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Research article

Effect of Putrescine and Growing Media on Vegetative Growth and Chemical Constituents of *Populus Euramericana* Plants

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Abstract

This study was carried out at the Experimental Arid of the ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt during two successive seasons 2007 and 2008 to study the effect of growing media and putrescine on vegetative growth and chemical constituents of *Populus euramericana*. The results showed that, growing the plants in mixture from sand + clay medium and spray with putrescine at 50 ppm gave the highest values of plant height, number of leaves, total leaf area, diameter of stem, length of root, fresh and dry weight of leaves and stems, leaf concentration of chlorophyll a, b also carbohydrate % in the stems and roots, N% in the leaves and stems, P % in the leaves, stems and roots and K % in leaves, stems and roots. While, mix media and spray with putrescine at 100 ppm gave the highest values of root diameter , fresh and dry weight of roots, carbohydrate % in the leaves and N % in the roots.

Key words: *Populus euramericana*, growing media, putrescine, vegetative growth and chemical constituents.

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1. Introduction

Populus (poplar, aspen and cotton wood) are a group of 30 – 40 species of dioecious, large or small trees with soft white wood belonging to the family salicaceae, much planted for pulpwood, windbreaks, avenues and as ornamentals. Poplars are of easy cultivation in almost any soil. Atahe roots are likely to stop drains or cause having of sidewalks. So poplar shoud be planted with caution. Propagated by hardwood cuttings, suckers or sometimes by seeds and the weeping sorts by grafting on upright forms [1]. Populus the common name from the early Roman expression arbor Popular, meaning "the people's tree" because poplars were frequently planted in public places and meetings were held beneath them [2].

The differences among the growing media are due to the variation in its physical and chemical characteristics. Tree seedlings are usually planted in fertile growing media such as clay and sometimes in

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unfertile on such as sand; sandy soil can be improved by mixing it with clay, particularly in the new reclaimed lands [3]. [4]on *Jatropha curca* L showed that clay and mixture media significantly increased plant height, root length, leaves number/ plant, stem diameter, leaf area and fresh and dry weight of leaves and shoot in the two seasons compared with the sandy soil which gave the lowest values and increase chlorophyll a, b, a+b and carotenoids as comparing with the sandy and mixing media in fresh leaves.

Polyamine (PAs) namely putrescine (Put), spermine (Spm) and spermidine (Spd) in different plant developmental process [5]. They modulate several growths and developmental processes viz., cell division, differentiation, flowering fruit ripening, embryogenesis, senescence and rhizogenesis [6]. In all these, PAs have been ascribed various roles such as that of a new class of plant growth regulators, hormonal second messengers and as one of the reserves of carbon and nitrogen at least in cultured tissues [7]. [8] found that foliar application of putrescine at 200 ppm significantly increased plant height, number of leaves/plant, fresh and dry weight of leaves/plant and highest values of chlorophyll a, chlorophyll b, carotenoids and soluble sugars content compared with untreated plants on gladiolus plant. [9] on chrysanthemum found that foliar application of putrescine significantly increased plant height, No. of branches/plant, No. of leaves/plant, leaf area, fresh and dry weight of plant. The best results were found when plants treated with 200 ppm putrescine.

2. Materials and Methods

This study was carried out at the Experimental Ared of the Ornamental Horticulture Department, Faculty of Agriculture, Cairo University, Giza, Egypt during the two successive seasons 20 and 20 to study the effected of growing media and putrescine on growth of *Populus euramericana* L. stem cuttings.

The stem cuttings of *Populous euramericana* were taken from mother trees grown in the Experimental station of Hort. Res. Lnst. The stem cuttings obtained from branches one year old, each two stem cuttings were cultivated in plastic pots 30 cm diameter. The cuttings were planted at March 2007 and 2008. *Populus euramericana* stem cuttings were treated with polyamine (diamines putrescine) at the rate of 50, 100 and 200 ppm in addition the control (distilled water). The cuttings were treated directly inserted in polyethylene bags, filled with clay, sand and the mixture of them 1:1 (v / v).

