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Chemical and Physiological Effect of Mycorrhiza and Yeast on Paulownia Seedlings Grown Under Saline Condition

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Abstract

The aim of this study to examine the effect of some biostimulants on growth characters of paulownia seedlings under irrigation with saline water. Different concentrations of biostimulants (Mycrrohiza and Yeast at 5 and 10 gm) were applied under the conditions of irrigation with salt water at four levels of water salinity (0,1000,2000 and 3000 ppm) on growth characters, photosynthesis pigments, carbohydrates , Proline, total indol , total Phenol and some Macro elements.The results indicated that application of Mycrrohiza and yeast at 10 gm/ pot combined with untreated salinity irrigation significantly increased plant height, stem diameter, fresh and dry weight of leaves and stems, compared with salinity at 3000 ppm plus untreated biostimulants treatment. While, irrigation at Zero salinity combined with Mycrrohiza at 10gm /pot followed by 5gm/pot and yeast at 10gm/pot significantly increased root length, root diameter, fresh and dry weight of roots, compared with salinity at 3000 ppm plus untreated biostimulants treatments. Mycrrohiza application (10gm/pot) was more effective on pigments content, Nitrogen and Potassium% under irrigation with tap water. The application of Yeast at 10gm/pot under non saline water resulted in increases the total carbohydrates. The interaction between salinity at 3000 ppm and untreated biostimulants significantly increased proline content, total phenol and sodium %. The application of yeast at 10gm/pot combined with untreated biostimulants significantly increased total indol. Application of Yeast at 10gm/pot and 5gm/pot combined with tap water gave the highest values of Phosphorus (P%) and Magnesium (Mg %). The results indicated that irrigation the seedlings with untreated saline water followed by 1000ppm significantly increased the growth parameter and chemical constituents except proline content, total phenols, sodium, calcium, which increased with irrigation at 3000 ppm salinity.

Keywords: Paulownia, Mycorrhiza , Yeast, saline water, plant growth.

1. Introduction

The *Paulownia* genus includes nine species known for their rapid growing timber trees that are native to China. It spreads and adapts in a large area and grows extremely fast. One of its prominent properties is its ability to grow very well on plains lands as well as on mountainous regions reaching a height of 30 m. Therefore, *Paulownia* makes for a great asset of extensive cultivation for the whole world [1].

Paulownia is considered of great importance in China, being fast-growing with high-quality wood, with over one billion trees in plantations, it produces almost 3 million cubic meters of timber a year worth over US$55 million. Paulownia is used in furniture, decorative products and musical instruments. It also accommodates agroforestry systems in temperate sub-humid areas, though a disadvantage is that it grows well only on fertile land. Improving wood properties and stress tolerance as well as increase its use in plantation still needs more research [2].

Paulownia timber prices vary according to the quality of the wood. For example, Timber FOB (Free On Board) China may range from 250USD per cubic meter, while quality timber from Australia may cost as much as 2,000 USD /m3[3].

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Salinity is considered one of the greatest stresses in arid and semi-arid region that adversely affect physiological, biological and molecular levels, limiting flowering and crop productivity [4]and [5]. Salt stresses is capable of disrupting the growth and photosynthetic processes as it changes in the inoculation of Na+ Cl-, and nutrients and disturbing the water and osmotic potential [6]. The increasing concentration of Na+ Cl- in water irrigation halts the absorption of essential nutrients N, P and K and alters ionic relationship [7]. In Actuality, Salinity poses the most serious threat to as salinity water is a major harmful factor around the globe [8]. Increasing salinity results in a decrease in the initial biomass differences between accessions, an expansion of morphological variability and diversity of mineral nutrient concentrations among plant parts in saline conditions is strongly pronounced. Changes in minerals possibly reflect a reprogramming of the metabolism to adapt accordingly to changes in growth, morphology, and ion accumulation resulting from the direct effect of NaCl[9].

