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RESPONSE OF *POPULUS NIGRA*, L. SEEDLINGS TO COMPOST, BIOFERTILIZERS AND MINERAL NPK FERTILIZATION.

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ABSTRACT

This investigation was conducted to investigate the response of *Populus nigra* seedlings to compost fertilization at four levels and bio. and/or mineral NPK treatments (control, phosphorein, Minia Azotein, Effective microorganisms (E.M.), phosphorein + Minia Azotein, phosphorein + Effective microorganisms, phosphorein + Minia Azotein + E.M., a mixture of bio. + 75 % NPK and mineral NPK, full dose) on vegetative and root growth and some chemical constituents. The obtained results indicated that, seedling height, stem diameter, whole seedling fresh and dry weights, main root length, fresh and dry weights of roots, stem/root ratio, as well as, chemical constituents including total chlorophyllS, percentage of N, P and K were gradually increased by increasing the levels of compost fertilizer. All bio. and/or mineral NPK fertilization treatments significantly increased all the previous parameters. Bio. + 75 % NPK dose followed by mineral NPK (full dose) treatments were more effective in this concern. The interaction between compost and bio. and/or mineral NPK fertilization treatments was significant for vegetative and root growth, except for stem/root ratio with the highest values for vegetative and root growth traits were obtained due to compost$_3$ fertilizer in combination with bio. + 75 % NPK dose or with mineral NPK (full dose)

INTRODUCTION

Poplar is one of the best fast-growing trees in the world (Liu *et al*., 2009). Poplar is a member of Saliaceae family, which includes several species and is distributed extensively in the world (Bradshaw *et al.,* 2007). Poplars provide a wide range of wood products including industrial roundwood, pulp and paper, reconstituted boards, playwood, veneer, sawn timber, packing crates, boxes, pallets and furniture. Poplars also produce young branches and foliage for use as an alternative sheep fodder. Poplars have a positive role in preserving the environment, they used as shelterbelts, windbreak against wind, soil erosion control, carbon sequestration, climate change mitigation, agroforestry and protection of water, crops, livestock and dwellings (Ball *et al.*, 2005).

Organic materials are added to soils to improve their physical and chemical properties of macro and micro elements, amino acids, organic acids, sugars and organic matter (Abo El-Fadl *et al.*, 1968). Also, they considered useful substrate for several beneficial microorganisms and water holding capacity. Tisdale *et al.*, (1985); Hart and Nguyen (1994) ; Gangoo *et al.* (1997) ; Ali *et al.* (2002) and Ahmed *et al.* (2006) on poplars found that organic manures treatment led to an increase in vegetative and root growth, as well as, pigments and N, P and K percentages in the leaves of poplars.

Biofertilizers are considered to be low costs, ecofriendly and renewable sources of plant nutrients than supplementing chemical fertilizers in sustainable agricultural systems. Ahmed *et al.* (2005) on *Populus nigra* seedlings concluded that biofertilizer treatments significantly increased stem length and diameter, number of branches, fresh and dry weights of seedlings, root length and fresh and weights and chemical constituents (pigments and NPK elements) compared to control. Similar results were reported by Rajeshkumar *et al.* (2009) on *Melia azedarach* ; Abdou and Ashour (2012) on jojoba seedling ; Umashankar *et al.* (2012) on *Grevillea robusta* and El-Quesni *et al.* (2013) on *Jatropha curcas*.

Many authors studied the effects of NPK fertilization on poplar plants as Zabek (1995) ; Kohan *et al.* (2000) ; Ali *et al.* (2002) ; Ahmed *et al.* (2005) ; Coleman *et al.* (2006) and Tripathi *et al.* (2012) who found that the treatments of mineral NPK fertilizer increased the vegetative growth characters. Amin (2013) on *Pinus radiata* and *Robinia pseudoacacia* transplants concluded that mineral NPK fertilizers increased plant height, root length, stem diameter, leaf area and fresh and dry weights of shoots and roots, as well as, N, P and K percentages in the two plants under investigation.

Poplar can grow well under arid area, however, fertilization needs to be investigated under the Egyptian conditions. This work aimed to investigate the response of *Populus nigra* seedlings grown in sandy soil to organic, biofertilizers and mineral fertilization in order to enhance and improve their characteristics.

MATERIALS AND METHODS

This investigation was carried out during the two successive seasons of 2011 and 2012 at the Nursery of Ornamental Plants, Faculty of Agriculture, Minia University to figure out the response of *Populus nigra* seedlings grown in sandy soil to organic and bio. and/or mineral fertilization treatments.

Cuttings of *Populus nigra* were obtained from Mallawy Agricultural Research Station, Minia Governorate, Egypt. Cuttings were planted on March 1st for both seasons in containers (25×25×35 cm) each filled with 20 kg of sandy soil. Each container contain 3 cuttings and seedlings were thinned to one seedling/container after one month from planting date. Physical and chemical properties of the soil used are listed in Table (a).