The layout of the experiment was a complete randomized design, the experiment included 12 treatments each treatment included 6 replicates; each replicate consisted of two stem cuttings.

The following data were recorded on September during two seasons. At the end of the experiment; plant height (cm), number of leaves, leaf area (cm^2), diameter of stem (cm), length of root (cm), diameter of root (cm), fresh and dry weight (g): leaves, stem and roots for each plant.

Chlorophyll a, b and carotenoids concentration (mg/g.F.W.) were determined in leaf according to [10]. Total carbohydrates (% D.W.) content in leaves, stem and roots was determined according to [11]. Nitrogen content were determined according to [12]. Phosphorus content was estimated according to [13] and potassium content was measured according to [14].

Data recorded on vegetative growth in two seasons were statistically an analyzed as described by [15]. Means of all

characters were compared by L. S. D. Test at 0.05 level of significance.

3. Results and Discussion

Vegetative growth:

Data presented in table 1 showed that mixture sand soil with clay significantly increased plant height, number of leaves and leaf area when compared with clay or sand soil, the clay soil gave moderate values of these characters, whereas, sandy soil produced lowest values, in both seasons, respectively. These results are in agreement with those obtained by [16] on *Nerium oleander*, *Adhatoda vasica* and *Lantana camara* [17] on *Caesalpinia pulcherrima* and *Thevetia peruviana* and [4] on *Jatropha curca* L. showed that mixture media significantly increased plant height, leaves number / plant, leaf area compared with the sandy soil which gave the lowest values.

Spraying *Populous euramericana* plant with putrescine at 50, 100 and 200 ppm significantly increased the plant height, number of leaves and leaf area, compared with untreated plants. The highest values of previous properties were obtained from application of putrescine at 50 ppm followed by 100 ppm and 200 ppm in the two seasons, respectively.

Concerning the interaction between growing mixture media (sand soil with clay) and putrescine at 50 ppm treatment significantly increased plant height, number of leaves in the both seasons and leaf area in the first season, while the same soil with using putrescine at 100 ppm in the second season gave the highest values of leaf area, respectively. Whereas, sandy soil without using putrescine produced the lowest values of these characters. With regard to the effect of putrescine, these results are in agreement with those obtained by many investigators; i. e. [18] on *Matthiola incana* plant, [19] on *Catharanthus roseus* plants, [20] on *Bougainvilla glabra* and [9] on *Chrysanthemum* plants, they found that foliar application of putrescine significantly increased plant height, number of leaves / plant and leaf area.

Table 1**. Effect of growing media [sandy: clay (1:1v/v), sandy and clay] and polyamine (putrescine) on plant height (cm), number of leaves and total leaf area (cm²) of *Populus euramericana* during 2006and 2007 seasons**

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Plant height (cm)							
Put. 0	81.70	72.4	76.30	76.80	84.00	70.5	77.00	77.17
Put. 50 ppm	130.5	85.4	110.3	108.7	220.0	93.0	186.0	166.3
Put. 100 ppm	125.80	90.70	104.50	107.00	194.00	96.30	119.60	136.63
Put. 200 ppm	119.60	93.30	98.60	103.83	124.20	98.50	109.50	110.73
Mean	114.40	85.45	97.43		155.55	89.58	123.03	
	Number of leaves							
Put. 0	54.67	48.67	51.67	51.67	81.00	71.00	76.00	76.00
Put. 50 ppm	96.33	57.33	75.33	76.33	140.00	86.00	113.00	113.00
Put. 100 ppm	88.67	61.67	74.67	75.00	125.00	94.00	108.00	109.00
Put. 200 ppm	81.67	67.00	71.00	73.22	120.00	98.00	105.00	107.67
Mean	80.33	58.67	68.17		116.50	87.25	100.50	

	leaf area (cm^2)							
Put. 0	35.40	28.13	32.27	31.93	48.75	41.38	44.30	44.81
Put. 50 ppm	52.32	38.21	45.70	45.41	67.10	50.16	58.29	58.52
Put. 100 ppm	50.14	38.65	46.88	45.22	65.60	53.80	60.34	59.91
Put. 200 ppm	49.50	41.75	42.18	44.48	62.95	54.10	57.35	58.13
Mean	46.84	36.68	41.76		61.10	49.86	55.07	