Biofertilizers are microbial inoculants applied to either seeds or soil to increase the fertility of the soil with the purpose of increasing the number of such micro-organisms and to cause and acceleration in certain microbial processes. These microbiological processes are incapable of causing any change to nutrient forms that are unavailable and change them to available ones that can be easily assimilated by plants [10]. Soil micro-organisms have a significant role in the regulation of the dynamics of organic matter decomposition and the plants nutrients availability, such as Nitrogen (N), Phosphorus(P) and Sulfur(S). It is a known fact that microbial inoculants comprise an important component of integrated nutrient management that leads to Agricultural sustainability. In addition, microbial inoculants can be utilized as an economic input to improve the crop productivity; fertilizer doses can be reduced and more nutrients can be harvested from the soil [11]. *Arbuscular mycorrhizal fungi* (AMF) and several plants form a symbiotic association. AMF possess the potential to improve soil structure and promote plant growth under normal as well as stressed environmental conditions. AMF behaves as vital bio-ameliorators of stress and helps in mitigating stress-induced damage in plants [12]. Morpho-physiological and nutritional changes brought about by AMF colonization improves plants' resistance to abiotic stresses. Moreover, AMF also directly affects the growth and vigor of plants [13]. Mycorrhizal inoculation influences root morphology as well as the physiological status of host plants. AMF-induced modifications in root architecture encourages roots to absorb the needed water and nutrients. AMF colonization boosts the uptake of essential mineral nutrients such as nitrogen phosphorous and potassium [12] and [14].

Yeast is considered a bio-fertilizer which is used in soil fertilization and foliar nutrition of various crops, since they contain various amino acids, proteins and a number of elements that are vital for plant growth [15]. Dry yeast extract is a source of nutrient for plants for its plant hormones, sugars, carbon, nitrogen, phosphorus, potassium, calcium, magnesium and other micronutrient [16] and [17].

The current study focuses on testing the effect of *Mycrohiza* and yeast on growth and chemical constituents of *Paulownia* seedlings grown under saline conditions.

2. Material and Methods:

The experimental was carried out at green house of privet farm in Qaluobya governorate during two successive seasons (2019-2020). The aims to this investigate to evaluate the effect of different of *Mycorrhiza* and yeast on vegetative growth and chemical constituents of *Paulownia* seedlings grown under saline conditions. The physical and chemical properties of the soil were determined according to [18] method.

2.1. The physical and chemical properties of the experimental soil

A: Physical analysis:

Soil	Coarse Sand%	Fine sand%	Silt + Clay %
Sample	40.50	11.50	48.00

B: Chemical analysis:

Soil Sample	E.C. dSm-1	pH	Soluble Cations (meq/100g soil)				Soluble anions (meq/100g soil		
			Ca++	Mg++	Na+	K+	Cl-	HCO3-	SO4-
Clay	0.39	8.37	1.50	0.80	1.70	0.22	1.50	1.60	1.12

One year seedlings of *poulownia* seedlings were obtained from nursery of forestry Department Horticulture Research Institute, Agriculture Research Centre. The seedlings were planted on 20th March in plastic pots 30 cm diameter (one plant/pot, the average height of seedlings were 20-25 cm) filled with 12 kg soil.

The available commercially fertilizer will be use through this experimental works Kristalon (NPK 19:19:19) produced Phayzen Company, Holland. The fertilizer rates are 5.0 g/pot in four doses after 4, 8, 16 and 20 weeks from transplanting.

The *mycorrhiza* fungi (0, 5 and 10 gm/pot) was mixed with the media before transplanting and covered with the sand. Bread yeast (0, 5and 10gm/L) was applied after one month from transplanting. Seedlings were irrigated for 4 weeks with tap water. Then, four salinity levels were prepared (0, 1000, 2000 and 3000) by adding a mixture of sodium chloride (NaCl) + calcium chloride (CaCl2) at a ratio (1:1) by weight for irrigating. Tap water was used for control. One liter of water (either fresh or salinity water) will be added to each pot twice per week through the course of this study (8 months).All the plants were hold under the open field condition for 8 month continuously. Other agriculture processes will be performed according to normal practical.

The layout of the experiment was a factorial based on randomized complete block design, with 20 treatments [4 different salinity concentrations x 5 biostimulants (including the control)], with 6 replicates. Each replicate contained one plant.

