The 1st Conf. of SSFOP "Future of Ornamental Plants in Egypt", Cairo, Egypt, 22/2/2015
Scientific J. Flowers & Ornamental Plants
www.ssfop.com/journal
ISSN: 2356-7864

RESPONSE OF *POPULUS ALBA*, L. TRANSPLANTS TO COMPOST, BIOFERTILIZERS AND MINERAL NPK FERTILIZATION

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Scientific J. Flowers & Ornamental Plants, 2(1):51-65 (2015).

Received:
4/12/2014

Revised by:
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ABSTRACT: This investigation was conducted to investigate the response of *Populus alba* transplants to compost fertilization at four levels and Bio. and/or mineral NPK treatments (control, phosphorein, effective microorganisms (E.M.), phosphorein + effective microorganisms, a mixture of Bio. (phosphorein + E.M.) + 75% NPK and mineral NPK, full dose) on vegetative and root growth parameters and some chemical constituents.

The obtained results indicated that, transplant height, stem diameter, whole transplant fresh and dry weights, main root length, fresh and dry weights of roots, as well as, chemical constituents including total chlorophylls, percentages of N, P and K were gradually increased by increasing the levels of compost fertilizer.

Biofertilizers and/or mineral NPK fertilization treatments significantly increased all the previous parameters. Bio. + 75% NPK dose followed by mineral NPK (full dose) treatments were the most effective in this concern.

The interaction between compost and Bio. and/or mineral NPK fertilization treatments was significant for vegetative and root growth parameters with the highest values for vegetative and root growth traits being obtained due to either compost fertilizer in combination with Bio. + 75% NPK dose or with mineral NPK (full dose).

Key words: *Populus alba*, compost fertilization, biofertilizers, phosphorein, E.M., NPK, vegetative growth, chemical constituents.

INTRODUCTION

Poplar is one of the best fast-growing trees in the world (Liu *et al*., 2009). Poplar is a member of Salicaceae 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, plywood, 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 are 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 are 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 increase vegetative and root growth traits, as well as, pigments and N, P and K percentages in the leaves.

Biofertilizers are considered to be low cost, ecofriendly and renewable sources of plant nutrients more than supplementing chemical fertilizers in sustainable agricultural systems. In this respect, Ahmed *et al.* (2005) on *Populus nigra* transplants concluded that biofertilizer treatments significantly increased stem length and diameter, number of branches, fresh and dry weights of transplants, root length and fresh and dry 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 seedlings ; 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 weight 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 alba* transplants 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 2012 and 2013 at the Nursery of Ornamental Plants, Faculty of Agriculture, Minia University to figure out the response of *Populus alba* transplants grown in sandy soil to organic and Bio. and/or mineral fertilization treatments.

Cuttings of *Populus alba* were obtained from Mallawy Agricultural Research Station, Minia Governorate, Egypt. Cuttings were planted on March 10^{th} for both seasons in containers (25×25×35 cm) as each was filled with 21 kg of sandy soil. Each container contained 3 cuttings and transplants were thinned to one transplant/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 4 transplants per replicate was followed in this experiment. The four levels of compost treatments were considered as main plots (A) and the six biofertilizers and/or mineral NPK fertilization treatments occupied the sub-plots (B). Therefore, the interaction treatments (A×B) were 24 treatments. The four levels of compost were $compost_0$ (without compost as control), $compost_1$ (250 g/container), $compost_2$ (500 g/container) and $compost_3$ (750 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 of 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- Effective microorganism (E.M.) at 50 ml/container (1 ml=10^7 cells), 4- phosphorein + E.M., 5- Bio. (phos. + E.M.) + 75% NPK and 6- 100% NPK as recommended dose. Fresh and active two biofertilizers namely, phosphorein (P-dissolving 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 24^{th} for the first and second seasons). Biofertilizers

Table a. Physical and chemical properties of the experimental soil.

Character		Value 2012	Value 2013
Sand %		89.00	90.00
Silt %		8.30	7.40
Clay %		2.70	2.60
Texture		Sandy	Sandy
$CaCO_3$ %		14.45	14.83
pH (1:2.5)		8.14	8.15
Organic matter %		0.05	0.04
E. C. (m mhos/cm)		1.09	1.11
Total N %		0.02	0.02
Available P %		3.34	3.51
Extr. K (mg/100 g soil)		0.90	1.01
	Fe	1.12	1.19
DTPA	**Cu**	0.40	0.42
Ext. ppm	**Zn**	0.35	0.31
	Mn	0.61	0.70

Table b. Physical and chemical properties of the used compost.

