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Effect of Growing Media and Microbien on Growth and Chemical Composition of *Swietenia mahagoni* (L.) Jacq. Plants

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Abstract: This investigation was carried out at the Experimental Area of the National Research Centre, Dokki, Giza, during the two successive seasons, 2013 and 2014. The aim of this work is to study the effect of growing media and bio fertilizer on vegetative growth and chemical composition of *Swietenia mahagoni* seedlings. Results showed that, clay and mixture media significantly increased all growth parameters in both seasons, except stem diameter in the second season, while the sandy soil gave the lowest values. Also the values of growth characters were increased by increasing microbien concentrations. The nitrogen content in the leaves increased from plants grown in clay and mixture media in the two seasons, respectively. Additionally, P% in leaves in both seasons grown in clay media was higher than of those grown in mixture media and sandy soil. In this respect, K% in leaves in the first season grown in mixture media was higher than of those grown in the other media, But in the second season, plant grown in clay media increased K% compared with mixture media and sandy soil. On the other hand, all concentrations of microbien increased nitrogen, phosphorus and potassium contents in leaves as compared with the control plant in the two seasons. This application may be recommended that for overcoming the beneficial effect on growth and nutrients contents of *Swietenia mahagoni* plants with treatments of clay or mixture media and microbien at 20 ml concentration.

Key words: *Swietenia mahagoni* · Media · Growth · Bio-fertilization · Nutrients contents

INTRODUCTION

Swietenia mahagoni Jacq belongs to Family Meliaceae, it is semi-ever green trees and considered tropical forest in west India [1]. Moreover, *Swietenia mahagoni* products are Fuel, in Haiti much of the branch wood and most of the crooked stems are converted to charcoal, particularly in regions isolated from urban markets by poor roads. The heartwood is highly resistant to decay and insect attack, performing better than all other mahoganies on the world markets. The wood is therefore the choice for high-quality furniture and cabinet work, joinery, boats and pattern work. *Swietenia mahagoni* is a medicinal plant throughout the Caribbean. The bark is considered an astringent and is taken orally as a decoction for diarrhea, as a source of vitamins and iron and as a medicine to induce hemorrhage. In addition, *S. mahagoni* has thrived as an ornamental tree in various parts of India. It provides deep shade [2]. The soil media have several important functions in relation to plant growth. They provide anchorage for the plant's roots; air spaces to allow respiration; and it acts as a plant support, serves as a source of water and essential plant nutrients and permits the diffusion of oxygen to roots to satisfy these basic plant requirements. Sandy soil (soils with a high proportion of sand) drains easily, so water logging is not a problem unless a "pan" or impervious layer has formed below the surface. Their open structure means that they are easy to work and quick to warm up in the spring, allowing earlier sowing and planting. However sandy soils do dry out very quickly and nutrients are easily washed through the soil. Clay soil is heavy and difficult to work. They are slow to warm in the spring, sticky when wet and very hard when dry. Clay soils hold moisture and

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nutrients well and remain warming the autumn because they are slow to cool down. Much of the water they contain will not be available to plants and in winter they are prone to water logging [3]. Kathiravan *et al.* [4] on *Jatropha curcas* and El-Assaly [5] on *Khaya senegalensis*, found that, clay soil was superior to sandy one in stimulating the morphological growth. In this respect, Mazher *et al.* [6] on *Jatropha curcas* L. and Youssef [7] on *Populus euramericana* reported that, the mixture media had a favorable effect on increasing all the growth parameters. El-Sallami [8] on *Leucaena leucocephala* seedlings and Mazher *et al*. [6] on *Jatropha curcas* mentioned that, clay medium gave the highest chlorophyll (*a* and *b*), N, P, K percentages and total carbohydrates compared with sand medium. Youssef [7] on *Populus euramericana* and El-Sayed [9] on *Moringa oleifera* reported that, N, P and K contents in leaves exhibited maximum values under the mixture clay and sand medium.

Bio-fertilizers are microbial inoculants used for application to either seeds or soil for increasing soil fertility with objective of increasing the number of such micro- organisms and to accelerate certain microbial processes. Such microbiological processes can change unavailable forms of nutrients into available ones that can be easily assimilated by plants [10]. Microbien is a biofertilizer which contains nitrogen fixing bacteria "*Azotobacter* sp, *Azospirillum* sp and *Pseudomonas* sp" as well as phosphate dissolving bacteria "*Bacillus megaterium*". Plant growth parameters induced by bio-fertilizers, these was proved by Karthikeyan *et al.* [11] on *Azadirachta indica* and El-Quesni *et al.* [12] showed that, biofertilizer led to an increase in quality and plant growth. Saher [13] on Jojoba seedlings indicated that, the highest values were always obtained from spraying plants with high rate of biomagic and inoculation with mixture of *Azotobacter* and *Bacillus*. The highest total carbohydrate in leaves, shoots and roots were recorded with spraying biomagic at the presence of a mixture of *Azotobacter* and *Bacillus*. The effect of biomagic application and bacterial inoculation on leaves, shoots and roots content of mineral elements was significantly increased as compared with control.