Data recorded:

2.2. Vegetative growth:

plant height (cm),stem diameter(cm2),number of leaves/plant, number of branches/plant ,leaf area (cm2) measured ,fresh weight

(f.w) of all plant organs [leaves, stem and roots (g/plant)] and dry weight(d.w) of all plant organs [leaves, stem and roots (g/plant)].

2.3. Chemical constituents:

*Chlorophyll a, b and carotenoid contents (mg/g F.W.) were determined according to [19].

*total carbohydrates content % was determined according to [20].

*proline content (mg/g F.W.) was determined by using dry material according to [21].

*Total indoles (mg. 100g-1 F.W.) were determined according to [22].

*Total phenols (mg. g-1 F.W.) were determined according to [23].

*Nitrogen, phosphorus, potassium, Manganese, sodium and calcium were determined according to [24].

2.4. Statistical analysis:

All previous data were subjected to statistical analysis by using least significant differences (L.S.D) at 5% level according to method described by [25].

3. Results and Discussion

3.1. The vegetative growth:

Data presented in Tables (1-5) stated that increases occurred in all growth parameters by reducing the level of salinity in irrigation water. Irrigation of all water salinity especially 3000 ppm significantly decrease plant height, stem diameter, root length and root diameter. The decrements were 38.76%, 51.35%, 58.42% and 42.68%, respectively in comparison with the tap water irrigated plant. These results are ascribed to the high salinity leaves which could be reduce by its reducing the synthesis of DNA, RNA and protein and hence which might lead to a disturbance in metabolism, cell division and elongation. In this respect, [26] reported that increasing salinity level decreased water permeability and osmotic potential. However, [27] attributed the undesirable effect of high salinity levels on plant growth to disturbance in mineral balance or utilization. [28] mentioned that several of the physiological changes that are characteristic of plant senescence may be attributed are also common to salt stress and include losses of chlorophyll,

protein and nucleic acids, a decline in membrane integrity and disruption of cell homeostasis. [29] reported that increasing salinity concentrations can reduce the endogenous level of IAA in root. Also, they indicated that the function of this hormone is impaired in salt stressed plants, and the alternation of IAA metabolism in the roots under salt stress may account for the reduction in growth potential via decreasing availability of for water and increasing tissue water deficient. The results also reveal that, leaves, stems and roots fresh and dry weights were gradually decreased by increasing salinity level. Irrigation of salinity at 3000 ppm significantly decreased of fresh and dry weight of leaves, stems and roots, the decrements were (57.22, 30.78, and 44.24%) for fresh weight, respectively. In this respect, leaves, stem and roots dry weight were decrement (63.47, 52. 65 and 48.78%), respectively, comparing with tap water. The effect of salinity on fresh and dry weights might be attributed to the inhibitory effects induced by salinity on many metabolic processes inducing enzyme activities, protein and nucleic acid synthesis and the activities of the mitochondria and chloroplasts. [30] and [31] pointed out that CO2 uptake was parallel by reduction in transpiration and stomata conductance. The change in stomata resistance under saline conditions may be responsible for reducing photosynthesis and water use efficiency. Similar results were obtained by [8], [32] and [33].

Data in the same Tables (1-5) demonstrate clearly that using biostmulants (*mycrrohiza* and yeast) resulted an increase in plant height, stem diameter, root length, root diameter and fresh and dry weight of all plant organs than control plants and other treatments. *Mycrrohiza* and yeast at 10 gm/ pot significantly increased of most parameters. The increments were (19.69 and 15.03 %) for plant height, (43.48 and 30.43 %) for stem diameter, (27.77 and 18.73) for fresh weight of leaves, (28.36 and 19.69 %)for dry weight of leaves), (19.03 and 15.45%) for fresh weight of stems and (20.40 and 16.78%) for dry weight of stems ,respectively, comparing with control plants. While, using *Mycrrohiza* at 10gm/pot followed by 5gm /pot and then using yeast at 10gm/pot significantly increased root length, root diameter, fresh and dry weight of roots, compared with untreated plants.