The split plot design with three replicates containing 5 seedlings per replicate was followed in this experiment. The four levels of compost treatments were considered as main plots (A) and the nine biofertilizers and/or mineral NPK fertilization treatments occupied the sub-plots (B).

Table(a) physical and chemical properties of the soil

Character		Value 2011	Value 2012
Sand %		88.00	89.00
Silt %		8.30	7.40
Clay %		3.70	3.60
Texture		Sandy	Sandy
Ca CO_3 %		14.42	14.91
pH (1 : 2.5)		8.17	8.21
Organic matter %		0.06	0.05
E. C. (m mhos / cm)		1.09	1.11
Total N %		0.02	0.02
Available P %		3.25	3.56
Extr. K (mg/100 g soil)		0.90	1.01
DTPA Ext. ppm	Fe	1.10	1.18
	Cu	0.39	0.43
	Zn	0.36	0.30
	Mn	0.60	0.71

Table(b) physical and chemical properties of the compost

Properties	Value	Properties	Value
Dry weight of 1 m^3	450 kg	NaCl (%)	1.1-1.75
Fresh weight of 1 m^3	650-700 kg	Total P (%)	0.5-0.75
Moisture (%)	25-30	Total K (%)	0.8-1.0
pH 1:10	7.5-8	Fe (ppm)	150-200
E.C. (m mhose/cm)	2-4	Mn (ppm)	25.56
Total N (%)	1-1.4	Cu (ppm)	75-150
Org. matter (%)	32-34	Zn (ppm)	150-225
Org. carbon (%)	18.5-19.7		
C/N ratio	18.5-14.1		

Therefore, the interaction treatments (A×B) were 36 treatments. The four levels of compost were compost$_0$ (without compost as control), compost$_1$ (200 g/container), compost$_2$ (400 g/container) and compost$_3$ (600 g/container). The used compost called (compost El-Neel) was obtained from the Egyptian Co. for Solid Waste Utilization, New Minia City. Compost was added during filling the container. Physical and chemical properties of the used compost are shown in Table (b).

The biofertilizers and/or mineral NPK fertilization treatments were as follows:

1- without any fertilizers (control),
2- phosphorein at 5 g/container,
3- Minia Azotein at 50 ml/container (1 ml=10^7 cells),
4- Effective microorganism (E.M.) at 50 ml/container (1 ml=10^7 cells),
5- phosphorein + Minia Azotein,
6- phosphorein + E.M.,
7- phosphorein + Minia Azotein + E.M.,
8- Bio. (phos. +M.A.+E.M.)+ 75 % NPK and 100 % NPK as recommended dose.

Fresh and active three biofertilizers namely, phosphorein (P-dissolving bacteria), Minia Azotein (containing N-fixing bacteria) and E.M. (containing photosynthetic bacteria + lactic acid + yeasts) were applied either separately or in a mixture at three times at one month interval starting 45 days after planting (April 14th for the first and second seasons). Biofertilizers were added to the soil around each seedling and then seedlings were irrigated immediately.

The recommended mineral NPK fertilization was 2 g/container of ammonium sulphate (20.6 % N) + 4 g/container of calcium superphosphate (15.5 % P_2O_5) + 2 g/container of potassium sulphate (48 % K_2O), while 75 % NPK were 1.5+3+1.5, respectively. The amounts of mineral NK fertilizers were divided into three equal batches and added at one month interval, starting April 21st in both seasons, while all amounts of P were added with the first dose of NK. All other agricultural practices were carried out as usual in the region in the two experimental seasons.

The following data were recorded at the last week of October for the two experimental seasons.

1- Vegetative growth characters: - seedling height (cm), stem diameter (mm), whole seedling fresh and dry weights (g).
2- Root growth characters: - main root length (cm), fresh and dry weights of roots and stem/root ratio (calculated as dry weight).
3- Determination of some chemical constituents: - total chlorophylls (mg/g f.w.) were determined in the fresh leaves samples using the method described by Moran (1982), the percentage of N, P and K in the dry leaves were estimated according to Page *et al*. (1982).

All of the obtained data were subjected to the statistical analysis of variance using MSTAT-C (1986). L.S.D. test at 0.05 was used to compare the average means of treatments.

RESULTS AND DISCUSSION

1-Vegetative growth characters:

Data presented in Tables (1 and 2) showed that seedling height, stem diameter, whole seedling fresh and dry weights/seedling were significantly increased in both seasons due to the use of $compost_1$, $compost_2$ and $compost_3$ fertilization in comparison with those of inorganic fertilized ($compost_0$). Moreover, the increase was gradual by the gradual increase in compost fertilizer levels. The increase in vegetative growth traits due to the low, medium and high level of compost over the control reached 17.08, 26.29 and 37.03 % for seedling height, 6.48, 11.40 and 22.02 % for stem diameter, 32.14, 51.39 and 65.73 % for whole plant fresh weight and 36.92, 60.45 and 78.79 % for whole plant dry weight, respectively, in the first season. The results in the second season took the same trend. Similar, results were found by Hart and Nguyen (1994); Gangoo *et al.* (1997); Ali *et al*. (2002) and Ahmed *et al.* (2006) on poplars.

