast (8 g/L) greatly improved plant height, stem diameter, leaf No./plant, fresh and dry weights of aerial parts, as well as content of pigments, N, P, K, Fe, Zn and Mn in the leaves of *Brassaia actinophylla* plants.

The objective of this work is to detect the effect of some commercial biofertilizers on growth and active constituents of Narrow leaf fig transplants in comparison with NPK chemical fertilizer.

MATERIALS AND METHODS

Two pot experiments were performed in the open field at the nursery of Antoniades Research Branch, Hort. Res. Inst., Alexandria, Egypt during the two consecutive seasons of 2009 and 2010 to fined out the role of some commercial biofertilizers on improving growth and quality of Narrow leaf fig (Amstel Queen) plants in order to use rather than NPK chemical fertilizer. Therefore, six-months-old transplants of *Ficus binnendykii* (Miq.) Miq. cv. "Amstel Queen" of about 20 cm height and carrying about 8-10 leaves were planted on March, 1st for the two seasons in 20-cm-diameter clay pots (one transplant/pot) filled with about 2.5 kg of an equal mixture of sand and clay (1:1, by volume). The physical and chemical properties of the soil mixture used in the two seasons were determined according to the standared methods described by Richards (1954) and averaged in Table (1).

The transplants were kept to grow under full sun for one month (till April, 1st), as they were received the following treatments, which added as a soil dressing, five times with one month interval:

1- No fertilization, reffered to as control.
2- Chemical fertilization with a mixture of NPK (2:1:1) at the rate of 2g/pot. Ammonium sulfate (20.5%), calcium superphosphate (15.5% P_2O_5) and potassium sulfate (48.5% K_2O) fertilizers were used to obtain the required ratio.
3- Biofertilization with either Rhizobacterien (a commercial product contains a specific strain of *Rhizobium sp.*bacteria, conc. 10^7-10^9 cells/ml), or Nitrobien (a commercial product contains a specific strain of *Azospirillum barasilense* bacteria, conc. 10^7-10^9 cells/ml), or Biogien (a commercial product contains a specific clone of *Azotobacter chroococcum* bacteria, conc. 10^6 cells/ml) at the rates of 3 and 6 g/pot for each.

Table (1): Some physical and chemical properties of the soil mixture used in 2009 and 2010 seasons

Season	Particle size distribution (%)					S.P.	E.C. (dS/m)	pH	Cations (meq/L)				Anions (meq/L)		
	Coarse sand	Fine sand	Silt	Clay	O.M				Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_4^{--}
2009	15.90	26.20	19.10	37.10	1.70	45.65	2.99	7.85	18.21	9.33	31.50	1.42	3.67	26.10	30.69
2010	18.76	23.88	21.33	34.46	1.57	43.79	3.36	7.90	21.73	10.26	33.11	1.53	3.89	24.89	37.85

O.M.: Organic matter.

The layout of the experiments in the two seasons was a complete randomized design (Das and Giri, 1986) with three replicates and each replicate contained five transplants. The regular agricultural practices recommended for such plantation were carried out whenever needed. At the end of each season (on October, 30th), data were recorded as follows: plant height (cm), stem diameter at the base (mm), number of branches and leaves/plant, leaf area (cm^2), as well as fresh and dry weights of leaves, stem and roots (g). In fresh leaf samples taken from the middle parts of the plants, photosynthetic pigments (chlorophyll a, b and carotenoids, mg/g F.W.) were determined according to Moran (1982), while in dry ones, the percentages of total carbohydrates (Herbert *et al.,* 1971), nitrogen using micro-Kjeldahle method as described by Pregl (1945), phosphorus colorimetrically as the method indicated by Luatanab and Olsen (1965) and potassium using flame-photometer set (Jackson, 1973) were measured. Data were then tabulated and statistically analyzed according to SAS program (1994) using Duncan's Multiple Range Test (1955) for elucidating the significancy level between the means of the different treatments.

RESULTS AND DISCUSSION

Effect of fertilization treatments on: 1. Vegetative growth: Data in Table (2) show that all fertilization treatments employed in this study improved all vegetative growth parameters; expressed as: plant height (cm), stem diameter (mm), No. branches and leaves/plant and leaf area (cm^2) with various significance levels in the

two seasons, but the greatest improvement in all of these parameters was due to biogien treatment at 6 g/pot, which gave the utmost high means in both seasons compared to control, NPK and other biofertilization treatments. However, rhizobacterien at 6 g/pot and biogien at 3g/pot treatments improved some vegetative growth traits, especially in the second season giving values closely near to those gained by the prevalent treatment (6g biogien/pot) with non-significant differences in some cases of the two seasons.

