Scientific J. Flowers & Ornamental Plants
www.ssfop.com/journal
ISSN: 2356-7864

RESPONSE OF *MORINGA OLEIFERA* TREES TO BIO-, CHEMICAL FERTILIZATION AND GROWING MEDIA

A.Z. Sarhan, Azza M.S. Arfa and H.A. Gonaw

Department of Ornamental Horticulture, Cairo Univ., Giza, Egypt.

Scientific J. Flowers & Ornamental Plants, 3(4):255-263 (2016).

Received:
10/10/2016

Revised by:
Prof. Dr. E.S. Nofal,
Kafr El-Sheikh Univ.

Prof. Dr. A.F. Al-Maathedi,
Mosul Univ., Iraq.

ABSTRACT: This trial was outlined at the nursery of the Ornamental Horticulture Department, Faculty of Agric., Cairo Univ. during two successive seasons of 2014 and 2015.

The study was conducted to investigate the effect of different soil types (sand, clay and sand + clay) and bio-fertilizers (microbine) and chemical fertilization (NPK at 6, 8 and 10 g/pot) and the interaction between them on vegetative growth parameters of *Moringa oleifera* plants.

The obtained results revealed that the use of clay in combination with NPK at 8 g/pot gave the highest values of plant height and stem diameter. Also, the obtained highest values of fresh and dry weights of vegetative growth resulted due to using clay or sand + clay medium in combination with microbine + NPK at 10 g/pot and NPK at 8 g/pot.

The best results of root fresh and dry weights, were obtained due to the use of clay in combination with microbine + NPK at 10 g/pot and NPK at 8 g/pot.

Key words: *Moringa oleifera*, fertilization, NPK, biofertilizer, growing media.

INTRODUCTION

Moringa oleifera, Lam. (horseradish or drumstick tree) is a fast growing tree which belongs to the Moringaceae Family. Moringa is one of the important traditional multipurpose food plants. It has a great potential to become one of the most economically important crops for the tropics and subtropics considering its use in many fields as a medicine, food and fodder plant (Ramachandran *et al.*, 1980; Morton, 1991; Amaglo, 2007; Peixoto *et al.*, 2011 and Pontual *et al.*, 2012).

Seeds of *Moringa oleifera* are used as a natural coagulant of raw water clarification, the powder of crushed seed kernels can leave water clear with 90:99% of the bacteria removed (Sutherland *et al.*,1989). Also the seeds are used for oil production, which is used in cosmetics and medicine.

Many researchers studied the effects of bio-fertilizer and mineral NPK fertilization on *Moringa oleifera*. Fagbenro *et al.* (2015) and Asaolu *et al.* (2012) concluded that bio-fertilizers operations significantly increased plant height, stem diameter and fresh and dry biomass as well as pigments compared to control.

Fagbenro *et al.* (2013), Abdullahi *et al.*, (2013) and Umar (2014) reported that supplying Moringa plant with NPK (15:15:15) increases plant height, stem diameter, leaf production and fresh and dry biomass as compared with non-fertilized plants (control).

The aim of this study is to investigate the response of *Moringa oleifera* to bio-, chemical fertilization and growing media in order to enhance and improve their characteristics.

MATERIALS AND METHODS

This study was carried out during the two successive seasons of 2014 and 2015 at the nursery of Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza. The investigation aimed to evaluate the effect of the type of growing medium, bio-fertilizer (microbine) and chemical fertilizer on vegetative growth traits of *Moringa oleifera*.

The seeds of *Moringa oleifera* were obtained from the National Research Center, Dokki, Giza. The seeds were sown in unheated greenhouse, on February, 15th for the two experimental seasons in 15 cm diameter pots filled with clay/sand soil (1:1 v/v). The seedling were transplanted on March, 15th in both seasons in plastic pots (25 cm) filled with soil [clay, sand and sand + clay (1:1 v/v)].

The fertilization with NPK (kristalon 20:20:20) began after one month after transplanting and continued at an interval of 45 days until end of the experiments.

The NPK fertilization was used with 6, 8 and 10 g/pot, and the first inoculation of bio-fertilization (microbine) began after one month from transplanting and the second after 6 months, using liquid fertilizer with 200 ml/pot (microbine).