The stimulatory effect of compost treatments on vegetative growth traits may be due to organic manure which gave availability of most nutrients. Such stimulation on the uptake of nutrient leads to enhancing the biosynthesis of organic foods and cell division, more carbohydrates and dry matter accumulation (Nijjar, 1985).

Data presented in Tables (1 and 2) indicated that seedling height, stem diameter, fresh and dry weights of whole plant/seedling were significantly increased, in both seasons, due to the use of all treatments of bio. and/or mineral NPK fertilization treatments in comparison with unfertilized control. The treatments of mixture biofertilizers (phosphorein, Minia Azotein and E.M.) + 75 % NPK dose followed by mineral NPK (full dose) seemed to be more effective than other six treatments. However, no significant differences were detected between such two superior treatments for the four vegetative growth characters in the two seasons. These findings go parallel with those of Ahmed *et al.* (2005) on *Populus nigra*; Moustafa (2008) on *Chorisia speciosa* and Abdou and Ashour (2012) on jojoba seedlings regarding the effect of biofertilizers, Meantime, Badran *et al.* (2003) on *Acacia saligna* ; Abd El-Dayem (2003) on *Taxodium distichum* ; Ali (2005) on *Sterculia diversifolia* and El-Morshedy (2007) on *Terminalia arjuna*, found that NPK treatments increased seedling height, stem diameter and fresh and dry weights of such plants.

The stimulatory effect of biofertilizers and/or mineral NPK may be attributed to the role of NPK on plant physiological processes (Devlin, 1975), also, biofertilizers increase soil available N and P, as well as, other nutrient elements, consequently increase formation of metabolites which encourage the plant vegetative growth or gibberellin and auxins which came as a result from inoculation of biofertilizers, that encourage the cell division and cell enlargement (Spernat, 1990 and Hauka, 2000).

The interaction between compost and bio. and/or mineral NPK fertilization treatments was significant in the two seasons for the four characters. The highest values were obtained due to supplying *Populus nigra* with compost$_3$ in combination with bio. + 75 % NPK dose or mineral NPK (full dose).

2- Root growth characters:

Data presented in Tables (3 and 4) during both seasons revealed that the used of compost treatments has pronounced significant effects on the length of main roots, fresh and dry weights of root system and stem/root ratio (D.T.) when compared with untreated ones in the two growing seasons. The highest values of the four parameters resulted from the treatment of compost$_3$ followed by compost$_2$ then compost$_1$. The differences among the different treatments reached the significant level (5 %) in all cases in the two seasons.

The increase in root growth may be due to the mode of action of organic manure in improving the physical characters of the soil that facilitate the roots penetration. Also, nutrients, cytokinins and vitamins from analyzed organic manure have an improving effect on plant growth, consequently weight of root system (Abo El-Fadl *et al*., 1968). Similar results were obtained by Saleh (2000) on *Ficus benjamina*, El-Sayed and Abdou (2002) on *Khaya senegalensis* ; Abdou *et al.* (2003) on *Delonix regia* and Ashour (2010) on jojoba seedlings.

Data in Tables (3 and 4) showed that all used fertilization treatments significantly increased in main root length, roots fresh and dry weights/seedling, as well as, stem/root ratio over the control in both seasons. The highest values of main root length, roots fresh and dry weights and stem/root ratio were resulted from the treatments of bio. + 75 % NPK dose and mineral NPK (full dose). Moreover, data showed that phosphorein as biofertilizer was much more effective than Minia Azotein in this concern.

These results may be referred to that the different fertilizers increased partitioning to perennial tissues as coarse roots. Also, they increase the biosynthesis and metabolites which consequently increased carbohydrates accumulation in the roots.

In agreement with these results concerning biofertilizers were those of Abdou *et al.* (2007) and El-Tayeb and El-Sayed (2010) on *Ficus* spp. and Twum-Ampofo (2008) on *Gliricida sepium*. While, the role of mineral NPK was reported by El-Morshedy (2007) on *Grivellea robusta* and *Terminalia arjuna* and Amin (2013) on *Pinus radiata* and *Robinia pseudoacacia*.

The interaction between main and sub plot treatments was significant for main root length and roots fresh and dry weights in both seasons. The tallest and heaviest weights of roots were obtained by adding compost$_3$, (600 g/container) in combination with bio. + 75 % NPK dose or with only mineral NPK (full dose) as clearly shown in Tables (3 and 4). Abdou and Ashour (2012) stated that organic manure in combination with bio.+ reduce dose of mineral NPK resulted in the heaviest roots weight which was equal to that from recommended dose of mineral NPK in combination with organic manure.

3-Chemical constituents:

3-1- N, P and K %:

Data presented in Tables (5 and 6) indicated that the three compost fertilization treatments had pronounced effects on N, P and K % in the dry leaves during the two growing seasons when compared with the control. The highest N, P and K percentages were resulted from the treatment of high level of compost (600 g/container).

This result may be referred to the increment of N, P and K in the root zone as a result of adding organic manure thereby improved the uptake of nutrient elements (Awad *et al.*, 2003).