$LSD_{0.05}$ for:	Plant height		Number of leaves		leaf area	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Treatments (A)	2.39	1.44	2.15	2.88	1.37	0.39
Concentrations (B)	2.76	1.67	2.49	3.33	1.64	0.45
Interactions (AB)	4.79	2.88	4.32	5.76	2.10	0.77

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

The data in Table 2 pointed out that, plants grown in mixing media significantly increased the stem diameter, length of root and diameter of root in the first and second seasons, respectively, compared with those grown in the clay and sandy soil. Whereas, the application of putrescine at the concentration of 50, 100 and 200 ppm on *populus euramericana* plants significantly increased of stem diameter, length of root and diameter of root, compared with untreated plants. Plants, which treated with putrescine at 50 ppm, produced the thickest stems and longest roots, in the first and second seasons, respectively. Whereas, the best results of root diameter were obtained when plants treated with 100 ppm in two seasons, Grown in mixing media combination with putrescine at 50 ppm produced the thickest stem and longest roots, in both seasons, while plants grown in the same media and sprayed with putrescine at 100 significantly increased the root diameter in the both seasons compared with those plants grown in sandy soil without treating with putrescine. Similar results are obtained by [17] on *Caesalpinia pulcherrima* and *Thevetia peruviana*, [4] on *Jatropha* curca L. showed that mixture media significantly increased stem diameter and root length compared with the sandy soil which gave the lowest values.

These results may be to polyamine having been implicated in awid range of biological process including growth development and abioltic stress responses and cell division, differentiation [21].

As shown in Table 3 plants grown in mixing media gave the heaviest / fresh weight of leaves, stems and roots, in the first and second seasons, respectively. The clay soil significantly increased the fresh weight of leaves, stems and roots, compared with sandy soil which gave the lowest fresh weight of leaves, stems and roots in both seasons.

Using concentration of 50, 100 and 200 ppm putrescine significantly increased fresh weight of leaves, stems and roots, in two seasons, respectively, compared with the control. Interaction between the mixture sand and soil with putrescine at 50 ppm significantly increased fresh weight of leaves, stems and roots, followed by mixture media with putrescine at 100 and 200 ppm, in both seasons, respectively, compared with sandy soil without putrescine treatment,

which produced the lightest weight of leaves, stems and roots. These results are in accordance with those found by [22] on *Chorisia speciosa* and *Leucaena leucocephala* seedlings, and [23] on *Dalbergia melanoxylon* plant. With regard to the effect of putrescine treatment, these results are in agreement with those obtained by [20] on *Bougainvillea* plants and [8] on *Gladiolus* plants.