Microbine is a complex bioenergy consisting of a wide range of microorganisms that are produced from soil fertility and reduce the rates of addition of nitrogen and phosphate fertilizers and micronutrients with at least 25% of the pollution of the environment and add to the previous irrigation treated with pesticides and fungicides.

Soil physical and chemical analyses were carried out using the procedures described by Black *et al.* (1981) and by Cottenie *et al.* (1982), Table (a).

The layout of the experiment was a factorial in a randomized complete block design with three replicates.

The recorded data on vegetative growth parameters were: plant height (cm), stem diameter (cm), fresh and dry weight of vegetative growth parts (g) and the fresh and dry weight of roots (g).

Data were analyzed statistically and compared between treatments and their interactions using LSD test at the probability level of 0.05.

RESULTS AND DISCUSSION

Effect of fertilization and growing media on vegetative growth of Moringa:

1- Plant height (cm):

Data presented in Table (1) showed that the soil type had a significant effect on plant height in both seasons.

In the first season, the growing medium of sand + clay was the most effective, which gave the tallest plants (94.58cm) followed by clayey (85.75 cm) compared with 44.71 cm for plants growing in sandy soil. The similar trend of the results was obtained in the second one.

It is clear in the second season that the growing medium of sand + clay was the most effective treatment, which gave the tallest plants (93.71 cm) compared to 37.71 cm for plants in sandy soil.

Table a. physical and chemical analyses of the used soil.

No.	pH	EC dS/m	Soluble anions (meq/L)				Soluble cations (meq/L)			
			CO_3	HCO_3	Cl	SO_4	Ca	Mg	K	Na
1	8.36	0.28	-	1.6	1.6	Nil	1.0	0.2	0.128	0.89
2	7.95	1.79	0.8	4.2	8.6	4.1	7.5	4.0	2.34	3.86

Table 1. Effect of growing media and fertilization treatments on plant height (cm) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Plant height (cm) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	38.67	80.67	90.33	69.89	13.000	15.33	19.00	15.78
Microbine	52.33	74.33	106.33	77.66	37.33	84.00	77.67	66.33
Microbine & NPK 6	46.67	100.00	91.33	79.33	43.33	91.00	87.33	73.89
Microbine & NPK 8	49.33	106.00	107.00	87.44	34.33	101.00	127.00	87.44
Microbine & NPK 10	29.67	108.33	102.67	80.22	30.33	82.67	98.00	70.33
NPK 6	30.67	62.67	104.67	66.00	39.33	66.67	118.00	74.67
NPK 8	79.00	101.00	93.33	91.11	74.00	109.00	125.33	102.78
NPK 10	31.33	53.00	61.00	48.44	30.00	60.00	97.33	62.44
Mean	44.71	85.75	94.58		37.71	76.21	93.71	
L.S.D at 0.05 of A	17.27				14.20			
L.S.D at 0.05 of B	8.07				6.63			
L.S.D at 0.05 of A × B	22.82				18.76			

These results are unanimously in agreement with those obtained by Mahmood (2005) on *Caesalpinia pulcherrima* and *Thevetia peruviana*; El-Mahrok *et al.* (2009) on *Cestrum aurantiacum*; Azza *et al.* (2010) on *Jatropha curcas* L.; Youssef (2011) on *Populous euramericana*; El- Assaly (2011) on *Khaya senegalensis* and El- Sayed (2013) on *Moringa oleifera*.

Regarding the effect of fertilization, the plant height significantly was increased in both seasons compared with (control) untreated plants. The highest values were obtained in the first and second seasons (91.11 and 102.78 cm, respectively) with NPK (20:20:20) at 8 g/pot, compared with 69.80 and 15.78 cm for control in the first and second seasons respectively.

These results are harmonized with the findings obtained by Gad (2003) on *Ficus benjamina*, who pointed out that NPK at 8g/pot resulted in the highest values of growth than control.

The interaction between soil type and fertilization had a significant effect on plant height in both seasons. Plants treated with microbine and NPK at 8 g/pot and growing in sand + clay soil gave the tallest plants (107.00 cm) compared with control plants (90.33 cm).