Similar results were obtained by Ali *et al.* (2002) and Ahmed *et al.* (2006) on *Populus nigra*; Wroblewska *et al.* (2009) on *Salix purpurea* and Ahmadloo *et al.* (2012) on cypress seedlings.

It is obvious from data presented in Tables (5 and 6) that the application of any biofertilizers either in mixture or separately, bio. + 75 % NPK dose and mineral NPK (full dose) resulted in a significant increase in N, P and K % in the dry leaves compared to the control in both seasons.

The highest values of N, P and K % were recorded for the treatment of mineral NPK (full dose), followed by the treatment of bio. + 75 % NPK dose without significant differences between such two superior treatments in case of P % in both seasons and N % in the second season.

The positive effect of mineral NPK and biofertilizers on N, P and K % may be due to the increment of NPK elements in the root zone from application of NPK and inoculation by bacteria, it turn account on the N, P and K uptake (Devlin, 1975 and Hauka, 2000).

This was in accordance with the previous results on poplar reported by Ali *et al.* (2002); Ahmed *et al.* (2005), Coleman *et al.* (2006) and Balasus *et al.* (2010) regarding the effects of NPK. Moreover, Ahmed *et al.* (2005) on *Populus nigra* ; Moustafa (2008) on *Chorisia speciosa*; Umashankar *et al.* (2012) on silver oak and Abdou and Ashour (2012) on jojoba seedlings concluded that biofertilizers plus mineral NPK fertilization treatments increased the percentages of N, P and K.

Table (1): Effect of compost, bio. and / or mineral NPK fertilization treatments on seedling height (cm) and stem diameter (mm) of *Populus nigra* seedlings in the two growing seasons 2011 and 2012.

Bio. and / or mineral NPK fertilization treatments	**Compost levels (ton/fed.) (A)**									
	1st season					2nd season				
	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)
	Seedling height (cm)									
Control	77.19	105.60	117.93	122.60	105.83	82.63	111.00	123.33	128.00	111.24
Phosphorein	84.77	109.10	121.60	126.93	110.60	90.17	114.50	127.00	132.33	116.00
Minia Azotein	97.48	110.77	122.27	127.43	114.49	102.88	116.17	127.67	132.83	119.89
E.M.	98.23	110.35	121.53	130.02	115.03	103.63	115.75	126.92	135.42	120.43
Phos. + M.A.	100.52	113.27	123.68	131.85	117.33	105.92	118.67	129.08	137.25	122.73
Phos. + E.M.	101.35	116.73	124.85	140.35	120.82	106.75	122.13	130.25	145.75	126.22
Phos.+M.A.+E.M.	105.73	118.60	126.52	138.98	122.46	111.13	124.00	131.92	144.38	127.86
Bio. + 75 % NPK	109.18	124.68	127.85	149.22	127.73	114.58	130.08	133.25	154.58	133.13
100 % NPK	107.29	123.18	127.35	140.85	124.67	112.69	128.58	132.75	152.25	131.57
Mean (A)	97.97	114.70	123.73	134.25		103.37	120.10	129.13	140.31	
L.S.D. at 5 %	A: 4.60	B: 3.59	AB: 7.18			A: 2.49	B: 3.02	AB: 6.05		
	Stem diameter (mm)									
Control	6.66	6.97	7.05	7.72	7.10	7.83	8.25	8.33	9.00	8.35
Phosphorein	7.10	8.22	7.39	8.22	7.73	8.38	9.50	8.67	9.50	9.01
Minia Azotein	7.14	7.39	8.14	8.80	7.87	8.42	8.67	9.42	10.08	9.15
E.M.	7.97	7.55	8.72	9.30	8.38	9.25	8.83	10.00	10.58	9.67
Phos. + M.A.	6.89	8.64	9.05	9.14	8.43	8.17	9.92	10.33	10.42	9.71
Phos. + E.M.	8.10	8.05	8.97	9.39	8.63	9.38	9.33	10.25	10.67	9.91
Phos.+M.A.+E.M.	8.22	8.97	9.22	9.47	8.97	9.50	10.25	10.50	10.75	10.25
Bio. + 75 % NPK	8.72	9.22	9.39	12.38	9.93	10.00	10.50	10.67	11.17	10.58
100 % NPK	8.73	8.98	9.48	10.38	9.39	9.83	10.08	10.58	10.92	10.35
Mean (A)	7.72	8.22	8.60	9.42		8.97	9.48	9.86	10.34	
L.S.D. at 5 %	A: 0.36	B: 0.57	AB:1.13			A: 0.13	B: 0.30	AB: 0.61		

$compost_0$ = 0 g / container; $compost_1$ = 200 g / container; $compost_2$ = 400 g / container; $compost_3$ = 600 g / container

Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

Table (2): Effect of compost, bio. and / or mineral NPK fertilization treatments on whole fresh and dry weights of seedling (g) of *Populus nigra* seedlings in the two growing seasons 2011 and 2012.