Table 2. Effect of growing media [sandy: clay (1:1v/v), sandy and clay] and polyamine (putrescine) on diameter of stem (cm), length of root (cm) and diameter of root (cm) of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Diameter of stem (cm)							
Control 0	0.78	0.76	0.74	0.76	0.82	0.75	0.74	0.77
Put. 50 ppm	1.00	0.79	0.89	0.89	2.00	1.05	1.30	1.45
Put. 100 ppm	0.96	0.82	0.85	0.88	1.70	1.10	1.10	1.30
Put. 200 ppm	0.92	0.81	0.86	0.86	1.50	1.08	1.30	1.29
Mean	0.92	0.80	0.84		1.51	1.00	1.11	
	Length of root (cm)							
Put. 0	56.20	51.70	54.60	54.17	65.00	60.00	64.50	63.17
Put. 50 ppm	74.30	57.50	68.20	66.67	103.30	74.30	84.30	87.30
Put. 100 ppm	72.30	58.33	65.30	65.31	94.00	76.60	83.00	84.53
Put. 200 ppm	71.50	59.00	61.50	64.00	87.50	82.00	82.30	83.93
Mean	68.58	56.63	62.40		87.45	73.23	78.53	
	Diameter of root (cm)							
Put. 0	1.19	1.12	1.14	1.15	1.20	0.90	1.02	1.04
Put. 50 ppm	1.40	1.18	1.30	1.29	2.20	1.00	1.40	1.53
Put. 100 ppm	1.43	1.26	1.29	1.33	2.20	1.40	1.40	1.67
Put. 200 ppm	1.37	1.22	1.32	1.30	2.10	1.27	1.50	1.62
Mean	1.35	1.19	1.26		1.93	1.14	1.33	

$LSD_{0.05}$ for:	diameter of stem		length of root		diameter of root	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Treatments (A)	0.06	0.09	2.12	1.74	0.02	0.04
Concentrations (B)	0.07	0.10	2.45	2.01	0.03	0.05
Interactions (AB)	0.10	0.18	4.25	3.49	0.07	0.08

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Table 3. Effect of growing media and polyamine (putrescine) on fresh weights of leaves, stem and roots (g) of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Fresh weight of leaves (g)							
Control 0	61.75	58.66	60.94	60.45	90.85	84.20	86.70	87.25
Put. 50 ppm	102.60	66.88	83.21	84.23	155.63	97.90	122.52	125.35
Put. 100 ppm	101.24	71.52	80.44	84.40	142.70	108.42	117.80	122.97
Put. 200 ppm	94.30	75.23	83.18	84.24	138.43	105.23	114.50	119.39
Mean	89.97	68.07	76.94		131.90	98.94	110.38	
	Fresh weight of stem (g)							
Put. 0	55.27	52.30	48.14	51.90	79.37	76.43	72.37	76.06
Put. 50 ppm	106.74	62.25	90.32	86.44	120.80	82.57	103.60	102.32
Put. 100 ppm	102.55	71.35	83.43	85.78	111.34	90.24	98.75	100.11
Put. 200 ppm	95.23	68.85	79.21	81.10	105.49	85.70	95.80	95.66
Mean	89.95	63.69	75.28		104.25	83.74	92.63	
	Fresh weight of roots (g)							
Put. 0	36.95	28.44	31.38	32.26	45.34	36.83	38.60	40.26
Put. 50 ppm	57.25	34.33	48.30	46.63	74.51	41.17	61.24	58.97
Put. 100 ppm	60.34	41.18	45.27	48.93	76.23	52.45	55.60	61.43
Put. 200 ppm	53.62	37.54	50.95	47.37	70.09	49.15	66.10	61.78
Mean	52.04	35.37	43.98		66.54	44.90	55.38	

$LSD_{0.05}$ for:	F. W. of leaves		F. W. of stem		F. W. of roots	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Treatments (A)	1.50	0.99	1.52	0.74	1.19	1.21
Concentrations (B)	1.74	1.14	1.74	0.86	1.36	1.39
Interactions (AB)	3.01	1.98	3.03	1.49	2.37	2.41

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Data presented in Table 4 indicate that, the mixture growing media significantly increased the dry weight of leaves, stems and roots, followed by clay and sand soil in both seasons, respectively. Using putrescine at 50 ppm followed by 100 treatments, produced the heaviest dry weight of leaves and stems. While, putrescine at 100 ppm produced the heaviest dry weight of roots, compared with the control which produced the lightest of leaves, stems and roots in two seasons. The mixing soil with 50 ppm followed by 100 and 200 ppm of putrescine treatments significantly increased the dry weight of leaves, stems and roots in both seasons, compared with other treatments. The obtained results are in harmony with those obtained by [20] on *Bougainvillea* plants and [4]on *Jatropha curca* L.