In the second season, the plants treated with NPK at 8 g/pot and growing in sand + clay soil gave the tallest plants (125.33 cm) compared with (19.00 cm) for control plants growing in the same medium and without any fertilization.

2- Stem diameter (cm):

Data presented in Table (2) showed the effect of fertilization and soil type treatments on the stem diameter.

It is clear that the soil type had a significant effect on stem diameter in both seasons.

The biggest stem diameter (0.84 cm) in the first season, (0.85 cm) and in the second season, were obtained from plants cultivated in sand + clay soil compared with control and other treatments.

These results are in agreement with those obtained by Azza *et al.* (2010) on *Jatropha curcas* L.; El-Mahrouk *et al.* (2009) on *Cestrum aurantiacum* and Youssef (2011) on *Populous euramericana*.

Data showed that cultivation in sand + clay soil increased stem diameter (cm).

Table 2. Effect of growing media and fertilization treatments on stem diameter (cm) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Stem diameter (cm) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	0.50	0.70	0.83	0.68	0.17	0.27	0.30	0.25
Microbine	0.63	0.83	0.83	0.76	0.50	0.67	0.60	0.59
Microbine & NPK 6	0.60	0.87	0.83	0.77	0.50	0.93	0.83	0.75
Microbine & NPK 8	0.50	1.00	0.90	0.80	0.47	1.03	1.23	0.91
Microbine & NPK 10	0.33	1.10	0.87	0.77	0.47	0.87	0.93	0.76
NPK 6	0.40	0.67	0.87	0.65	0.47	0.63	1.03	0.71
NPK 8	0.83	0.80	0.87	0.83	0.77	1.02	1.05	0.95
NPK 10	0.50	0.63	0.70	0.61	0.40	0.67	0.83	0.63
Mean	0.54	0.83	0.84		0.47	0.76	0.85	
L.S.D at 0.05 of A		0.19				0.18		
L.S.D at 0.05 of B		0.09				0.08		
L.S.D at 0.05 of A × B		0.26				0.23		

Regarding the effect of fertilization, data presented in Table (2) during both seasons, revealed that, the use of NPK at 8 g/pot significantly increased the stem diameter to 0.83 cm and 0.95 cm, followed by microbine + NPK at 8 g/pot which gave 0.80 cm and 0.91 cm, compared with untreated ones which gave 0.68 cm and 0.25 cm in the first and second seasons, respectively.

Concerning effect of the interaction between soil type and fertilization on stem diameter, data presented in Table (2) showed a significant effect in all treatments in the two seasons compared with the untreated plants.

The highest stem diameter (1.10 cm) was obtained due to the treatment of microbine + NPK at 10 g/pot in clayey soil compared with 0.70 cm in the control treatment in the first season.

Also in the second season, the microbine + NPK at 8 g/pot gave the highest values (1.23 cm and 1.03 cm) of stem diameter in sand + clay medium and clayey compared with 0.30 cm and 0.27 cm in the control respectively.

These findings go parallel with those of Rabie (2002) on *Taxodium distichum* and El-Assaly (2011) on *Khaya senegalensis*.

3- Vegetative parts fresh weight (g):

Data presented in Table (3) showed that the growing medium significantly increased vegetative parts fresh weight in both seasons.

The highly significant fresh weight values (56.72 and 60.01 g/plant) were obtained from plants cultivated in sand + clay growing medium in the first and second seasons respectively. However, the lowest values (18.60 and 14.41 g/plant) were obtained from plants growing in sandy medium in both seasons, respectively.

Regarding the effect of fertilization on fresh weight of vegetative growth parts data presented in Table (3) showed that the fertilization with NPK at 8 g/pot gave the significantly highest values (57.45 and 69.97 g/plant) in the first and second seasons respectively compared with untreated plants (25.84 and 8.48 g/plant, respectively).

The interaction between bio and/or chemical NPK fertilization treatments in any used growing medium was significant in the two seasons compared with control plants.