Properties	Value	Properties	Value
Dry weight of 1	450 kg	**NaCl (%)**	1.1-1.75
Fresh weight of 1	650-700	**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	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		

were added to the soil around each transplant and then they were irrigated immediately.

The recommended mineral NPK fertilization was 3 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) El–Kayal (1996), while 75% NPK were 2.25+3+1.5, respectively. The amounts of mineral NK fertilizers were divided into three equal batches and added at one month interval, starting April 30th 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: - transplant height (cm), stem diameter (mm), whole fresh and dry weights (g).

2- Root growth characters: - main root length (cm), fresh and dry weights of roots.

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 percentages 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 transplant height, stem diameter, whole fresh and dry weights/transplant 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 fertilizer ($compost_0$). Moreover, the increase was gradual by the gradual increase in compost levels. The increase in vegetative growth traits due to the low, medium and high level of compost over the control reached 19.31, 28.22 and 40.12% for transplant height, 3.51, 7.81 and 21.29% for stem diameter, 30.59, 50.76 and 65.65% for whole plant fresh weight and 35.94, 59.53 and 79.65% for whole plant dry weight, respectively, in the first season. The results in the second season took a similar 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 of the uptake of nutrients leads to enhancing the biosynthesis of organic foods

Table 1. Effect of compost, Bio. and/or mineral NPK fertilization treatments on plant height (cm) and stem diameter (mm) of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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)
Transplant height (cm)										
Control	84.91	116.16	129.72	134.86	116.41	90.89	122.10	135.66	140.80	122.36
Phosphorein	93.25	120.01	133.76	139.62	121.66	99.19	125.95	139.70	145.56	127.60
E.M.	108.05	121.39	133.68	143.02	126.54	113.99	127.33	139.61	148.96	132.47
Phos. + E.M.	111.49	128.40	137.34	154.39	132.90	117.43	134.34	143.28	160.33	138.84
Bio.+ 75 % NPK	120.10	137.15	140.64	164.14	140.51	126.04	143.09	146.58	170.04	146.43
100 % NPK	118.02	135.50	140.09	154.94	137.13	123.96	141.44	146.03	167.48	144.72
Mean (A)	105.97	126.43	135.87	148.49		111.92	132.37	141.81	155.53	
L.S.D. at 5 %		A: 4.62	B: 3.61	AB: 7.20			A: 2.51	B: 3.04	AB: 6.07	
Stem diameter (mm)										
Control	7.46	7.81	7.90	8.65	7.95	8.77	9.24	9.33	10.08	9.35
Phosphorein	7.95	9.21	8.28	9.21	8.66	9.39	10.64	9.71	10.64	10.09
E.M.	8.93	8.46	9.77	10.42	9.39	10.36	9.89	11.20	11.85	10.82
Phos. + E.M.	9.07	9.02	10.05	10.52	9.66	10.51	10.45	11.48	11.95	11.10
Bio.+ 75 % NPK	9.77	10.33	10.52	13.87	11.12	11.20	11.76	11.95	12.51	11.86
100 % NPK	9.78	10.06	10.62	11.63	10.52	11.01	11.29	11.85	12.23	11.59
Mean (A)	8.83	9.14	9.52	10.71		10.21	10.54	10.92	11.54	
L.S.D. at 5 %		A: 0.28	B: 0.61	AB: 1.22			A: 0.15	B: 0.32	AB: 0.63	

$Compost_0$ = 0 g/container
$Compost_1$ = 250 g/container
$Compost_2$ = 500 g/container
$Compost_3$ = 750 g/container

Phos. = Phosphorein
E.M. = Effective microorganisms
Bio. = Phos. + E.M.