Table (2): Effect of fertilization treatments on some vegetative growth parameters of *Ficus binnendykii* (Miq) Miq. "Amstel Queen" transplants during 2009 and 2010 seasons.

Treatments	Plant height (cm)	Stem diameter (mm.)	No. branches per plant	No. leaves per plant	Leaf area ($cm^{2)}$
	First season: 2009				
Control	37.52 e	3.21 d	4.33 d	23.36 e	16.30 e
NPK at 2g/pot	45.00 c	3.85 dc	5.16 c	27.38 d	19.51 c
Rhizobacterien at 3 g/pot	42.46 dc	4.10 c	4.86 cd	29.16 cd	19.42 c
Rhizobacterien at 6 g/pot	44.56 c	4.80 b	4.98 cd	34.10 ab	21.50 ab
Nitrobien at 3 g/pot	39.72 ed	4.53 bc	5.13 c	25.95 ed	18.39 d
Nitrobien at 6 g/pot	41.33 d	4.79 b	5.46 cb	30.76 c	20.67 b
Biogien at 3 g/pot	49.28 b	5.42 ab	5.81 b	33.00 b	20.58 b
Biogien at 6 g/pot	52.60 a	6.60 a	6.33 a	36.21 a	22.33 a
	Second season:2010				
Control	35.90 e	3.40 d	4.40 d	26.51 e	15.06 e
NPK at 2g/pot	43.10 c	4.33 cd	5.31 c	31.83 cd	18.00 c
Rhizobacterien at 3 g/pot	43.81 c	4.68 c	5.00 cd	33.10 c	17.85 c
Rhizobacterien at 6 g/pot	46.35 ab	5.31 b	5.19 cd	37.81 a	19.80 ab
Nitrobien at 3 g/pot	40.23 d	5.00 b	5.33 c	30.78 d	17.00 d
Nitrobien at 6 g/pot	45.20 b	5.71 ba	5.67 cb	35.56 b	19.03 b
Biogien at 3 g/pot	46.18 b	6.03 ab	5.90 b	36.23 ba	18.36 bc
Biogien at 6 g/pot	48.79 a	6.92 a	6.40 a	38.25 a	20.76 a

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

A similar trend was also obtained concerning the fresh and dry weights (g) of leaves, stem and roots (Table, 3), as they were significantly increased in response to applying either NPK or biofertilizers used in this work, with the superiority of 6 g/pot biogien treatment, which scored the higheat records in the two seasons and followed by the treatment of biogien at 3 g/pot that gave some values in the same rank of the super-treatment. This may be attributed to the capability of biogien in fixing more atmospheric N and secrete more vitamins and growth promoting substances necessary for good and healthy growth (Darwish, 2002).

In addition, Subba Rao (1993) affirmed that *Azotobacter chroococcum* (the bacteria found in biogien) synthesize antifungal antibiotics which gave it a special advantage for the use in field of production.These results, however are coincidenced

with those attained by Martin *et al.* (2003) on *Quercus palustris,* Sarhan *et al.* (2006) on *Khaya senegalensis,* Giri *et al.* (2007) on *Acacia nilotica* and Abdel-Fattah *et al.* (2009) on Dracaena and Ruscus.

Table (3): Effect of fertilization treatments on fresh and dry weights of *Ficus binnendykii* (Miq) Miq. "Amstel Queen" leaves, stem and roots during 2009 and 2010 seasons.