The main purpose of this study is to determine the effect of some soil media and microbien on growth and chemical composition of *Swietenia mahagoni* L. seedlings in order to increase its quantity and improve its quality.

MATERIALS AND METHODS

The present study was carried out at the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza and the experiment of this investigation was carried out at the Experimental Area of the National Research Centre, Dokki, Giza, during the two successive seasons; 2013 and 2014. It was intended to study the effect of growing media and bio fertilizer on growth and chemical composition of *Swietenia mahagoni* (L.) Jacq. seedlings. The seedlings of *Swietenia mahagoni* (L.) Jacq. (one-year-old, 20-25 cm height and 4-6 compound leaf/plant in average) were used. The plants were obtained from the Forestry Department, Horticulture Research Institute, ARC. The experiment was under open field conditions through the two seasons. The seedlings were transplanted on March 15th 2013and 2014 for the first and second seasons respectively. Seedlings were transplanted in 30 cm pottery pots (one seedling/pot) filled with one of the different growing media according to treatments i.e. clay, sand and the mixture of them 1:1 (V/V).The plants irrigation was done according to the plants need. The physical and chemical properties of the different media were determined according to Chapman and Pratt [14] and are shown in Table 1.

The biofertilizer microbien was added to soil as fresh inocula mainly prepared by General Organization for Agricultural Equalization Fund (G.O.A.E.F) under control of Agricultural Research Center, Ministry of Agriculture, Giza, Egypt. The concentration were 0, 10 and 20 ml/pot and applied at 90 and 150 day after planting (DAP). The following data were recorded at the end of the experiment, plant height (cm), stem diameter (cm), number of leaves/plant, leaf area (cm^2), fresh and dry weight of leaves (g/plant). The chemical analysis was determined in leaves N, P and K percentage. Nitrogen (% DW) was determined by the modified Kjeldahl method as described by Cottenie *et al.* [15]. Phosphorus (% DW) was estimated using ammonium molybdate method according to Snell and Snell [16]. Potassium content was measured in the digested solution by flam photometer according to Chapman and Pratt [14]. The experiment was sitting completely randomized block design with two factor was used for analysis all data with three replications for each parameter. The treatment means were compared by least significant difference (LSD) test as given by Snedecor and Cochran [17] by used Assistat program.

Table 1: Physical and chemical properties of the growing media used in the experiment

						Anion (meq/L)			Cation (meq/L)			
Soil sample	E.C. dS/m	pH	Coarse sand%	Fine sand %	Silt + Clay %	HCO_3^-	Cl^-	SO_4^{--}	Ca^{++}	Mg^{++}	Na^+	K^+
Clay	0.40	8.47	43.0	13.0	44.0	1.6	1.50	1.12	1.5	0.8	1.7	0.22
Sand	0.20	7.76	72.5	16.5	11.0	0.6	0.75	0.85	0.6	0.5	0.9	0.2

RESULTS AND DISCUSSION

Vegetative Growth: The results obtained in Tables 2-4 showed that clay and mixture media significantly increased all growth parameters in two seasons, except stem diameter in the second season was insignificant compared with the sandy soil which gave the lowest values. The tallest plants and the heaviest fresh and dry weight of leaves in both seasons and the greatest number of leaves in the second season were produced from the treatment of clay soil compared with mixture media and sandy soil. The increments were (51.52 and 47.38%) plant height, (29.44 and 62.84 %) leaves fresh weight, (40.26 and 81.67 %) leaves dry weight in both seasons, respectively and (45.94 %) leaves numbers in the second season compared with sandy soil. In this respect, stem diameter and leaf area in the first and second seasons and leaves number in the first season gave the highest values of mixture media compared with sandy soil. The increments were (20.56 and 17.95%) stem diameter and (18.96 and 20.97%) leaf area in both seasons, respectively and (50.7%) leaves number in the first season compared with sandy soil. This effect may be attributed to the physical properties of the soil. Sand soil is porous; the ions absorption is easier, while some of ions adhere on the clay soil particles. Also, sandy soil do dry out very quickly and nutrients are easily washed through the soil while, clay soil hold moisture and nutrients well [3]. These results were confirmed by Mazher *et al.* [6], Youssef [7] and El-Mahrouk *et al.* [18].