The interactions between different treatments (salinity + biostimulants) were almost significant for vegetative growth characters. Using *mycrrohiza* and yeast at 10 gm/ pot combined with untreated salinity irrigation significantly increased plant height, stem diameter, fresh and dry weight of leaves and stems, compared with salinity at 3000 ppm plus untreated biostimulants (*mycrrohiza* and yeast) treatments. While, irrigation at Zero salinity combined with mycrrohiza at 10gm /pot followed by 5gm/pot and then yeast at 10gm/pot significantly increased root length, root diameter, fresh and dry were of roots, compared with salinity at 3000 ppm plus untreated biostimulants treatments.

Table (1): Plant height and stem diameter of *Paulownia* seedlings as affected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Plant height(cm)						Stem diameter					
	0	Yeast(gm)		*Mycrrohiza*(gm)			0	Yeast(gm)		*Mycrrohiza*(gm)		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap Water	152.34	161.53	175.11	165.09	179.61	166.74	3.10	3.41	4.00	3.60	4.30	3.70
Sal.1000 ppm	138.17	144.57	153.61	149.51	159.35	149.04	2.60	2.83	3.40	3.00	3.60	3.10
Sal.2000 ppm	108.53	113.53	132.12	121.74	140.08	123.20	2.00	2.50	2.61	2.10	2.90	2.40
Sal.3000 ppm	93.71	98.64	105.96	101.53	110.71	102.11	1.30	1.60	2.02	1.80	2.20	1.80
Mean (A)	123.19	129.57	141.70	134.47	147.44		2.30	2.50	3.00	2.60	3.30	
LSD at 5% A B AXB			 12.48 13.52 22.36						 0.28 0.20 0.59			

Table (2): Leaves Fresh and Dry weights (gm) of *Paulownia* seedlings as affected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Leaves fresh weight (gm)						Leaves dry weight (gm)					
	0	Yeast(gm)		*Mycrrohiza*(gm)			0	Yeast(gm)		*Mycrrohiza*(gm)		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap Water	90.12	98.19	100.75	93.51	106.76	97.87	25.23	27.49	28.21	26.18	29.89	27.40
Sal.1000 ppm	72.31	77.96	87.35	76.12	92.35	81.22	19.52	21.05	23.58	20.55	24.93	21.93
Sal.2000 ppm	58.81	68.97	74.06	63.13	87.53	70.50	15.29	17.93	19.26	16.41	22.76	18.33
Sal.3000 ppm	37.61	41.96	45.17	40.53	44.06	41.89	8.65	10.07	11.15	9.61	10.57	10.01
Mean(A)	64.71	71.77	76.83	68.32	82.68		17.17	19.14	20.55	18.19	22.04	
LSD at 5% A B AXB			8.44 7.28 14.98						2.04 2.45 5.63			

Table (3): Stem Fresh and Dry weights (gm) of *Paulownia* seedlings as affected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Stem fresh weight (gm)						Stem dry weight (gm)					
	0	Yeast(gm)		Mycrrohiza(gm)			0	Yeast(gm)		Mycrrohiza(gm)		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap Water	237.61	261.37	269.15	242.91	273.51	256.91	130.69	143.75	148.03	133.60	150.43	141.30
Sal.1000 ppm	227.41	241.24	246.35	239.16	259.60	242.75	120.53	127.86	133.03	126.75	140.19	129.67
Sal.2000 ppm	198.17	231.41	235.17	220.12	241.71	225.32	103.05	120.33	122.29	114.49	125.69	117.17
Sal.3000 ppm	151.21	183.53	189.51	170.43	194.51	177.84	77.12	93.53	100.44	88.62	103.09	92.56
Mean(A)	203.60	229.39	235.05	218.06	242.34		107.85	121.37	125.95	115.87	129.85	
LSD at 5% A B AXB			23.54 22.50 27.33						12.04 11.31 21.45			