Treatments	Fresh weight (g)			Dry weight (g)		
	Leaves	Stem	Roots	Leaves	Stem	Roots
	First season: 2009					
Control	8.82 f	10.00 e	10.98 g	1.27 e	3.50 d	4.50 g
NPK at 2g/pot	10.56 fe	12.33 d	13.21 ef	1.53 d	4.21 c	5.33 f
Rhizobacterien at 3 g/pot	13.13 d	13.78 cd	16.28 d	2.71 c	4.81 cb	7.26 d
Rhizobacterien at 6 g/pot	14.83 c	14.50 c	18.50 c	3.53 b	5.03 b	8.33 c
Nitrobien at 3 g/pot	11.57 e	11.90 de	13.10 fe	2.50 cd	4.20 c	5.94 ef
Nitrobien at 6 g/pot	13.10 d	13.87 cd	14.38 e	2.87 c	4.83 cb	6.43 e
Biogien at 3 g/pot	17.54 b	16.33 b	20.33 b	3.96 b	5.71 ba	9.13 b
Biogien at 6 g/pot	20.71 a	18.56 a	21.78 a	5.00 a	6.30 a	9.80 a
	Second season:2010					
Control	10.00 f	10.53 e	11.73 f	2.15 e	3.61 d	5.00 f
NPK at 2g/pot	11.93 ef	12.70 de	14.10 ef	2.60 d	4.32 cd	6.20 e
Rhizobacterien at 3 g/pot	14.16 d	14.68 c	17.80 c	2.95 cd	5.11 cb	8.01 c
Rhizobacterien at 6 g/pot	15.60 c	16.00 b	20.35 b	3.71 c	5.58 b	9.00 bc
Nitrobien at 3 g/pot	12.35 e	13.50 d	14.50 e	2.30 de	4.73 c	6.53 de
Nitrobien at 6 g/pot	13.78 d	16.20 b	16.19 d	3.23 c	5.63 b	7.29 d
Biogien at 3 g/pot	18.10 b	18.61 a	20.70 b	4.47 b	6.50 a	9.32 b
Biogien at 6 g/pot	21.85 a	18.93 a	22.26 a	5.32 a	6.61 a	10.03 a

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

2. Chemical composition: From data averaged in Table (4), it could be concluded that dressing with biogien at either 3 or 6 g/pot gave the pronounced beneficial effect on active constituents of the fertilized plants with few exceptions in the two seasons. However, the mastery in all measured constituents was for the high rate of biogien (6 g/pot), which gave more green leaves and higher percentages of total carbohydrates, N, P and K when compared to control, NPK and other biofertilization treatments. Application of rhizobacterien, especially at 6 g/pot improved the content of P and K to reach the same significance level of dressing with biogien at 6 g/pot. This may indicate the role of biofertilizers in fixing atmospheric N and mobilizing phosphate and other nutrients to be available for plants (Quoreshi, 2003). Analogus observations were also noticed by Attia and Abdel-Azeem (2005) on *Populus nigra,* Sarhan *et al.* (2007) on jojoba, El-Sayed *et al.* (2009) on *Nephrolepis exaltata* and Abdel Fattah *et al.* (2009) on *Brassaia actinophylla.* According to the afforestated results, it could be recommended to fertilize the 6-months-old transplants of *Ficus binnendykii* cv. "Amstel Queen" grown in 20-cm-diameter clay pots filled with about 2.5 kg of sand + clay mixture (1:1, v/v) with biogien biofertilizer at the rate of 6 g/pot, five times (commencing from April, 1st) with one month interval to score the best growth and high quality.

Table (4): Effect of fertilization treatments on chemical composition of *Ficus binnendykii* (Miq) Miq. "Amstel Queen" leaves during 2009 and 2010 seasons

Treatments	Pigments content (mg/g F.W.)			Total carbohydrates (%)	N (%)	P (%)	K (%)
	Chlorophyll a	Chlorophyll b	Carotenoids				
	First season: 2009						
Control	0.90 e	0.21 e	0.63 f	27.98 f	1.20 f	0.09 d	1.10 d
NPK at 2g/pot	1.40 c	0.38 cd	0.78 e	33.21 e	1.37 e	0.11 d	1.38 c
Rhizobacterien at 3 g/pot	1.06 d	0.40 c	0.89 d	41.76 d	1.85 c	0.21 b	1.56 b
Rhizobacterien at 6 g/pot	1.47 c	0.53 b	1.00 c	48.90 c	1.94 b	0.25 a	1.77 ab
Nitrobien at 3 g/pot	1.07 d	0.30 d	0.90 d	41.40 d	1.47 e	0.16 c	1.21 d
Nitrobien at 6 g/pot	1.33 cd	0.35 cd	1.07 c	50.33 c	1.63 d	0.18 cb	1.38 c
Biogien at 3 g/pot	1.80 b	0.58 b	1.30 b	54.60 b	2.10 b	0.23 a	1.60 b
Biogien at 6 g/pot	2.25 a	0.95 a	1.67 a	60.91 a	2.33 a	0.28 a	1.93 a
	Second season:2010						
Control	1.03 e	0.33 f	0.71 f	28.20 f	1.16 g	0.11 c	1.05 e
NPK at 2g/pot	1.51 d	0.48 e	0.88 e	36.28 e	1.24 f	0.15 bc	1.31 d
Rhizobacterien at 3 g/pot	1.65 cd	0.64 d	1.00 d	45.87 d	1.72 d	0.24 a	1.50 c
Rhizobacterien at 6 g/pot	1.75 c	0.87 c	1.16 c	52.10 c	1.91 c	0.30 a	1.69 ab
Nitrobien at 3 g/pot	1.58 cd	0.65 d	1.03 d	45.00 d	1.50 e	0.15 bc	1.23 d
Nitrobien at 6 g/pot	1.97 b	0.80 c	1.21 c	53.87 bc	1.68 d	0.18 b	1.40 c
Biogien at 3 g/pot	2.10 b	1.06 b	1.46 b	55.86 b	2.13 b	0.25 a	1.62 b
Biogien at 6 g/pot	2.59 a	1.25 a	1.81 a	64.61 a	2.70 a	0.29 a	1.89 a