Bio. and / or mineral NPK fertilization treatments	**Compost levels (ton/fed.) (A)**									
	1st season					2nd season				
	compost$_0$	compost$_1$	compost$_2$	compost$_3$	Mean (B)	compost$_0$	compost$_1$	compost$_2$	compost$_3$	Mean (B)
	Whole fresh weight of seedling (g)									
Control	54.75	69.57	88.91	102.79	79.01	64.47	78.16	97.50	111.38	87.88
Phosphorein	60.03	80.98	97.51	111.75	87.57	68.62	89.57	106.10	120.34	96.16
Minia Azotein	67.46	91.44	109.94	119.18	97.01	76.05	100.03	118.53	127.77	105.59
E.M.	79.21	105.29	116.58	128.81	107.47	87.80	113.88	125.17	137.40	116.06
Phos. + M.A.	85.92	112.71	126.58	137.27	115.62	94.51	121.30	135.17	145.86	124.21
Phos. + E.M.	91.74	121.16	136.68	144.52	123.53	100.33	129.75	145.27	153.20	132.14
Phos.+M.A.+E.M.	93.09	129.17	139.66	152.43	128.59	101.68	137.76	148.25	161.02	137.18
Bio. + 75 % NPK	102.65	132.81	149.86	163.34	137.17	111.24	141.40	158.45	170.84	145.48
100 % NPK	101.94	130.52	149.70	161.03	135.80	110.53	139.58	158.29	169.62	144.51
Mean (A)	81.87	108.18	123.94	135.68		90.58	116.83	132.53	144.16	
L.S.D. at 5 %	A: 4.79	B: 2.87	AB: 5.74			A: 4.15	B: 3.34	AB: 6.68		
	Whole dry weight of seedling (g)									
Control	21.21	26.67	31.30	37.20	29.10	25.66	30.30	34.93	40.83	32.93
Phosphorein	23.74	31.36	38.38	45.91	34.85	27.37	34.99	42.01	49.54	38.48
Minia Azotein	26.79	35.39	43.94	48.74	38.72	30.42	39.02	47.57	52.37	42.35
E.M.	31.43	40.78	47.47	55.19	43.72	35.06	44.41	51.10	58.73	47.33
Phos. + M.A.	34.01	45.48	52.38	57.42	47.32	37.64	49.11	56.01	60.96	50.93
Phos. + E.M.	36.63	49.04	57.33	62.02	51.26	40.26	52.67	60.96	65.56	54.86
Phos.+M.A.+E.M.	36.72	54.48	61.86	66.47	54.88	40.36	58.11	65.49	70.01	58.49
Bio. + 75 % NPK	40.63	58.63	67.10	74.55	60.23	44.27	62.26	70.73	77.01	63.57
100 % NPK	39.46	56.05	66.51	72.05	58.52	43.10	59.68	70.14	75.59	62.13
Mean (A)	32.29	44.21	51.81	57.73		36.02	47.84	55.44	61.18	
L.S.D. at 5 %	A: 1.66	B: 1.64	AB: 3.28			A: 2.90	B: 2.23	AB: 4.46		

compost$_0$ = 0 g / container; compost$_1$ = 200 g / container; compost$_2$ = 400 g / container; compost$_3$ = 600 g / container

Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

Table (3): Effect of compost, bio. and / or mineral NPK fertilization treatments on main root length (cm) and fresh weight of roots / seedling (g) of *Populus nigra* seedlings in the two growing seasons 2011 and 2012.

Bio. and / or mineral NPK fertilization treatments	Compost levels (ton/fed.) (A)									
	1st season					2nd season				
	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)
	Main root length (cm)									
Control	10.11	11.04	11.67	12.10	11.23	12.24	12.50	13.13	13.56	12.86
Phosphorein	10.90	12.29	12.97	13.03	12.30	12.36	13.75	14.43	14.49	13.76
Minia Azotein	11.27	11.86	12.69	12.73	12.14	12.73	13.32	14.15	14.19	13.60
E.M.	11.72	12.12	12.73	12.75	12.33	13.18	13.58	14.19	14.21	13.79
Phos. + M.A.	12.12	12.58	13.19	13.78	12.92	13.58	14.04	14.65	15.24	14.38
Phos. + E.M.	12.38	12.98	13.59	14.78	13.43	13.84	14.44	15.05	16.24	14.89
Phos.+M.A.+E.M.	12.37	13.65	15.05	18.06	14.78	13.83	15.11	16.51	19.52	16.24
Bio. + 75 % NPK	13.46	14.82	15.91	24.43	17.16	14.92	16.28	17.37	24.89	18.36
100 % NPK	13.24	14.45	15.67	23.22	16.65	14.70	15.91	17.13	24.68	18.11
Mean (A)	11.95	12.87	13.72	16.10		13.49	14.32	15.18	17.45	
L.S.D. at 5 %	A: 0.43	B: 0.48	AB: 0.96			A: 0.19	B: 0.52	AB : 1.05		
	Fresh weight of roots / seedling (g)									
Control	19.93	30.56	39.00	45.90	33.85	23.58	32.88	41.32	48.22	36.50
Phosphorein	31.14	39.63	47.01	48.72	41.63	33.46	41.95	49.33	51.04	43.94
Minia Azotein	26.97	38.52	44.49	45.65	38.91	29.29	40.84	46.81	47.97	41.22
E.M.	32.85	39.96	45.09	50.02	41.98	35.17	42.28	47.41	52.34	44.30
Phos. + M.A.	34.73	40.04	45.61	50.46	42.71	37.05	42.36	47.93	52.78	45.03
Phos. + E.M.	35.26	42.42	46.59	53.72	44.50	37.58	44.74	48.91	56.04	46.82
Phos.+M.A.+E.M.	36.73	43.21	49.61	54.14	45.92	39.05	45.53	51.93	56.46	48.24
Bio. + 75 % NPK	42.86	49.54	55.31	66.19	53.47	45.18	51.86	57.63	67.84	55.63
100 % NPK	42.11	49.06	55.28	64.67	52.78	44.43	51.38	57.60	66.99	55.10
Mean (A)	33.62	41.44	47.55	53.27		36.09	43.76	49.87	55.52	
L.S.D. at 5 %	A: 4.56	B: 2.13	AB: 4.26			A: 4.06	B: 1.99	AB: 3.97		