Plant pigments:

Data presented in Table 5 show that, mixture media produced the highest chlorophyll a, b and carotenoids

concentration, followed by clay medium. Whereas sandy medium gave the lowest value of these pigments, in both seasons. Spray with putrescine at 50, 100 and 200 ppm treatments, increased chlorophyll a, b and carotenoids in the leaves, compared with control in both seasons. The highest chlorophyll a and b concentration was obtained from plant grown in mixture soil with putrescine at 50 ppm, followed by plant grown in the same media with putrescine at 100 ppm, in two seasons, compared with other treatments.

While plants grown in mixing soil and treated with putrescine at 100 ppm produced the highest carotenoids in the first season, whereas in the second season, plant grown in the same media and treated with putrescine at 200 ppm produced the highest carotenoids, compared with other treatments. These results are in harmonywith those obtained by [24] on *Schefflera actinophylla*, [25] on *Rosa bourboniana* and *Rosa damascene* and [8] on *Gladiolus* plants.

Table 4. Effect of growing media and polyamine (putrescine) on dry weights of leaves, stem and roots (g) of *Populus euramericana* during 2006 and 2007 seasons

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Dry weight of leaves (g)							
Control 0	16.98	15.54	16.45	16.32	25.26	22.48	23.36	23.70
Put. 50 ppm	31.80	18.73	24.96	25.16	48.71	27.51	37.00	37.74
Put. 100 ppm	30.88	20.17	23.74	24.93	43.95	31.33	34.78	36.69
Put. 200 ppm	28.48	21.59	24.12	24.73	42.22	29.99	33.32	35.17
Mean	27.04	19.01	22.32		40.03	27.83	32.12	
	Dry weight of stem (g)							
Put. 0	18.79	17.52	15.88	17.40	27.23	25.76	24.00	25.66
Put. 50 ppm	39.49	21.29	32.52	31.10	44.93	28.47	37.71	37.04
Put. 100 ppm	37.53	24.97	29.78	30.76	41.20	31.58	35.30	36.03
Put. 200 ppm	34.84	23.89	27.96	28.90	38.41	29.74	33.82	33.99
Mean	32.66	21.92	26.54		37.94	28.89	32.71	
	Dry weight of roots (g)							
Put. 0	13.75	10.33	11.55	11.88	17.00	13.55	14.28	14.94
Put. 50 ppm	23.81	12.70	18.74	18.42	31.29	15.32	23.88	23.50
Put. 100 ppm	25.34	15.65	17.38	19.46	32.48	20.07	21.52	24.69
Put. 200 ppm	22.04	14.08	19.87	18.66	29.09	18.57	25.98	24.55
Mean	21.24	13.19	16.88		27.47	16.88	21.42	

LSD at 5% for:	D. W. of leaves		D. W. of stem		D. W. of roots	
	1st season	2nd season	1st season	2nd season	1st season	2nd season
Treatments (A)	0.56	0.39	0.89	0.34	0.58	0.67
Concentrations (B)	0.65	0.45	1.02	0.40	0.67	0.77
Interactions (AB)	1.12	0.78	1.78	0.70	1.16	1.33