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

إستجابة شتلات فيكس (أمستيل كوين) لبعض الأسمدة الحيوية

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الخلاصة

أجري هذا البحث في العراء بمشتل فرع بحوث حدائق أنطونيادس، معهد بحوث البساتين، الأسكندرية، مصر خلال الموسمين المتتاليين: ٢٠٠٩ و ٢٠١٠ و ذلك لدراسة تأثير الاضافة الأرضية للأسمدة الحيوية التجارية التالية: ريزوباكترين (Rhizobacterien)، نيتروبين (Nitrobien) و بيوجين (Biogien) فى النمو و التركيب الكيميائي لشتلات فيكس الورقة الضيقة (*F. binnendykii* cv. "Amstel Queen") عمر ستة أشهر، المنزرعة في أصص فخار قطرها ٢٠سم و مملوءة بحوالي ٢,٥ كجم من مخلوط الرمل و الطين (بنسبة ١ : ١ حجماً)، و ذلك عند إضافتها بمعدلات: صفر و ٣ و ٦ جم/أصيص، خمس مرات و بفاصل شهر واحد بين كل مرتين، و أيضاً للتعرف على مدى إمكانية إحلال هذه الأسمدة الحيوية محل السماد الكيمائي المركب (NPK) عند إضافته بمعدل ٢ جم/أصيص. و لقد أوضحت النتائج المتحصل عليها أن جميع معاملات التسميد التي تمت إضافتها في هذه الدراسة أحدثت تحسناً معنوياً في جميع قياسات النمو الخضري و الجذري (ارتفاع النبات (سم) و قطر الساق (مم) و عدد الأفرع و الأوراق/نبات والوزن الطازج و الجاف (جم) لكل من الأوراق و الساق و الجذور) وكذلك محتوى الأوراق من المكونات الفعالة (كلوروفيللي أ، ب و الكاروتينويدات (ملليجم/جم وزن طازج) و النسبة المئوية للكربوهيدرات الكلية، والنيتروجين و الفوسفور و البوتاسيوم). و لقد كانت السيادة في جميع القياسات السابقة للمعاملة بالبيوجين بمعدل ٦ جم/إصيص ، و الذي أعطى أعلى المتوسطات على الإطلاق مقارنة بالمقارنة والسماد الكيميائي المركب (NPK) و باقي معاملات التسميد الحيوي الأخرى في كلا الموسمين. كما لوحظ أن المعاملة بالأسمدة الحيوية، خاصة بمعدل ٦ جم/أصيص، أدت الى نتائج أفضل من النتائج التي حققها السماد الكيمائي المركب (NPK) في معظم الحالات بكلا الموسمين. و عليه، فانه للحصول على أفضل نمو و أعلى محتوى من المكونات الفعالة في أوراق شتلات فيكس الورقة الضيقة عمر ستة أشهر و المنزرعة في أصص فخار قطرها ٢٠ سم، فانه يوصى بتسميدها بالسماد الحيوي بيوجين (Biogien)، على أن يضاف للتربة خمس مرات بمعدل ٦ جم/أصيص و بفاصل شهر واحد بين كل مرتين.

REFERENCES

Abdel-Fattah, H. Gehan; A. El-Sayed Boshra and A. M. Khenizy Soad (2009). Response of Dracaena and Ruscus plants to humic acid and biofertilizer supply. Annals of Agric. Sci., Moshtohor, 47(1): 111-119.