Table 2. Effect of compost, Bio. and/or mineral NPK fertilization treatments on whole fresh and dry weights (g) of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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 transplant (g)										
Control	64.61	82.09	104.91	121.29	93.23	76.07	92.23	115.05	131.43	103.70
Phosphorein	70.84	95.56	115.06	131.87	103.33	80.97	105.69	125.20	142.00	113.47
E.M.	93.47	124.24	137.56	152.00	126.82	103.60	134.38	147.70	162.13	136.95
Phos. + E.M.	108.25	142.97	161.28	170.53	145.76	118.39	153.11	171.42	180.78	155.92
Bio. + 75 % NPK	121.13	156.72	176.83	192.74	161.85	131.26	166.85	186.97	201.59	171.67
100 % NPK	120.29	154.01	176.65	190.02	160.24	130.43	164.70	186.78	200.15	170.52
Mean (A)	96.43	125.93	145.38	159.74		106.79	136.16	155.52	169.68	
L.S.D. at 5 %		A: 4.81	B: 2.89	AB: 5.76			A: 4.17	B: 3.36	AB: 6.70	
Whole dry weight of transplant (g)										
Control	23.97	30.14	35.37	42.04	32.88	29.00	34.24	39.47	46.14	37.21
Phosphorein	26.83	35.44	43.37	51.88	39.38	30.93	39.54	47.47	55.98	43.48
E.M.	35.52	46.08	53.64	62.36	49.40	39.62	50.18	57.74	66.36	53.48
Phos. + E.M.	41.39	55.42	64.78	70.08	57.92	45.49	59.52	68.88	74.08	61.99
Bio. + 75 % NPK	45.91	66.25	75.82	84.24	68.06	50.03	70.35	79.92	87.02	71.83
100 % NPK	44.59	63.34	75.16	81.42	66.12	48.70	67.44	79.26	85.42	70.20
Mean (A)	36.37	49.44	58.02	65.34		40.63	53.55	62.13	69.17	
L.S.D. at 5 %		A: 2.68	B: 1.95	AB: 3.88			A: 3.92	B: 2.25	AB: 4.48	

$Compost_0$ = 0 g/container
$Compost_1$ = 250 g/container
$Compost_2$ = 500 g/container
$Compost_3$ = 750 g/container

Phos. = Phosphorein
E.M. = Effective microorganisms
Bio. = Phos. + E.M.

and cell division, more carbohydrates and dry matter accumulation (Nijjar, 1985).

Data presented in Tables (1 and 2) indicated that transplant height, stem diameter, fresh and dry weights of whole plant/transplant 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 treatment of mixture of biofertilizers (phosphorein and E.M.) + 75% NPK dose followed by mineral NPK (full dose) seemed to be more effective than the other four 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. In addition to gibberellins 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 alba* 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) revealed that the used of compost treatments had pronounced significant effects on the length of main root, fresh and dry weights of root system 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 presented in Tables (3 and 4) showed that all used fertilization treatments significantly increased, main root length, roots fresh and dry weights/transplant 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).

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*.

Table 3. Effect of compost, Bio. and/or mineral NPK fertilization treatments on main root length (cm) and fresh weight of roots/transplant (g) of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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	11.02	12.03	12.72	13.19	12.24	13.34	13.63	14.31	14.78	14.01
Phosphorein	11.88	13.40	14.14	14.20	13.40	13.47	14.99	15.73	15.79	15.00
E.M.	12.77	13.21	13.88	13.90	13.44	14.37	14.80	15.47	15.49	15.03
Phos. + E.M.	13.49	14.15	14.81	16.11	14.64	15.09	15.74	16.40	17.70	16.23
Bio. + 75 % NPK	14.67	16.15	17.34	26.63	18.70	16.26	17.75	18.93	27.13	20.02
100 % NPK	14.43	15.75	17.08	25.31	18.14	16.02	17.34	18.67	26.90	19.73
Mean (A)	13.05	14.12	14.99	18.22		14.76	15.71	16.59	19.63	
L.S.D. at 5 %		A: 0.45	B: 0.66	AB: 1.32			A: 0.21	B: 0.54	AB: 1.07	
Fresh weight of roots/transplant (g)										
Control	22.12	33.92	43.29	50.95	37.57	26.17	36.50	45.87	53.52	40.52
Phosphorein	34.57	43.99	52.18	54.08	46.20	37.14	46.56	54.76	56.65	48.78
E.M.	36.46	44.36	50.05	55.52	46.60	39.04	46.93	52.63	58.10	49.17
Phos. + E.M.	39.14	47.09	51.71	59.63	49.39	41.71	49.66	54.29	62.20	51.97
Bio. + 75 % NPK	47.57	54.99	61.39	73.47	59.36	50.15	57.56	63.97	75.30	61.75
100 % NPK	46.74	54.46	61.36	71.78	58.59	49.32	57.03	63.94	74.36	61.16
Mean (A)	37.77	46.47	53.33	60.91		40.59	49.04	55.91	63.36	
L.S.D. at 5 %		A: 4.58	B: 2.15	AB: 4.28			A: 4.08	B: 2.01	AB: 3.99	