$compost_0$ = 0 g / container; $compost_1$ = 200 g / container; $compost_2$ = 400 g / container; $compost_3$ = 600 g / container

Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

Table (4): Effect of compost, bio. and / or mineral NPK fertilization treatments on dry weight of roots / seedling (g) and stem / root ratio of *Populus nigra* seedlings in the two growing seasons 2011 and 2012.

Bio. and / or mineral NPK fertilization treatments	Compost levels (ton/fed.) (A)									
	1st season					2nd season				
	compost$_0$	compost$_1$	compost$_2$	compost$_3$	Mean (B)	compost$_0$	compost$_1$	compost$_2$	compost$_3$	Mean (B)
	Dry weight of roots / seedling (g)									
Control	7.04	12.97	17.19	20.65	14.46	11.50	16.43	20.65	24.11	18.17
Phosphorein	13.27	17.51	21.20	22.06	18.51	16.73	20.97	24.66	25.52	21.97
Minia Azotein	11.18	16.95	19.94	20.52	17.15	14.64	20.41	23.40	23.98	20.61
E.M.	14.12	17.68	20.24	22.71	18.69	17.58	21.14	23.70	26.17	22.15
Phos. + M.A.	15.06	17.72	20.50	22.93	19.05	18.52	21.18	23.96	26.39	22.51
Phos. + E.M.	15.29	18.91	20.99	24.56	19.94	18.75	22.37	24.45	28.02	23.40
Phos.+M.A.+E.M.	16.06	19.30	22.50	24.77	20.66	19.52	22.76	25.96	28.23	24.12
Bio. + 75 % NPK	19.12	22.47	25.35	31.13	24.52	22.58	25.93	28.81	33.92	27.81
100 % NPK	18.48	22.23	25.34	30.03	24.02	22.21	25.69	28.80	33.49	27.55
Mean (A)	14.40	18.42	21.47	24.37		18.00	21.88	24.93	27.76	
L.S.D. at 5 %	A: 0.43	B: 1.16	AB: 2.31			A: 0.29	B: 1.01	AB: 2.02		
	Stem / root ratio									
Control	0.98	1.02	1.05	1.10	1.04	1.04	1.08	1.20	1.30	1.16
Phosphorein	0.99	1.05	1.07	1.12	1.06	1.06	1.11	1.28	1.35	1.20
Minia Azotein	1.13	1.14	1.08	1.18	1.13	1.08	1.14	1.33	1.39	1.24
E.M.	1.14	1.16	1.17	1.22	1.17	1.11	1.18	1.38	1.43	1.28
Phos. + M.A.	1.16	1.20	1.24	1.28	1.22	1.12	1.19	1.40	1.45	1.29
Phos. + E.M.	1.19	1.20	1.24	1.28	1.23	1.14	1.21	1.41	1.48	1.31
Phos.+M.A.+E.M.	1.21	1.24	1.25	1.27	1.24	1.18	1.24	1.43	1.51	1.34
Bio. + 75 % NPK	1.22	1.25	1.26	1.29	1.26	1.22	1.25	1.46	1.59	1.38
100 % NPK	1.22	1.25	1.25	1.28	1.25	1.22	1.26	1.43	1.53	1.36
Mean (A)	1.14	1.17	1.18	1.23		1.13	1.19	1.37	1.45	
L.S.D. at 5 %	A: 0.02	B: 0.02	AB: N.S.			A: 0.03	B: 0.03	AB: N.S.		

compost$_0$ = 0 g / container; compost$_1$ = 200 g / container; compost$_2$ = 400 g / container; compost$_3$ = 600 g / container

Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

Table (5): Effect of compost, bio. and / or mineral NPK fertilization treatments on N % and P % in the dry leaves of *Populus nigra* seedlings in the two growing seasons 2011 and 2012.