The highest value of fresh weight of vegetative growth parts (95.54 g/plant) was obtained by microbine + NPK at 10 g/pot treatment for plants growing in clayey medium compared with untreated plants

Table 3. Effect of growing media and fertilization treatments on vegetative parts fresh weight (g) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Vegetative parts fresh weight (g) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	9.51	39.48	40.51	25.84	8.34	7.87	9.23	8.48
Microbine	17.15	46.42	53.21	38.93	14.02	31.64	24.92	23.53
Microbine & NPK 6	15.72	61.55	46.17	42.48	13.24	64.24	43.42	40.30
Microbine & NPK 8	16.86	87.24	76.95	56.50	11.30	95.00	96.71	67.67
Microbine & NPK 10	8.58	95.54	51.52	51.39	10.93	51.71	64.13	42.26
NPK 6	7.54	24.93	65.87	32.78	10.31	21.37	97.94	43.21
NPK 8	54.87	72.43	45.79	57.45	37.73	78.24	93.94	69.97
NPK 10	10.61	23.53	25.35	25.84	9.42	22.61	49.75	27.26
Mean	18.60	55.54	56.72		14.41	46.59	60.01	
L.S.D at 0.05 of A	23.49				18.46			
L.S.D at 0.05 of B	10.97				8.62			
L.S.D at 0.05 of A × B	31.04				24.39			

(39.48 g/plant) in the first season, while in the second season. NPK at 6 g/plants treatment gave the highest value of 97.94 g/plant in the mixture medium compared with untreated plants (9.23 g/plant).

Also these results are in accordance with those obtained by Knapik and Angelo (2007) on *Prunus sellowii koehne*; Gad (2003) on *Ficus benjamina*; El-Sallami (2002) on *Chorisia speciesa*, *Leucaena leucocephala* and *Prosoppis juliflora* and Rabie (2002) on *Taxodium distichum*.

4- Vegetative parts dry weight (g):

The results recorded in both two seasons in Table (4) show that the growing medium of sand + clay significantly increased the dry weight of vegetative parts compared with the other used media.

Table 4. Effect of growing media and fertilization treatments on vegetative parts dry weight (g) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Vegetative parts dry weight (g) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	7.32	9.25	11.02	9.20	6.63	7.51	8.12	7.42
Microbine	10.14	14.87	14.62	13.21	9.44	12.88	12.00	11.44
Microbine & NPK 6	9.73	14.21	14.09	12.68	9.30	17.17	13.70	13.39
Microbine & NPK 8	10.11	20.32	20.67	17.03	8.71	23.59	22.61	18.30
Microbine & NPK 10	8.51	21.70	22.32	17.51	8.96	17.00	18.17	14.71
NPK 6	8.28	11.13	17.70	12.37	8.66	10.39	22.88	13.98
NPK 8	16.88	18.37	15.38	16.88	14.04	20.57	22.42	19.01
NPK 10	9.71	10.16	10.00	9.96	8.77	11.17	15.58	11.84
Mean	10.09	15.00	15.73		9.31	15.04	16.94	
L.S.D at 0.05 of A	3.58				4.07			
L.S.D at 0.05 of B	1.67				1.90			
L.S.D at 0.05 of A × B	4.73				5.37			

The heaviest dry weight of vegetative growth parts (15.73 and 16.94 g/plant) was obtained from plants growing in sand + clay medium in the first and second seasons, respectively.

Regarding the effect of fertilization, data presented in Table (4) showed that all fertilization treatments significantly increased the dry weight of vegetative growth as compared with the control which recorded 9.20 and 7.42 g/plant in the first and second seasons, respectively.

5- Roots fresh weight (g):

Data presented in Table (5) during both seasons revealed that all used fertilization treatments increased roots fresh weight in all used growing media.

The highest values of roots fresh weight were obtained with fertilization by microbine + NPK at 10 g/pot, which gave 30.36 g/plant in the first season In the second season NPK at 8 g/pot gave the highest value 39.36 g/plant , compared with control, which gave 21.32 and 9.19 g/plant in the first and second seasons respectively.

Regarding the effect of growing medium, clayey medium gave the highest values of roots fresh weight, which were 32.25 and 33.79 g/plant in the first and second seasons compared with those cultivated in sandy soil which gave 13.16 g/plant in the first season and 15.12 g/plant in the second one.

The interaction between growing medium and fertilization had a significant effect on roots fresh weight.