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Table 5. Effect of growing media and polyamine (putrescine) on chlorophyll a, chlorophyll b and carotenoids of leaves (mg/g. F. W.) of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Chlorophyll a (mg/g. F. W.)							
Control 0	1.38	1.31	1.35	1.34	1.46	1.41	1.42	1.43
Put. 50 ppm	1.58	1.40	1.50	1.49	1.65	1.47	1.59	1.57
Put. 100 ppm	1.55	1.41	1.48	1.48	1.64	1.50	1.56	1.57
Put. 200 ppm	1.51	1.43	1.46	1.47	1.62	1.52	1.53	1.56
Mean	1.51	1.38	1.45		1.59	1.47	1.53	
	Chlorophyll b (mg/g. F. W.)							
Put. 0	0.35	0.29	0.32	0.32	0.40	0.36	0.38	0.38
Put. 50 ppm	0.55	0.37	0.49	0.47	0.59	0.40	0.51	0.50
Put. 100 ppm	0.54	0.39	0.47	0.47	0.57	0.41	0.49	0.49
Put. 200 ppm	0.51	0.40	0.42	0.44	0.54	0.44	0.49	0.49
Mean	0.49	0.36	0.42		0.52	0.40	0.47	
	Carotenoids (mg/g. F. W.)							
Put. 0	0.29	0.21	0.23	0.24	0.29	0.25	0.27	0.27
Put. 50 ppm	0.42	0.27	0.41	0.36	0.44	0.31	0.39	0.38
Put. 100 ppm	0.43	0.31	0.35	0.36	0.42	0.30	0.41	0.37
Put. 200 ppm	0.39	0.33	0.37	0.36	0.46	0.36	0.33	0.39
Mean	0.38	0.28	0.34		0.40	0.31	0.35	

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Carbohydrate percentage:

The results in Table 6 indicate that, mixture medium produced the highest total carbohydrates % in leaves, stems and roots, followed clay medium,compared with sandy media which decreased total carbohydrates content in previous orangs, in the first and second seasons. Spraying the plants with concentration of 50, 100 or 200 ppm increased total carbohydrates % in the leaves, stems and roots, compared with untreated plants, in two seasons.

While plants grown in mixture media and treated with 50 ppm produced the highest values of total carbohydrates % in the leaves, stems and roots, followed by those grown in the same media and treated with 100 ppm, compared with other treatments, in both seasons. These results are in agreement with those obtained by [26] on *Aleppo pine*, [27] on *Dianthus caryophyllus* and [9] on *Chrysanthemum* plants obtained increases in total carbohydrates content in the plants treated with different concentrations of putrescine. These increments in total carbohydrates content may be attributed to the increase in photosynthetic process efficiency, which led to increase assimilation of leaf Co_2.

Mineral percentage :

Nitrogen % :

As shown in Table 7 plants grown in mixture soil produced the highest N% values in leaves, stems and roots, compared with sandy soil which resulted

the lowest N values, whereas the clay soil gave moderate N values in these organs, in both seasons. The N % in the leaves, stems and roots were increased when the plants treated with putrescine at different concentration, as compared with untreated plants, in both seasons. Regarding the plants grown in mixing soil and treated with putrescine at 50 ppm produced the highest N value in leaves and stems, followed by plants grown in the same soil and treated with putrescine at 100 and 200 ppm, in both seasons, compared with all other treatments.

Table 6. Effect of growing media and polyamine (putrescine) on Carbohydrate% of leaves, stems and roots of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Leaves%							
Control 0	23.26	21.60	22.80	22.55	26.40	22.30	24.93	24.54
Put. 50 ppm	28.21	23.53	26.32	26.02	30.71	26.72	28.69	28.71
Put. 100 ppm	27.75	24.33	26.65	26.24	30.27	27.35	29.50	29.04
Put. 200 ppm	27.23	25.45	25.76	26.15	29.83	27.94	28.20	28.66
Mean	26.61	23.73	25.38		29.30	26.08	27.83	
	Stem%							
Put. 0	16.53	15.42	16.40	16.12	18.82	17.54	18.39	18.25
Put. 50 ppm	22.31	17.89	20.36	20.19	23.18	19.10	21.75	21.34
Put. 100 ppm	21.50	18.28	19.86	19.88	22.96	19.89	21.61	21.49
Put. 200 ppm	20.87	18.68	19.34	19.63	22.25	20.38	20.85	21.16
Mean	20.30	17.57	18.99		21.80	19.23	20.65	
	Roots%							
Put. 0	14.45	13.26	13.98	13.90	12.81	10.22	11.77	11.60
Put. 50 ppm	19.77	15.12	17.24	17.38	18.80	14.76	16.95	16.84
Put. 100 ppm	18.88	14.47	16.95	16.77	17.25	13.27	16.29	15.60
Put. 200 ppm	19.50	15.80	16.47	17.26	17.75	15.48	15.87	16.37
Mean	18.15	14.66	16.16		16.65	13.43	15.22	