Table (4): Roots Length and Diameter (cm) of *Paulownia* seedlings as affected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Root length(cm)						Root diameter(cm)					
	0	Yeast(gm)		*Mycrrohiza*(gm)			0	Yeast(gm)		*Mycrrohiza*(gm)		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap Water	28.11	31.61	35.61	38.15	43.17	35.33	3.00	3.27	3.95	4.33	5.23	3.96
Sal.1000 ppm	23.31	28.01	29.75	32.61	39.61	30.66	2.63	2.91	3.75	3.85	4.12	3.45
Sal.2000 ppm	18.21	21.25	23.17	24.51	31.37	23.70	2.24	2.45	2.63	3.21	3.65	2.84
Sal.3000 ppm	10.21	12.95	15.27	16.51	18.51	14.69	1.77	1.93	2.11	2.65	2.91	2.27
Mean(A)	19.96	23.46	25.95	27.95	33.17		2.41	2.69	3.11	3.51	3.98	
LSD at 5% A B AXB			2.61 2.55 5.88						0.41 0.34 0.91			

Table (5): Roots Fresh and Dry weights (gm) of *Paulownia* seedlings as affected by biostimulants and irrigation with saline water (average two seasons)

Treatments	Root fresh weight (gm)						Root dry weight (gm)					
	0	Yeast(gm)		*Mycrrohiza*(gm)			0	Yeast(gm)		*Mycrrohiza*(gm)		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap Water	60.12	65.37	72.13	87.12	93.62	75.67	24.05	26.15	28.13	33.98	37.45	29.95
Sal.1000 ppm	48.15	52.13	63.64	81.53	88.47	66.78	18.78	20.33	24.18	30.98	34.50	25.75
Sal.2000 ppm	39.67	44.12	51.35	65.11	70.51	54.15	14.68	15.88	18.95	24.09	26.09	19.94
Sal.3000 ppm	33.08	36.61	39.67	49.61	52.11	42.22	11.58	13.18	14.28	18.36	19.28	15.34
Mean(A)	45.26	49.58	56.70	70.84	76.18		17.27	18.89	21.39	26.85	29.33	
LSD at 5% A B AXB			6.05 5.93 10.89						2.92 2.25 5.36			

3.2. Photosynthetic pigments:

Data presented in Table (6,7) showed that the content of chlorophyll (a), chlorophyll (b), chlorophyll (a+b) and carotenoids were decreased by 38.46% 42.55, 39.02 and 44.68% respectively, owing to salinity at 3000 ppm, compared to control. Chlorophyll and carotenoids were affected by salinity and decreased steadily with increasing salt concentration. The lowest photosynthetic ability under salt stress condition was due to stomata closure, inhibition of chloro synthesis, a decrease of carboxylase and due to high cholorophylase activity

[34] and [35]. Similar response was previously observed in other plants, salinity caused a decreased in pigment content of *Grevilla robusta* and a reduction in chlorophyll concentration of *Khaya sengalensis* [36] and [37]. Concerning to the effect of biostimulants, *mycrrohiza* or yeast on phytosynthetic characteristics, application of *mycrrohiza* at 10gm/pot significantly increased Chll (a), Chll (b), Chll (a+b) and carotenoid, The increments were (80.28, 134.78, 93.62 and 128.00%), respectively, compared with control plants. Such findings were obtained by [38] on Kahay senegalensis. Regarding the effect of interaction, *mycrrohiza* application (10g/pot) was more effective on pigments content under irrigation with tap water.

Table (6): Chlorophyll a, b, a+band carotenoids content of *paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Chall.-a mg/g F.W						Chall.-b mg/g F.W					
	0	Yeast gm		*Mycrrohiza* gm			0	Yeast gm		*Mycrrohiza* gm		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap /water	0.81	0.85	0.96	1.36	1.87	1.17	0.29	0.32	0.39	0.63	0.73	0.47
Sal. 1000 pm	0.76	0.78	0.86	1.62	1.55	1.11	0.26	0.28	0.34	0.42	0.61	0.38
Sal. 2000 pm	0.68	0.71	0.77	1.07	0.90	0.83	0.20	0.22	0.32	0.41	0.44	0.32
Sal. 3000 pm	0.57	0.61	0.64	0.99	0.80	0.72	0.17	0.20	0.26	0.35	0.39	0.27
Mean(A)	0.71	0.74	0.1	1.26	1.28		2.23	0.26	0.33	0.45	0.54	
LSD at 5%												
A			0.09						0.09			
B			0.10						0.04			
AXB			0.21						0.16			