The clayey medium with the use of microbine + NPK at 10 g/pot gave the highest value of roots fresh weight as 55.21 g/plant compared with 25.56 g/plant from the plants growing in the same medium without any fertilization. In the second season the highest value of 56.76 g/plant was obtained from plants cultivated in clayey soil and fertilized with NPK at 8 g/pot compared to 9.05 g /plant from plants cultivated in the same medium without any fertilization treatments.

These results are in agreement with findings by Mahmood (2005) on *Caesalpinia pulcherrima* and *Thevetia peruviana*; El-Khateeb *et al.* (2006) on *Ficus alii*; El-Mahrouk *et al.* (2009) on *Cestrum aurantiacum*; Singh and Niar (2003) on some foliage plants; Gavat *et al.* (2008) on some coniferous and deciduous species and Karchikeyan *et al.* (2007) on *Azadirachta indica*.

Table 5. Effect of growing media and fertilization treatments on roots fresh weight (g) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Roots fresh weight (g) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	15.86	25.56	22.54	21.32	8.22	9.05	10.29	9.19
Microbine	17.86	32.71	33.75	28.11	13.89	37.94	29.38	27.07
Microbine & NPK 6	13.29	21.95	26.26	20.50	14.62	32.86	25.83	24.44
Microbine & NPK 8	10.79	46.36	21.9	26.35	13.93	38.86	38.44	30.41
Microbine & NPK 10	5.15	55.21	30.73	30.36	7.85	28.08	34.96	23.63
NPK 6	10.14	26.35	36.91	24.47	15.35	48.20	52.65	38.73
NPK 8	20.93	27.18	29.25	25.79	23.94	56.76	37.37	39.36
NPK 10	11.29	22.69	45.08	26.35	23.17	18.54	30.17	23.96
Mean	13.16	32.25	30.80		15.12	33.79	32.39	
L.S.D at 0.05 of A	15.30				11.89			
L.S.D at 0.05 of B	7.14				5.55			
L.S.D at 0.05 of A × B	20.21				15.72			

6- Roots dry weight (g):

Data presented in Table (6) showed that the type of growing medium had a significant effect on roots dry weight in both seasons.

The growing medium of clayey soil had a significant effect on roots dry weight, which gave the highest values of 11.08 and 13.20 g/plant in the first and second seasons, respectively compared with plants cultivated in sandy soil which gave 6.94 and 6.92 g/plant in the first and second seasons, respectively.

These results are in agreement with the findings obtained by Mahmood (2005) on *Caesalpinia pulcherrima* and *Thevetia peruviana*; El-Khateeb *et al.* (2006) on *Ficus alii*; El-Mahrouk *et al.* (2009) on *Cestrum aurantiacum.* They showed that agriculture in clayey soil increased roots dry weight.

Bio-ertilizers (microbine) + NPK 10 g/pot and NPK at 8 g/pot significantly increased roots dry weight in the first and second seasons, respectively. In the first season, it gave the highest value of 11.04 g/plant, while in the second season, it gave the highest value of roots dry weight (15.56 g/plant) compared with 9.74 and 4.28 g/plant, in the first and second seasons respectively for control plants.

In relation to the influence of interaction between growing medium and fertilization on roots dry weight, the highest value of roots dry weight was obtained from clayey soil and microbine with NPK at 10 g/pot which gave 19.20 g/plant in the first season, while in the second season the highest value (28.19 g/plant) was obtained from plants cultivated in clayey soil and fertilized with NPK 8g/pot, compared to the lowest values of 9.25 and 4.20 g/plant in the first and second seasons, respectively from unfertilized plants cultivated in clayey soil.

REFERENCES

Abdullahi, I.N.; Ochik, K. and Gwaram, A.B. (2013). Plant population and fertilizer application effects on biomass productivity of Moringa. Peak Jouurnal of Agricultural Sciences, 1(6):94-100.

Amaglo, N.K. (2007). Effect of spacing and harvest frequency on the growth and leaf yield of moringa (*Moringa oleifera* Lam.), a leafy vegetable crop. Ghana J. Hort., 6:33-40.

Table 6. Effect of growing media and fertilization treatments on roots dry weight (g) of moringa (*Moringa oleifera* Lam.) plants during 2014 and 2015 seasons.