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

While the maximum values of N % in roots were obtained at 50 or 100 ppm, in the first seasons, whereas, in the second season, plant grown in mix soil and spray with putrescine at 100 ppm produced the highest N value. These results are in harmony with those obtained by [16] on *Adhatoda vasica*, *Nerwm oleander* and *Lantana camara,* [28] on *myrtte olants* and [29] noticed that PAs have possibly increased activities on metabolic processes in plant. Accordingly, physiological performance of such plants was improved, as manifested by increased efficiency of roots in absorbing macronutrients from the soil.

Phosphorus % :

Data presented in Table (8) show that, mixture sand and clay soil produced the highest P values in leaves, stems and roots, compared with sandy soil which

Table 7. Effect of growing media [sandy: clay (1:1v/v), sandy and clay and polyamine (putrescine) on N% of leaves, stems and roots of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Leaves%							
Control 0	2.34	2.19	2.25	2.26	2.31	1.99	2.25	2.18
Put. 50 ppm	2.96	2.40	2.65	2.67	3.07	2.36	2.86	2.76
Put. 100 ppm	2.85	2.45	2.70	2.67	3.01	2.41	2.68	2.70
Put. 200 ppm	2.78	2.54	2.61	2.64	2.93	2.73	2.52	2.73
Mean	2.73	2.40	2.55		2.83	2.37	2.58	
	Stems%							
Put. 0	0.60	0.55	0.58	0.58	1.00	0.92	0.97	0.96
Put. 50 ppm	0.97	0.62	0.85	0.81	1.22	1.08	1.18	1.16
Put. 100 ppm	0.92	0.67	0.81	0.80	1.24	1.10	1.18	1.17
Put. 200 ppm	0.91	0.70	0.78	0.80	1.21	1.13	1.14	1.16
Mean	0.85	0.64	0.76		1.17	1.06	1.12	
	Roots%							
Put. 0	0.77	0.68	0.74	0.73	1.02	0.91	0.97	0.97
Put. 50 ppm	1.08	0.81	0.97	0.95	1.30	1.09	1.22	1.20
Put. 100 ppm	1.08	0.86	0.92	0.95	1.35	1.14	1.21	1.23
Put. 200 ppm	1.00	0.81	0.91	0.91	1.27	1.10	1.18	1.18
Mean	0.98	0.79	0.89		1.24	1.06	1.15	

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Table 8. Effect of growing media [sandy: clay (1:1v/v), sandy and clay] and polyamine (putrescine) on P% of leaves, stems and roots of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Leaves %							
Control 0	0.26	0.25	0.28	0.26	0.33	0.26	0.30	0.30
Put. 50 ppm	0.62	0.31	0.52	0.48	0.65	0.34	0.52	0.50
Put. 100 ppm	0.60	0.36	0.48	0.48	0.61	0.39	0.40	0.47
Put. 200 ppm	0.56	0.40	0.45	0.47	0.59	0.48	0.42	0.50
Mean	0.51	0.33	0.43		0.55	0.37	0.41	
	Stem %							
Put. 0	0.26	0.20	0.24	0.23	0.37	0.28	0.32	0.32
Put. 50 ppm	0.59	0.30	0.47	0.45	0.68	0.42	0.57	0.56
Put. 100 ppm	0.55	0.35	0.42	0.44	0.65	0.45	0.50	0.53
Put. 200 ppm	0.52	0.38	0.43	0.44	0.61	0.47	0.52	0.53
Mean	0.48	0.31	0.39		0.58	0.41	0.48	