3.3. Total carbohydrates percentage:

Results in Table (8) indicated that, increasing salinity levels decreased total carbohydrates% compared to control treatment. The lowest value (20.28%) resulted from the highest level of salinity. These results agree with those obtained by [39] who stated that, the obtained reduction in total carbohydrate as salinity level increased might have relation to respiration processes since the free sugars were the main sugar pattern involved in the mechanism of respiration. In many species, salt stress alters leaf carbohydrate partitioning and concentration. 14CO2 pulse-chase experiments showed an increase in mannitol and a decrease in sucrose and glucose partitioning in the leaves of salt-stressed celery and olive plants [40] and [41]. As for the effect of biostmulants application on total carbohydrates percentage, it is clear from data that total carbohydrates percentage in the two growing seasons, were increased by using biostmulants application, especially by using a higher rate of yeast 10g/pot (29.10%), followed by yeast at 5.g/pot (26.95%) in comparison with the untreated plants which gave (20.22%). With regard the effect of interaction, bio stimulants application was also effective on total carbohydrates percentage of salinized water irrigated plant, where total carbohydrates percentage were greatly induced. These trends point out that biostimulant treatment especially application of yeast at 10gm/pot under non saline conditions resulted in an increase in seedling growth. This stimulatory effect was accompanied by the observed increases in total carbohydrates percentage.

3.4. Proline content (mg/g):

Data in Table (8) revealed that the proline in leaves of paulownia plants, increasing the salinity levels caused increase proline content; this may be due to the proline metabolism which is a typical mechanism of biochemical adaptation subjected to stress condition. Proline is considered as a cell stabilizer for osmatic potential and some enzymes synthesis, proline concentration increased under salinity levels to make plants more adapted to unsuitable condition, [42]. In addition, that proline alleviates the harmful effect of stress condition on

growth of biochemical constituents. The increase of proline concentrations in Corips tagel with increasing Na concentration indicates that higher proline accumulation may help alleviate NaCL stress in C. tagel, [43]. With regard, the effect of biastimulants (yeast and mycorrhiza) application on proline content, it is evident that a decrease attributed to the ability of applied yeast and mycorrhiza compared with untreated plants. It supplying to the soil is used for the materials might surpass the need for field to retain these materials on the field in order to build up to soil fertility. From the above-mentioned results, it could be concluded that yeast or mycorrhiza application had decreased the hazardous effect of salinity stress, in addition had a favorable effect on growth of paulownia seedling. Regarding the effect of interaction between biostimulants and salinity, the interaction between salinity at 3000 ppm and untreated biostimulants treatment of allowed by yeast at 5g/pot and saline water at 3000 ppm treatment significantly increased total proline which gave 275.17 and 268.60 mg/g, respectively, compared with control plants

Table (8): Carbohydrates (%) and Proline content (mg/g) of *paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Carbohydrates (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	25.12	31.43	33.18	28.90	29.90	29.71
Sal. 1000 pm	22.16	28.21	30.30	26.40	27.41	26.94
Sal. 2000 pm	18.31	25.87	27.84	22.60	23.20	23.56
Sal. 3000 pm	15.27	22.28	24.86	18.90	20.10	20.28
Mean(A)	20.22	26.75	29.10	24.20	25.15	
LSD at 5% A B AXB			2.40 2.51 4.31			
Treatments	Proline content (mg/g)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	217.51	211.63	201.13	201.15	186.14	203.51
Sal. 1000 pm	241.15	232.49	212.42	221.93	203.83	222.36
Sal. 2000 pm	253.31	246.93	221.94	243.14	221.27	237.32
Sal. 3000 pm	275.17	268.60	236.73	265.88	245.14	285.11
Mean(A) LSD at 5% A B AXB	246.79	239.67	218.06 22.96 23.68 39.12	233.03	214.10	