Bio. and / or mineral NPK fertilization treatments	Compost levels (ton/fed.) (A)									
	1st season					2nd season				
	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)
N % in the dry leaves										
Control	2.011	2.042	2.055	2.066	2.044	2.085	2.123	2.139	2.154	2.125
Phosphorein	2.022	2.059	2.079	2.097	2.064	2.104	2.148	2.170	2.182	2.151
Minia Azotein	2.036	2.081	2.109	2.136	2.091	2.122	2.162	2.191	2.220	2.174
E.M.	2.046	2.099	2.136	2.173	2.114	2.138	2.193	2.234	2.269	2.209
Phos. + M.A.	2.041	2.088	2.118	2.145	2.098	2.132	2.174	2.205	2.229	2.185
Phos. + E.M.	2.054	2.108	2.145	2.182	2.122	2.149	2.201	2.243	2.277	2.218
Phos.+M.A.+E.M.	2.076	2.136	2.184	2.229	2.156	2.181	2.272	2.291	2.312	2.264
Bio. + 75 % NPK	2.114	2.189	2.249	2.304	2.214	2.222	2.297	2.359	2.414	2.323
100 % NPK	2.129	2.214	2.287	2.350	2.245	2.243	2.311	2.368	2.429	2.338
Mean (A)	2.059	2.113	2.151	2.187		2.153	2.209	2.244	2.276	
L.S.D. at 5 %	A: 0.012	B: 0.015	AB: 0.030			A: 0.009	B: 0.021	AB: 0.042		
P % in the dry leaves										
Control	0.210	0.237	0.250	0.266	0.241	0.226	0.254	0.270	0.287	0.259
Phosphorein	0.253	0.275	0.298	0.316	0.286	0.268	0.288	0.311	0.327	0.299
Minia Azotein	0.231	0.259	0.285	0.302	0.269	0.243	0.272	0.297	0.315	0.282
E.M.	0.242	0.263	0.289	0.309	0.276	0.256	0.279	0.302	0.319	0.289
Phos. + M.A.	0.264	0.287	0.310	0.329	0.298	0.281	0.302	0.326	0.343	0.313
Phos. + E.M.	0.271	0.295	0.319	0.337	0.306	0.288	0.310	0.335	0.355	0.322
Phos.+M.A.+E.M.	0.283	0.309	0.335	0.353	0.320	0.297	0.321	0.346	0.367	0.333
Bio. + 75 % NPK	0.298	0.326	0.354	0.374	0.338	0.313	0.339	0.366	0.389	0.352
100 % NPK	0.309	0.335	0.362	0.383	0.347	0.325	0.351	0.377	0.400	0.363
Mean (A)	0.262	0.287	0.311	0.330		0.277	0.302	0.326	0.345	
L.S.D. at 5 %	A: 0.010	B: 0.015	AB: 0.030			A: 0.010	B: 0.015	AB: 0.030		

$compost_0$ = 0 g / container; $compost_1$ = 200 g / container; $compost_2$ = 400 g / container; $compost_3$ = 600 g / container
Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

Table (6) : Effect of compost, biofertilization and / or mineral NPK treatments on K % in the dry leaves and total chlorophyll content (mg / g. f.wt.) of Populus nigra plants in the two growing seasons 2011 and 2012.

Biofertilization and / or mineral NPK treatments	Compost levels (ton/fed.) (A)									
	1st season					2nd season				
	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)	$compost_0$	$compost_1$	$compost_2$	$compost_3$	Mean (B)
K % in the dry leaves										
Control	1.611	1.632	1.644	1.660	1.637	1.674	1.686	1.701	1.718	1.695
Phosphorein	1.623	1.642	1.659	1.677	1.650	1.693	1.694	1.711	1.726	1.706
Minia Azotein	1.637	1.652	1.675	1.695	1.665	1.712	1.723	1.738	1.745	1.730
E.M.	1.648	1.663	1.681	1.703	1.674	1.726	1.738	1.745	1.757	1.742
Phos. + M.A.	1.641	1.658	1.677	1.701	1.669	1.721	1.727	1.741	1.749	1.735
Phos. + E.M.	1.654	1.673	1.700	1.715	1.686	1.738	1.747	1.756	1.766	1.752
Phos.+M.A.+E.M.	1.678	1.699	1.715	1.726	1.705	1.770	1.792	1.809	1.824	1.799
Bio. + 75 % NPK	1.715	1.737	1.761	1.776	1.747	1.810	1.840	1.821	1.839	1.828
100 % NPK	1.730	1.759	1.782	1.809	1.770	1.830	1.851	1.856	1.865	1.851
Mean (A)	1.660	1.679	1.699	1.718		1.742	1.755	1.764	1.777	
L.S.D. at 5 %	A: 0.017	B: 0.010	AB: 0.021			A: 0.009	B: 0.017	AB: 0.034		
Total chlorophyll content (mg / g. f.wt.)										
Control	2.972	3.100	3.200	3.261	3.133	3.019	3.138	3.240	3.281	3.170
Phosphorein	3.205	3.292	3.350	3.410	3.315	3.226	3.350	3.404	3.448	3.357
Minia Azotein	3.263	3.350	3.400	3.441	3.364	3.273	3.390	3.442	3.483	3.397
E.M.	3.292	3.390	3.437	3.511	3.408	3.315	3.438	3.469	3.535	3.439
Phos. + M.A.	3.340	3.412	3.510	3.530	3.448	3.361	3.466	3.528	3.570	3.482
Phos. + E.M.	3.380	3.480	3.540	3.543	3.486	3.391	3.512	3.556	3.579	3.510
Phos.+M.A.+E.M.	3.420	3.510	3.580	3.600	3.528	3.431	3.545	3.596	3.602	3.544
Bio. + 75 % NPK	3.450	3.581	3.610	3.658	3.575	3.454	3.566	3.610	3.630	3.565
100 % NPK	3.472	3.601	3.630	3.675	3.594	3.478	3.579	3.630	3.647	3.583
Mean (A)	3.310	3.413	3.473	3.515		3.328	3.443	3.497	3.530	
L.S.D. at 5 %	A: 0.022	B: 0.030	AB: N.S.			A: 0.018	B: 0.020	AB: N.S.		