Concerning the effect of biofertilizers (microbien), it significantly increased all growth parameters. Date presented in Tables 2-4 demonstrated clearly that using microbien had appositive effect on the aforementioned growth characters. The values of growth characters were increased by increasing microbien concentration. Microbien caused increments on growth characters by (11.98 and 14.75%) plant height, (19.81 and 13.33%) stem diameter, (23.82 and 36.26%) leaves number, (27.82 and 22.93%) leaf area, (60.23 and 43.59%) leaves fresh weight and (75.96% and 57.85%) leaves dry weight in both seasons respectively for 20 ml compared with the untreated plants. This might be related to the improvement of physical conditions of soil provided energy for microorganisms activity and increase the availability and uptake of N, P and K which was reflected on growth [19]. These results are in agreement with those obtained by El-Quesni *et al.* [12]. In addition, the results obtained in the same tables, indicated that, the interaction between different involved factors (soil type and microbien) were almost significant for growth characters. The highest value due to treatments were obtained due to clay media and 20 ml microbien for plant height and leaves fresh and dry weight in both seasons and leaves number in the second season and mixture media with 20 ml microbien for stem diameter and leaf area in the two seasons and leaves number in the first season.

Nutrient Contents: The response of nitrogen content in the leaves of *Swietenia mahagoni* to the different growing media is presented in Table 5 indicated that plants grown in clay and mixture media increased N % in the first and second season respectively. The increments were (22.33 and 11.81%) in both seasons, respectively compared with sandy soil. Additionally, P% in leaves in the two seasons grown in clay medium was higher than of those grown in mixture media and sandy soil. The increments were (6.94 and 5.19%) in the two seasons, respectively, compared with sandy soil. In this respect, K % in leaves in the first season grown in mixture media was higher than of those grown in the other media. But, in the second season, plant grown in clay media increased K% compared with mixture and sand media. The increments were (6.17 and 9.64%) in both seasons, respectively compared with sandy soil. This effect may be attributed to the ability of such soil to supply the plant with its needs from minerals. These results are in accordance with those obtained by El-Sallami [8] on *Leucaena leucocephala,* Mazher *et al*. [6] on *Jatropha curcas* and El-Assaly [5] on *Khaya senegalensis*. Concerning the effect of microbien is represented in Table 5. All concentrations of microbien increased nitrogen content in leaves as compared with the control in the two seasons. The most effective concentrations were 20 ml microbien which produced the highest nitrogen in the first and second seasons (1.28 and 1.65 %), respectively. Additionally, phosphorus content

Table 2: Effect of growing media and microbien on Plant height and stem diameter during 2013 and 2014 seasons

	Growing media (A)							
	Clay	Clay + sand	Sand	Mean	Clay	Clay + sand	Sand	Mean
Biofertilization (B)	2013 season				2014 season			
	Plant height (cm)							
Control	130.33	106.50	84.33	107.06	127.0	113.33	86.00	108.78
Microbien 10ml	136.00	125.50	89.50	117.00	136.0	128.33	89.67	118.00
Microbien 20ml	139.00	127.00	93.67	119.89	140.8	135.33	98.33	124.83
Mean	135.11	119.67	89.17	--	134.6	125.67	91.33	--
LSD 0.05								
A		2.92				3.84		
B		2.92				3.84		
AB		5.05				6.66		
	Stem diameter(cm)							
Control	1.07	1.13	0.97	1.06	1.23	1.23	1.13	1.20
Microbien 10ml	1.23	1.33	1.10	1.22	1.30	1.40	1.17	1.29
Microbien 20ml	1.27	1.40	1.13	1.27	1.37	1.50	1.2	1.36
Mean	1.19	1.29	1.07	--	1.30	1.38	1.17	--
LSD 0.05								
A		0.20				NS		
B		NS				NS		
AB		0.38				NS		

Table 3: Effect of growing media and microbien on number of leaves and leaf area during 2013 and 2014 seasons.