3.5. Total phenols content (mg.g-1 F.W.) and total indoles content (mg. 100g-1 F.W.):

The results in Table (9) showed the response of total indoles in leaves of *paulownia* plants to saline water irrigation and biostimulants. All treatments of salinity decreased the total indoles content in the leaves, in comparison to the control. The highest level of salinity (3000 ppm) gave the lowest values of total indoles content (2.38 mg/100 g). In the contrary, total phenols gradually increased by increasing salinity levels. The increment were (13.55, 43.94 and 105.04%) in total phenol, respectively, compared with 2000, 1000 ppm salinity and control plants. Those finding were in agreement with this obtained by [44]and [45] suggested that on accumulation of phenolic compounds in response to abiotic stress would be attributed to activation of phenylalanine ammonialyase (PALs). This would beneficial to achieve acclimatization and tolerance to stress, since many kinds of plant total phenols have been considered to the main line of cell acclimatization against stress in plant. The effect of bio stimulants showed that, the highest value of indole recorded in *paulownia* leaves were obtained by yeast at 10g/pot but the untreated plants gave the highest value of total phenols.

Regarding the interaction between saline water and biostimulants, the application of yeast at 10gm/pot followed by 5gm/pot of yeast and 10gm/pot of *mycrrohiza* combined with untreated salinity significantly increased total indoles, the increments were (157.54, 123.29 and 123.29%), respectively, compared with salinity at 3000 ppm plus untreated biostimulants treatments. While, irrigation of saline water at 3000 and 2000ppm combined with untreated of biostimulants significantly increased total phenols compared with other treatments

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Table (9): Total Indols (mg/100g) and phenols (mg/g) of *paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Total Indols(mg/100g)						Total Phenols (mg/g)					
	0	Yeast gm		*Mycrrohiza* gm			0	Yeast gm		*Mycrrohiza* gm		
		5	10	5	10	Mean(B)		5	10	5	10	Mean(B)
Tap /water	4.06	4.89	5.64	1.12	4.89	4.71	1.75	1.22	1.02	1.33	1.65	1.39
Sal. 1000 pm	4.00	4.03	4.31	3.18	3.56	3.82	2.93	1.64	1.08	1.41	2.85	1.98
Sal. 2000 pm	2.67	3.01	3.86	2.94	2.91	3.08	3.11	2.45	1.98	2.03	2.98	2.51
Sal. 3000 pm	2.19	2.23	2.63	2.32	2.64	2.38	3.23	3.01	2.61	2.34	3.07	2.85
Mean(A)	3.23	3.53	4.11	3.11	3.5		2.76	2.08	1.67	1.70	2.64	
LSD at 5%												
A			0.38						0.24			
B			0.35						0.22			
AXB			0.81						0.51			

.

*3.6. Minerals percentage***:**

Data in Table (10-12) indicated that nitrogen, phosphorus, potassium and magnesium % was decreased in leaves of *paulownia* plants by increasing salinity concentration as compared with untreated plants. The lowest values of nitrogen, phosphorus, potassium and magnesium percentages were obtained from treated plants with salinity level at 3000 ppm, which gave (1.05, 0.25, 1.18 and 1.07%), respectively in comparison with the other treatments. In this respect, the decrease in nitrogen percentage might be attributed to the inhibition of cell division and cell elongation, this might be due to as a result of the disturbance in nitrogen metabolism beside sugar synthesis [46], [47] such decrease in phosphorus percentage might be due to the raising of soil PH which lower the availability of phosphorus [48], Concerning the effect of biostimubants, yeast at 10 g/pot gave the highest values of N, P and Mg which resulted (1.58. 0.39 and 1.24) compared with

the control and the other treatments. With, mycorrhiza at 10 g/pot gave the highest value of potassium. On the contrary, untreated plants with biostimulants gave the highest values of sodium compared with other treatments of biostimulants. While, yeast at 10gm/pot significantly increases calcium % compared with other treatments and control plants. The greatest absorption and accumulation of sodium and Calcium by plant at high concentration may be attributed to the damage of protoplasm of plant cells and as a result the selective salt absorption is replaced by passive absorption which causes abnormal accumulation of salt in plant [49]. The interaction between mycrohiza at 10gm/pot plus tap water gave the highest values of Nitrogen and Potassium %, (1.88 and 1.78 %) , respectively, while application of yeast at 10gm/pot and yeast at 5gm/pot combined with tap water gave the highest values of P% and Mg% (0.41 and 1.35%),respectively, the application of yeast at 5gm/pot and yeast at 10gm/pot combined with salinity at 3000 ppm gave the highest values of Na and Ca % (1.43 and 1.55 %), respectively