Abdel-Fattah, H. Gehan; M. Abdel-Moniem Azza and M.A.I. El-Shamy (2009). Response of Australian umbrella tree (Brassaia) transplants to some fertilization, salysilic acid and dry yeast treatments. Annals of Agric. Sci., Moshtohor, 47(2):275-283.

Abdel-Wahid, M. K. Safwat; Y. Labib Naglaa and B.B. Rezk-Alla (2006). Effect of active dry yeast and chemical fertilization on vegetative growth and the main constituents of *Euonymus japonicus* Thunb. plant. Fayoum J. Agric. Res. & Dev., 20(1):136-147.

Attia, Elham M. and H.M. Abdel-Azeem Hoda (2005). Effect of biofertilization on yield and active materials in *Lawsonia inermis* L. plants. The 6th Arab. Conf. Hort., March 20-22, Dept. Hort., Fac. Agric., Ismailia, Egypt:109-128.

Darwish, F.M. (2002). Effect of different fertilizer sources and levels on growth, yield and quality of tomato. Ph. D. Thesis, Fac. Agric., Cairo univ., Egypt.

Das, M.N. and N.C. Giri (1986). Design and Analysis of Experiments. 2nd Ed., Published by Mohinder Singh Sejwal for Wiley, New Delhi 110 002, 488 pp.

Duncan, D.B. (1955). Multiple range and multiple F-tests. J. Biometrics, 11:1-42.

El-Sayed, A. Boshra; A. El-Din Hanan and S.M.Shahin (2009). Response of *Nephrolepis exaltata* Schatt. plant to medium type and nitrobien biofertilization. J. Bio. Chem. Environ. Sci., 4(1):705-717.

Giri, B.; R. Kapoor and K. G. Mukerji (2007). Improved tolerance of *Acacia nilotica* to salt stress. Microbial Ecology, 54 (4):753-760.

Herbert, D.; P.J. Philips and R.E. Strange (1971). Determination of total carbohydrates. Methods in Microbiology, 5(8):290-344.

Huxley, A.; M. Griffiths and M. Levy (1992). The New Royal Hort. Society Dictionary of Gardening. The Stockton Press, 257 Park Avenue South, New York, NY 10010, USA, vol. 2, 747 pp.

Jackson, M.L. (1973). Soil Chemical Analysis. Prentice-Hall of India Private Limited M-97, New Delhi, India, 498 pp.

Luatanab, F.S. and S.R. Olsen (1965). Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts from soil. Soil Sci. Soc. Amer. Proc., 29:677-678.

Martin, T.P.; J.R. Harris; G.K. Eaton and O.K. Miller (2003). The efficacy of ectomycorrhizal colonization of pin and scarlet oak in nursery production. J. Environ. Hort. 21(1):45-50.

Moran, R. (1982). Formula for determination of pigments extracted with N, N-dimethyl formamide. Plant Physol., 69:1376-1381.

Pregl, F. (1945). Quantitative Organic Micro-Analysis, 4th Ed., J. and A. Churchill Ltd., London, p:203-209.

Quoreshi, A.M. (2003). Nutritional preconditioning and ectomycorrhizal formation of *Picea mariana* (Mill.) B.S.P. seedlings. Eurasian J. Forests Res., 6:1-63.

Richards, L.A. (1954). Diagnosis and Improvement of Saline and Alkali Soils. USDA, Handbook No. 60.

Sarhan, A.Z.; Effat I. El-Maadawy and S.S. Surour (2007). Effect of biopromotors and biofertilizers application on growth and chemical somposition of jojoba plants. J. Agric. Sci., Mansoura Univ., 32(8):6575-6598.

Sarhan, A.Z ; M.A. Salem and L. Soliman (2006). Effect of irrigation water salinity levels and soil mycorrhizal fungi inoculation on growth of African mahogany (*Khaya senegalensis*) transplants. Ann. Agric. Sci., Moshtohor, 44(2):625-635.

SAS Institute (1994). SAS/STAT User's Guide: Statistics. Vers. 6.04, 4th Ed., SAS Institute Inc., Cary, N.C., USA.

Subba Rao, N.S. (1993). Biofertilizers in Agriculture, 3rd Ed., Oxford & IBH Publishing Co. Ltd., New Delhi, Bombay, Calcutta, 242 p.