Fertilizer (A)	Growing media (B) Roots dry weight (g) 2014				2015			
	Sandy	Clayey	Sandy & Clayey	Mean	Sandy	Clayey	Sandy & Clayey	Mean
Control	9.77	9.25	10.20	9.74	3.94	4.20	4.71	4.28
Microbine	6.82	12.38	8.08	9.09	5.98	13.48	10.27	9.91
Microbine & NPK 6	8.80	9.17	10.13	9.37	5.99	8.38	8.86	7.74
Microbine & NPK 8	5.16	15.42	6.71	9.10	10.18	12.91	9.92	11.00
Microbine & NPK 10	4.24	19.20	9.67	11.04	5.51	8.52	12.12	8.72
NPK 6	7.10	8.48	8.05	7.88	5.67	23.42	11.20	13.43
NPK 8	8.11	7.11	9.67	8.30	8.20	28.19	10.28	15.56
NPK 10	5.53	7.65	13.05	8.74	9.92	6.51	8.09	8.17
Mean	6.94	11.08	9.45		6.92	13.20	9.43	
L.S.D at 0.05 of A			6.22				5.65	
L.S.D at 0.05 of B			2.90				2.64	
L.S.D at 0.05 of A × B			8.22				7.47	

Asaolu, V.O.; Binuomote, R.; Akinlade, J.; Aderinola, O. and Oyelami, O. (2012). Intake and growth performance of West African dwarf goats fed on *Moringa oleifera*, *Geiriciaia sepium* and *Leucaena leucocephala* dried leaves as supplements to casava peels. J. Biol Agric. Health Care, 2(10):76- 88.

Azza, A.M.M.; Nahed G.A. and El-Habba, E. (2010). Impact of different soil media on growth and chemical constituents of *Jatropha curcas* L. grown under water regime. Journal of American Science, 6(8):549-556.

El-Assaly, R.M. (2011). Effect of Growing Media and Fertilization on Growth and Composition of *Khaya senegalensis* Plant. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt. 125pp.

El-Khateeb, M.A.; El-Maadawy, E.E. and El-Atter, A.A. (2006). Effect of growing media on growth and chemical composition of *Ficus alii*. plants. Annals of Agricultural Science Moshtohor, 46(2):1987-1998.

El-Mahrouk, E.M.; Kandeel, Y.M.; Hegazi, M.A.; Nasr Mary N. and, Adam Amani I. (2009). Effect of soil type and fertilization treatments on growth and chemical composition of some ornamental shrubs *Cestrum aurantiancum* (Lindley). Alex. Journal of Agriculture Research, 54(1):111-121.

El-Sallami, I. H. (2002). Seedling responses of some ormamental trees to soil type and NPK fertilization. Assiut Journal of Agriculture Science, 33(3):49-83.

El-Sayed, A.A. (2013). Effect of Soil Type, Fertilization and Salinity on Growth and Constituents of *Moringa oleifera* Lam. M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt., 107p.

Fagbenro, J.A.; Oshunsanya, S.O. and Onawumi, O.A. (2013). Effect of saw dust biochar and NPK 15:15:15 inorganic fertilizer on *Moringa oleifera* seedlings grown in an oxisol. Agrosearch, 13(1):57-68.

Fagbenro, J.A.; Oshunsanya, S.O.; Oyeleye, B.A. (2015). Effects of gliricidia biochar and inorganic fertilizer on moringa plant grown in an Oxisol. Communications in Soil Science and Plant Analysis., 46(5):619-626.

Gad, M.M. (2003). Evaluation of various potting media and fertilizer levels for commercial nursery production of *Ficus benjamina* L. Assiut J. Agric., Sci. 34(4):123-151.

Gavat, C.; Dumitru, L.M.; Trandafirescu, M. and Caretu, G. (2008). Response of some container-type cropped coniferous and deciduous species to application of fertilizer and other nutrients. International Symposium on Growing Media. Acta Horticulture, 1:779.

Karthikeyan, A.; Savio, M.M.D and Deeparaj, B. (2007). Application of bio-fertilizers for quality seedling production of *Azadirachta indica*. J. Indian. Forest., 8(1):111-113.