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Table (10): Nitrogen and phosphorus (%) of *paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Nitrogen (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	1.57	1.65	1.85	1.73	1.88	1.70
Sal. 1000 pm	1.41	1.43	1.74	1.64	1.73	1.58
Sal. 2000 pm	1.05	1.38	1.54	1.05	1.12	1.23
Sal. 3000 pm	0.92	1.19	1.23	0.89	1.00	1.05
Mean(A) LSD at 5% A B AXB	1.24	1.41	1.58 0.14 0.14 NS	1.06	1.43	
Treatments	Phosphorus (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	0.33	0.43	0.48	0.38	0.40	0.40
Sal. 1000 pm	0.26	0.38	0.41	0.31	0.35	0.34
Sal. 2000 pm	0.23	0.33	0.36	0.27	0.31	0.30
Sal. 3000 pm	0.41	0.28	0.31	0.22	0.26	0.25
Mean LSD at 5% A B AXB	0.25	0.36	0.39 0.04 0.32 0.49	0.30	0.33	

Table (11): Potassium and Magnesium (%) of *Paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Potassium (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	1.16	1.22	1.35	1.53	1.783	1.40
Sal. 1000 pm	1.03	1.29	1.11	1.48	1.62	1.31
Sal. 2000 pm	0.94	1.38	1.02	1.31	1.54	1.24
Sal. 3000 pm	0.88	1.45	1.00	1.23	1.33	1.18
Mean(A)	1.00	1.34	1.12	1.39	1.56	
LSD at 5%						
A			0.13			
B			0.13			
AXB			NS			
Treatments	Magnesium (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	1.19	1.35	1.30	1.27	1.28	1.28
Sal. 1000 pm	1.1	1.19	1.27	1.23	1.22	1.21
Sal. 2000 pm	1.05	1.11	1.23	1.16	1.18	1.15
Sal. 3000 pm	0.92	1.06	1.15	1.09	1.11	1.07
Mean(A)	1.07	1.18	1.24	1.19	1.20	
LSD at 5%						
A			0.12			
B			0.12			
AXB			NS			

Table (12): Sodium and Calcium (%) of *paulownia* seedlings as effected by biostimulants and irrigation with saline water (average two seasons).

Treatments	Sodium (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	1.15	1.09	1.01	1.02	1.12	1.08
Sal. 1000 pm	1.27	1.21	1.14	1.18	1.16	1.19
Sal. 2000 pm	1.35	1.29	1.18	1.24	1.24	1.26
Sal. 3000 pm	1.42	1.43	1.24	1.35	1.34	1.36
Mean(A)	1.30	1.26	1.14	1.20	1.22	
LSD at 5%						
A			0.13			
B			0.12			
AXB			0.29			
Treatments	Calcium (%)					
	0	Yeast		*Mycrrohiza*		
		gm		gm		
		5	10	5	10	Mean(B)
Tap /water	1.26	1.29	1.38	0.84	0.93	1.14

Sal. 1000 pm	1.35	1.31	1.49	0.91	1.15	1.24
Sal. 2000 pm	1.38	1.41	1.53	1.10	1.23	1.33
Sal. 3000 pm	1.45	1.48	1.55	1.21	1.39	1.42
Mean(A)	1.36	1.37	1.49	1.02	1.18	
LSD at 5%						
A			0.12			
B			0.12			
AXB			NS			

4. Conclusions:

The research concluded that the use of biostimulants (*Mycrrohiza* and Yeast), especially at high concentrations (10gm), led to a reduction and alleviate in the damage caused to the growth of *paulownia* seedlings resulting from irrigation with salt water.

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