	Roots %							
Put. 0	0.24	0.20	0.22	0.22	0.30	0.28	0.32	0.30
Put. 50 ppm	0.55	0.27	0.42	0.41	0.55	0.35	0.47	0.46
Put. 100 ppm	0.50	0.28	0.40	0.39	0.53	0.36	0.46	0.45
Put. 200 ppm	0.48	0.31	0.36	0.38	0.50	0.39	0.41	0.43
Mean	0.44	0.27	0.35		0.47	0.35	0.42	

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

Table 9. Effect of growing media [sandy: clay (1:1v/v), sandy and clay and polyamine (putrescine) on K% of leaves, stems and roots of *Populus euramericana* during 2006 and 2007 seasons.

Conc.(B)	Treatments (A)							
	S/C	S	C	Mean	S/C	S	C	Mean
	1st season				2nd season			
	Leaves %							
Control 0	1.34	1.27	1.32	1.31	1.33	1.21	1.25	1.26
Put. 50 ppm	1.69	1.38	1.52	1.53	1.83	1.47	1.70	1.67
Put. 100 ppm	1.57	1.37	1.42	1.45	1.74	1.41	1.64	1.60
Put. 200 ppm	1.61	1.50	1.44	1.52	1.80	1.51	1.55	1.62
Mean	1.55	1.38	1.43		1.68	1.40	1.54	
	Stem %							
Put. 0	0.80	0.75	0.80	0.78	0.68	0.68	0.71	0.69
Put. 50 ppm	1.04	0.84	0.98	0.95	1.06	0.81	1.02	0.96
Put. 100 ppm	1.00	0.81	0.88	0.90	1.10	0.77	0.97	0.95
Put. 200 ppm	0.92	0.84	0.85	0.87	1.00	0.89	0.93	0.94
Mean	0.94	0.81	0.88		0.96	0.79	0.91	
	Roots %							
Put. 0	0.88	0.80	0.82	0.83	0.91	0.80	0.87	0.86
Put. 50 ppm	1.05	0.96	0.99	1.00	1.26	1.00	1.12	1.13
Put. 100 ppm	1.02	0.93	0.96	0.97	1.22	1.03	1.07	1.11
Put. 200 ppm	1.02	0.90	1.01	0.98	1.19	0.94	1.16	1.10
Mean	0.99	0.90	0.95		1.15	0.94	1.06	

S/C= sandy: clay (1:1) S= sandy C= clay put. = putrescine

resulted in the lowest P values, whereas the clay gave moderate P values in the leaves, stems and roots in two seasons. Application of putrescine at three concentrations (50, 100 and 200 ppm) increased P % in the leaves, stems and roots, compared with control plants, in both seasons. Plants grown in soil mixture and treated with putrescine at 50 ppm produced the highest P values in leaves, stems and roots, followed by those plants grown in mixing soil treated with 100 ppm, compared with other treatments, in the first and second seasons. These results are in agreement with obtained by [25] on *Brasaia actinophylla*, showed that plants grown in sand / clay media produced the highest values of P content in leaves.

Concerning the effect of putrescine, these results are in accordance with those obtained by [8]) on *Gladiolus* plants and [9] on *Chrysanthemum* plant.

Potassium % :

Data presented in Table 9 show that, mixture of sand and clay medium produced the highest K values in leaves, stems and roots, in both seasons. Clay medium gave moderate K value, compared with the sandy soil which produced the lowest K% values in previous organs. Spraying plants with putrescine at different concentration increased the K content in the leaves, stems and roots, giving the highest values of K % from plants treated with 50 ppm putrescine, in both seasons, compared with control. Plant grown in mixing soil and sprayed with putrescine at 50 and 100 ppm produced the highest K values in leaves, stems and roots, followed by those plants grown in clay soil and sprayed with putrescine at 50 ppm, compared with unsprayed plants grown in sandy soil which gave the lowest K values, in the first and second seasons. These results are in agreement with those obtained by [25] on *Brasaia actinophylla*, [28] on myrtte plants and [8] on *Gladiouls*.

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