$Compost_0$ = 0 g/container **Phos. = Phosphorein**
$Compost_1$ = 250 g/container **E.M. = Effective microorganisms**
$Compost_2$ = 500 g/container **Bio. = Phos. + E.M.**
$Compost_3$ = 750 g/container

Table 4. Effect of compost, Bio. and/or mineral NPK fertilization treatments on dry weight of roots/transplant (g) of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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/transplant (g)									
Control	7.60	14.01	18.57	22.30	15.62	12.42	17.74	22.30	26.04	19.63
Phosphorein	14.33	18.91	22.90	23.82	19.99	18.07	22.65	26.63	27.56	23.73
E.M.	15.25	19.09	21.86	24.53	20.18	18.99	22.83	25.60	28.26	23.92
Phos. + E.M.	16.51	20.42	22.67	26.52	21.53	20.25	24.16	26.41	30.26	25.27
Bio. + 75 % NPK	20.65	24.27	27.38	33.62	26.48	24.39	28.00	31.11	36.63	30.03
100 % NPK	19.96	24.01	27.37	32.43	25.94	23.99	27.75	31.10	36.17	29.75
Mean (A)	15.72	20.12	23.46	27.21		19.68	23.86	27.19	30.82	
L.S.D. at 5 %		A: 0.45	B: 1.20	AB: 2.40			A: 0.31	B: 1.03	AB: 2.04	

$Compost_0$ = 0 g/container
$Compost_1$ = 250 g/container
$Compost_2$ = 500 g/container
$Compost_3$ = 750 g/container

Phos. = Phosphorein
E.M. = Effective microorganisms
Bio. = Phos. + E.M.

However, the role of mineral NPK was obtained 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 $compost_3$, (750 g/container) in combination with Bio. + 75% NPK dose or with only mineral NPK (full dose) as clearly shown in Tables (3 and 4). In this concern, Abdou and Ashour (2012) stated that organic manure in combination with Bio.+ reduce the 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:

a. 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 (750 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 either phosphorein or Effective microorganisms whether 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 which, 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.

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.

b. 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 in both seasons followed by $compost_2$ and then $compost_1$. This result may be attributed to the increase in 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*;

Table 5. Effect of compost, Bio. and/or mineral NPK fertilization treatments on N and P % in the dry leaves of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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	2.031	2.062	2.075	2.086	2.064	2.105	2.143	2.159	2.174	2.145
Phosphorein	2.042	2.079	2.099	2.117	2.084	2.124	2.168	2.190	2.202	2.171
E.M.	2.066	2.119	2.156	2.193	2.134	2.158	2.213	2.254	2.289	2.229
Phos. + E.M.	2.074	2.128	2.165	2.202	2.142	2.169	2.221	2.263	2.297	2.238
Bio. + 75 % NPK	2.134	2.209	2.269	2.324	2.234	2.242	2.317	2.379	2.434	2.343
100 % NPK	2.149	2.234	2.307	2.370	2.265	2.263	2.331	2.388	2.449	2.358
Mean (A)	2.083	2.139	2.179	2.215		2.177	2.232	2.272	2.308	
L.S.D. at 5 %		A: 0.014	B: 0.017	AB: 0.032			A: 0.011	B: 0.022	AB: 0.044	
P % in the dry leaves										
Control	0.290	0.317	0.330	0.346	0.321	0.306	0.334	0.350	0.367	0.339
Phosphorein	0.333	0.355	0.378	0.396	0.366	0.348	0.368	0.391	0.407	0.379
E.M.	0.322	0.343	0.369	0.389	0.356	0.336	0.359	0.382	0.399	0.369
Phos. + E.M.	0.351	0.375	0.399	0.417	0.386	0.368	0.390	0.415	0.435	0.402
Bio. + 75 % NPK	0.378	0.406	0.434	0.454	0.418	0.393	0.419	0.446	0.469	0.432
100 % NPK	0.389	0.415	0.442	0.463	0.427	0.405	0.431	0.457	0.480	0.443
Mean (A)	0.344	0.369	0.392	0.411		0.359	0.384	0.407	0.426	
L.S.D. at 5 %		A: 0.012	B:0.017	AB: 0.032			A: 0.012	B : 0.017	AB: 0.032	

$Compost_0$ = 0 g/container
$Compost_1$ = 250 g/container
$Compost_2$ = 500 g/container
$Compost_3$ = 750 g/container

Phos. = Phosphorein
E.M. = Effective microorganisms
Bio. = Phos. + E.M.