	Growing media (A)							
	Clay	Clay + sand	Sand	Mean	Clay	Clay + sand	Sand	Mean
Biofertilization (B)	2013 season				2014 season			
	Number of leaves							
Control	28.00	30.67	19.67	26.11	43.67	41.33	29.00	38.00
Microbien 10ml	30.00	34.00	22.00	28.67	52.33	49.67	36.00	46.00
Microbien 20ml	32.00	38.33	26.67	32.33	58.67	55.67	41.00	51.78
Mean	30.00	34.33	22.78	--	51.56	48.89	35.33	--
LSD 0.05								
A		2.05				2.93		
B		2.05				2.93		
AB		3.55				5.08		
	Leaf area							
Control	97.00	104.33	88.67	96.67	102.67	112.00	95.00	103.22
Microbien 10ml	125.00	118.33	103.33	115.56	130.67	131.00	109.00	123.56
Microbien 20ml	127.00	135.00	108.67	123.56	132.33	137.67	110.67	126.89
Mean	116.33	119.22	100.22	--	121.89	126.89	104.89	--
LSD 0.05								
A		2.84				2.84		
B		2.44				2.44		
AB		4.92				4.22		

in leaves increased markedly in the first season (0.161%) in response to 20 ml microbien inoculation, as compared to the control. In the second season, a similar response to 20 ml microbien was recorded. In this regard, K content in leaves reached the highest value (0.87 and 0.91 %) by applying 20 ml microbien compared with other treatment in the two seasons respectively. Similarly, previous studies on other tree species showed that biofertilizers resulted in the greatest values of nitrogen, phosphorus and potassium in *Paulownia kawakamii* by Hashish [20] and Mazher *et al*. [21] on *Moringa oleifera*. As regarding the effect of interaction, it is evident from data that, the

Table 4: Effect of growing media and microbien on fresh and dry weight of leaves during 2013 and 2014 seasons.

	Growing media (A)							
	Clay	Clay + sand	Sand	Mean	Clay	Clay + sand	Sand	Mean
Biofertilization (B)	2013 season				2014 season			
	Fresh weight of leaves							
Control	43.40	40.30	31.70	38.47	61.20	56.60	47.10	54.97
Microbien 10ml	66.40	54.70	50.80	57.30	85.60	80.40	50.90	72.30
Microbien 20ml	68.93	60.40	55.60	61.64	96.00	89.70	51.10	78.93
Mean	59.58	51.80	46.03	--	80.93	75.57	49.70	--
LSD 0.05								
A		2.97				2.53		
B		2.97				2.53		
AB		5.14				4.39		
	Dry weight of leaves							
Control	10.63	9.80	7.63	9.36	15.47	14.20	11.40	13.69
Microbien 10ml	18.47	14.10	12.77	15.11	23.97	21.80	12.53	19.43
Microbien 20ml	19.30	16.00	14.10	16.47	27.17	24.93	12.73	21.61
Mean	16.13	13.30	11.50	--	22.20	20.31	12.22	--
LSD 0.05								
A		0.83				2.13		
B		0.83				2.13		
AB		1.43				3.68		

Table 5: Effect of growing media and microbien on N%, P% and K% of leaves during 2013 and 2014 seasons

	Growing media (A)							
	Clay	Clay + sand	Sand	Mean	Clay	Clay + sand	Sand	Mean
Biofertilization (B)	2013 season				2014 season			
	N% of leaves							
Control	1.03	0.97	0.92	0.97	1.43	1.49	1.22	1.38
Microbien 10ml	1.33	1.27	1.07	1.22	1.59	1.62	1.58	1.58
Microbien 20ml	1.41	1.34	1.10	61.64	1.65	1.71	1.65	1.65
Mean	1.26	1.19	1.03	--	1.56	1.61	1.44	--
	P % of leaves							
Control	0.132	0.136	0.124	0.131	0.151	0.150	0.142	0.148
Microbien 10ml	0.165	0.158	0.152	0.158	0.166	0.160	0.157	0.161
Microbien 20ml	0.166	0.162	0.155	0.161	0.169	0.170	0.162	0.167
Mean	0.154	0.152	0.144	--	0.162	0.160	0.154	--
	K% of leaves							
Control	0.79	0.81	0.78	0.81	0.87	0.81	0.78	0.82
Microbien 10ml	0.83	0.87	0.81	0.84	0.90	0.85	0.85	0.87
Microbien 20ml	0.88	0.89	0.85	0.87	0.96	0.89	0.87	0.91
Mean	0.83	0.86	0.81	--	0.91	0.85	0.83	--

previous minerals in leaves in the two seasons were increased by using clay media or mixture media and adding 20 ml microbien. Hence, it could be recommended that, treatment of clay or mixture media and microbien especially at the concentration of 20 ml had a beneficial effect on growth and nutrient contents of *Swietenia mahagoni* plants.

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