$compost_0$ = 0 g / container; $compost_1$ = 200 g / container; $compost_2$ = 400 g / container; $compost_3$ = 600 g / container

Phos. = Phosphorein; M.A. = Minia Azotein; E.M. = Effective microorganisms; Bio. = Phos. + M.A. + E.M.

The interaction was significant for N, P and K % in both seasons. The highest values were obtained from the treatment of compost$_3$ in combination with mineral NPK followed by the treatment of compost$_3$ in combination of bio. + 75 % NPK dose.

3-2- Total chlorophylls:

The content of total chlorophylls in the fresh leaves of popular was significantly promoted due to compost treatments, in the two seasons, in comparison with those of untreated plants as shown in Table (6). Compost$_3$ gave the highest values for total chlorophyll pigments in both seasons followed by compost$_2$ and then compost$_1$. This result may be attributed to the increase nutrient elements and/or positive role of Mg that reflect on the chlorophyll content.

In harmony with these results regarding organic fertilization treatments were those reported by Abass (2003) on *Rosa hybrida*; Sakr (2005) on senna plants; El-Khateeb *et al.* (2006) and Abdou *et al.* (2007) on *Ficus* spp.

In relation to the influence of different biofertilizer and/or mineral NPK treatments, total chlorophylls content was promoted in the two seasons (Table, 6). Obtained data show that the differences between any fertilization treatment and control were statistically significant. The highest contents of chlorophylls were obtained due to the treatment of mineral NPK (full dose) or the treatment of bio. + 75 % NPK dose.

This result may be attributed to the increase in nutrient elements which came as a result from adding NPK or inoculated with bacteria that reflect on chlorophyll content. Similar results were obtained by Ashour (2010) on jojoba seedlings.

The interaction between compost and bio. and/or mineral NPK fertilization treatments was not significant in both seasons.

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الملخص العربي

استجابة شتلات الحور الأسود للتسميد العضوي والحيوي والمعدني النتروجيني الفوسفوري البوتاسي

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تم إجراء هذا البحث بغرض استقصاء مدى استجابة شتلات الحور الأسود للتسميد بالكمبوست بأربع مستويات وكذلك التسميد الحيوي والمعدني أو كلاهما معاً (كنترول – الفوسفورين – المنيا أزوتين – الميكروبات الدقيقة النشطة – الفوسفورين + المنيا أزوتين – الفوسفورين + الميكروبات الدقيقة النشطة – الثلاثة أسمدة حيوية مختلطة + 75 % من التسميد المعدني النتروجيني الفوسفوري البوتاسي – التسميد المعدني (جرعة كاملة). أوضحت النتائج أن ارتفاع الشتلة وسمك الساق والوزن الطازج والجاف للنبات وطول الجذر الرئيسي والوزن الطازج والجاف للجذور ونسبة الساق إلى الجذور (الوزن الجاف) والمحتوى الكيماوي متضمناً الكلوروفيل الكلي ونسبة النتروجين والفوسفور والبوتاسيوم في الأوراق زاد تدريجياً مع زيادة مستويات سماد الكمبوست.

كل معاملات التسميد الحيوي والمعدني أو كلاهما معاً زادت معنوياً كل صفات النمو الخضري والجذري والكيماوي السابقة مقارنة بمعاملة الكنترول.

معاملة خليط الأسمدة الحيوية + 75 % من التسميد المعدني ثم التسميد المعدني بالجرعة الكاملة كانت أكثر تأثيراً في هذا الشأن.

التفاعل بين معاملات التسميد العضوي (كمبوست) والحيوي والمعدني أو هما معاً كانت معنوية عدا صفة نسبة الساق/الجذور وأحسن القيم تم الحصول عليها من استخدام سماد الكمبوست بالمستوى العالي مع التسميد بخليط الأسمدة الحيوية + 75 % من السماد المعدني أو مع التسميد المعدني بالجرعة الكاملة.