Table 6. Effect of compost, Bio. and/or mineral NPK fertilization treatments on K% in the dry leaves and total chlorophyll content (mg/g f.w.) of *Populus alba* transplants in the two growing seasons of 2012 and 2013.

Bio. and/or mineral NPK fertilization treatments	Compost levels (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	1.638	1.660	1.672	1.688	1.665	1.702	1.715	1.730	1.747	1.724
Phosphorein	1.651	1.670	1.687	1.706	1.678	1.722	1.723	1.740	1.755	1.735
E.M.	1.676	1.691	1.710	1.732	1.702	1.755	1.768	1.775	1.787	1.771
Phos. + E.M.	1.682	1.701	1.729	1.744	1.714	1.768	1.777	1.786	1.796	1.782
Bio. + 75 % NPK	1.744	1.767	1.791	1.806	1.777	1.841	1.871	1.852	1.870	1.859
100 % NPK	1.759	1.789	1.812	1.840	1.800	1.861	1.882	1.888	1.897	1.882
Mean (A)	1.692	1.713	1.733	1.753		1.775	1.789	1.795	1.809	
L.S.D. at 5 %		A: 0.019	B: 0. 012	AB: 0.023			A: 0.011	B: 0.019	AB: 0.036	
Total chlorophyll content (mg/g f.w.)										
Control	2.994	3.122	3.222	3.283	3.155	3.041	3.160	3.262	3.303	3.192
Phosphorein	3.227	3.314	3.372	3.432	3.336	3.248	3.372	3.426	3.470	3.379
E.M.	3.314	3.412	3.459	3.533	3.430	3.337	3.460	3.491	3.557	3.461
Phos. + E.M.	3.402	3.502	3.562	3.565	3.508	3.413	3.534	3.578	3.601	3.532
Bio. + 75 % NPK	3.472	3.603	3.632	3.680	3.597	3.476	3.588	3.632	3.652	3.587
100 % NPK	3.494	3.623	3.652	3.697	3.617	3.500	3.601	3.652	3.669	3.606
Mean (A)	3.317	3.429	3.483	3.532		3.336	3.453	3.507	3.542	
L.S.D. at 5 %		A: 0.024	B: 0.032	AB: N.S.			A: 0.020	B: 0.022	AB: N.S.	

Compost$_0$ = 0 g/container **Phos. = Phosphorein**
Compost$_1$ = 250 g/container **E.M. = Effective microorganisms**
Compost$_2$ = 500 g/container **Bio. = Phos. + E.M.**
Compost$_3$ = 750 g/container

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 chlorophyll 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 inoculating 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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استجابة شتلات الحور الأبيض للتسميد العضوي والحيوي والمعدني النتروجيني الفوسفوري البوتاسي

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تم إجراء هذا البحث بغرض دراسة مدى استجابة شتلات الحور الأبيض للتسميد بالكمبوست بأربع مستويات وكذلك التسميد الحيوي والمعدني أو كلاهما معاً (كنترول – الفوسفورين– الميكروبات الدقيقة النشطة – الفوسفورين + الميكروبات الدقيقة النشطة - خليط الأسمدة الحيوية (الفوسفورين + الميكروبات الدقيقة النشطة) + ٧٥ % 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 والمحتوى الكيماوي متضمناً الكلوروفيل الكلي ونسبة النتروجين والفوسفور والبوتاسيوم في الأوراق زاد تدريجياً مع زيادة مستويات سماد الكمبوست.

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

وكانت معاملة خليط الأسمدة الحيوية + ٧٥ % من التسميد المعدني ثم التسميد المعدني بالجرعة الكاملة أكثر تأثيراً في هذا الشأن.

وكان التفاعل بين معاملات التسميد العضوي (كمبوست) والحيوي والمعدني أو هما معاً معنوياً حيث تم الحصول على أحسن القيم من استخدام سماد الكمبوست بالمستوى العالي مع التسميد بخليط الأسمدة الحيوية + ٧٥ % من السماد المعدني أو مع التسميد المعدني بالجرعة الكاملة.