Knapik, J.G. and Angelo, A.C. (2007). Growth of *Prunus sellowii koehne* seedlings in response to NPK fertilizers and basalt dust. Floresta, 37(2):257-264.

Mahmood, S.M. (2005). Effect of different soil media on seed germination, seedling growth and NPK content in *Caesalpinia pulcherrima* and *Thevetia peruviana*. University of Aden. Journal of Natural and Applied Sciences, 9(2):319-330.

Morton, J.F. (1991). The horseradish tree, *Moringa pterygosperma* (Moringaceae) a boon to arid lands. Econ. Bot., 45:318-333.

Peixoto, R.; Silva, G.C.; Costa, R.A.; Josei, L.S.; Vieira, G.H.F.; Filho, A.A.F. and Vieira H.S.F. (2011). In vitro antilacterial effect of aqueous and ethanolic Moringa leaf extracts. Asian Pacific J. Trop. Med. 4(3):201-2014.

Pontual, V.E.; Belany, E.A.C.; Bezerra, S.R.; Coelho, C.B.; Napoleao, H.T. and paiva, M.G.P. (2012). Caseinolytic and milk-clotting activities from *moringa oleifera* flowers. Food Chem., 135(3-1):1848-1854.

Rabie, A.R. (2002). Effect of Some Fertilization Treatments on Growth and Chemical Composition of *Taxodium distichum* Seedlings Growing in Different Soil Types. Ph.D. Thesis, Fac., Agric., Cairo Univ., Egypt, 231pp.

Ramachandran, C.; Peter, K.V. and Gopalakrishnana, P.K. (1980). Drumstick (*Moringa oleifera*): A multipurpose Indian vegetable. Econ. Bot., 34:276-283.

Singh, D.R. and Nair, S.A. (2003). Standardization of rooting media for cuttings of certain house plants. Journal Ornamental Horticulture, New-Series, 6(1):78-79.

Sutherland, J.P.; Folkard, G.K. and Grant, W.D. (1989). Seeds of *Moringa* species as naturally occurring flocculants for water treatment. Science Technology and Development, 7 (3):191-197.

Umar, A.F. (2014). Effect of farm-yard manure and inorganic fertilizer application on the coppicing alility of *Moringa oleifera* (Lam.) plantation at Gaya, Kano, Nigeria. Umar, World J. Biol. Med. Science, 1(2):37-45.

Youssef, N.M. (2011). Physiological Studies on Some Types of Poplar Plant (*Populus euramericana* and *Populus nigra*). M.Sc. Thesis, Fac. Agric., Cairo Univ., Egypt, 138 pp.

استجابة أشجار المورينجا اوليفيرا للتسميد الحيوي (ميكروبين) والكيمائي وبيئة النمو

عاطف زكريا سرحان، عزة محمد سعيد عرفة، حسين علي أحمد قناو
قسم بساتين الزينة، كلية الزراعة، جامعة القاهرة، الجيزة، مصر.

أجريت هذه التجربة لدراسة تأثير نوع التربة (التربة الرملية والطينية والخليط [رمل + طين ١:١] بالحجم) والسماد الحيوي (الميكروبين) والاسمدة الكيماوية (NPK) بمعدلات (٦ و٨ و١٠ جم/ الاصيص) على صفات النمو الخضري (ارتفاع النبات، قطر الساق، وزن المجموع الخضري الطازج والجاف، وزن المجموع الجذري الطازج والجاف).

تم الحصول على أعلى القيم لارتفاع النبات وقطر الساق عند الزراعة في التربة الخليط (الرمل + الطين ١: ١) مع المعاملةبالتسميد الكيمائي ٨ جم / اصيص. وأيضا تم الحصول على أعلى القيم من وزن المجموع الخضري الطازج والجاف عند الزراعة في التربة الخليط (الرمل + الطين ١: ١) مع معاملة بالتسميد الكيمائي ٨ جم / اصيص. وتم الحصول على أفضل القيم من الوزن الطازج والجاف للمجموع الجذري في التربة الطينية مع المعاملة (الميكروبين + NPK ١٠ جم / اصيص) والسماد الكيمائي بمعدل ٨ جم / اصيص.