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RESEARCH ARTICLE

Response of *Melia azedarach* L. tree seedlings to the addition of salt water and yeast

Ebeid A.F.A. [1]*, A.M.M. Mahmoud [1], A. Gahory [2] and Y.M. Soliman [3]

[1] *Woody trees Department, Horticulture Research Institute, Agricultural Research Center, 12511 Giza, Egypt.*
[2] *Department of Horticulture, Faculty of Agriculture and Natural Resources, Aswan University, 81528 Aswan, Egypt.*
[3] *Department of Horticulture, Faculty of Agriculture, Sohag University, 82524 Sohag, Egypt.*

Abstract

The present work was carried out during the two seasons of 2019 and 2020 in Al-Marashda Research Station, Qena Governorate, Egypt. This experiment was conducted to examine the possibility of producing *Melia azedarach* L. as a valuable trees under salinity stress by using yeast extract levels as bio fertilizers. The layout of the experiment was sitting as completely randomized in a split- plot design with two factors (salinity and yeast extract with two controls) and included 16 treatments; 4 levels of salinity (0, 2000, 3000 and 4000 ppm) and 4 levels of yeast extract (0, 5, 10 and 15%). Results indicated that the different vegetative growth characters as well as chemical constituents of *M. azedarach* were decreased due to various salinity concentrations. Foliar application of yeast extract with salinity levels increased of vegetative characters and chemical composition compared to the control. Meanwhile, the exogenous application of yeast extract showed a significant reduction in values of free proline content in leaves of *M. azedarach* and this decrease was higher with spraying 15%, in the average of seasons. These results assure the possibility of growing *M. azedarach* seedlings at the same conditions of salt stress by the use of some bio fertilizers as yeast. Accordingly, these trees can be planted in newly reclaimed soils and afforestation programs in areas that affected by salinity with spraying by yeast extracts at 15%.

Keywords: Growth parameters; *Melia azedarach*; Salinity; Yeast extract.

1. Introduction

Melia azedarach L. is a deciduous tree belonging to the family Meliaceae. It is native to tropical Asia, a multi-purpose tree species valued for timber (Duong *et al*., 2017), ornamental tree (Marwal *et al*., 2014) and bio-pesticide (Hammad, 2004). It is usually deciduous during winter except in some humid tropical locations like Malaysia and Tonga where it is evergreen (Ahmed and Idris, 1997). The wood is used to manufacture agricultural implements, furniture, plywood, boxes, poles, and tool handles (EL-Juhany, 2011). It is also used in cabinet making as well as in construction (Nghia, 2007). Its leaves can be used as green manure and insecticides. *M. azedarach* is reported to be a salt tolerant tree species (Daga, 2013). Some provenances can grow normally in 3– 4‰ saline soil and survive in 5–6‰ saline soil (Lin, 2004). Therefore, the species is useful for soil reclamation. Some landrace of *M. azedarach* exist due to a long history of cultivation in different soils and climate regions (Cheng and Gu, 2005). However, the effect of salt stress differs from one tree species to another. There are tree species with low tolerance, and others tolerant to salinity. The effects of salinity appears in yield reduction. For example, it was revealed that to meet the need and demand for the reforestation programs,

***Corresponding author: Ahmed Fakhry Ebeid**
Email: ahmedfakhry930@gmail.com
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some of *M. azedarach* provenances could serve as selective plantings along saline zones (Xu *et al*., 2018). Physiological responses of plants to salinity also include inhibition of photosynthesis (Vijayan *et al*., 2008). The role of plant growth-promoting microorganisms in plant growth, nutrient acquisition, and biocontrol activity has been well established. Despite the difference between these types of microbes, these microorganisms strains can colonize the rhizosphere soils or endo-rhizosphere of plants and they can protect plants from both abiotic (e.g., drought, salinity, and extreme temperature) and biotic stresses (e.g., phytopathogens) and enhance plant establishment and growth *via* the same plant growth-promoting mechanisms that involve direct and indirect mechanisms (Ma *et al.*, 2019). Now a day, pollution and soil contamination is one of the major concerns and biofertilizers play a very significant role in improving soil fertility by fixing atmospheric nitrogen, both, in association with plant roots and without it, solubilize insoluble soil phosphates and produces plant growth substances in the soil. They are in fact being promoted to harvest the naturally available, biological system of nutrient mobilization (Mishra *et al*., 2013). Phosphate absorbers (Mycorrhiza) is a symbiotic association between host plants and certain group of fungi at the root system, in which the fungal partner is benefited by obtaining its carbon requirements from the photosynthates of the host and the host in turn is benefited by obtaining the much needed nutrients especially phosphorus, calcium, copper, zinc etc., which are otherwise inaccessible to it, with the help of the fine absorbing hyphae of the fungus. Yeast extract as a biostimulants is rich with a mixture of amino acids, peptides, sources of B-complex such as B1, B2, B6 , and B12, carbohydrates, sugars, vitamins, enzymes and minerals (Marzouk *et al*, 2014). In this context, El-shazly and Mustafa (2013) reported that biostimulation like yeast extract are very safe for human, animal and environment to get lower pollution and reduce soil salinity via decreases mineral usage fertilization as well as saving fertilization cost. However, the mode of action of biostimulatns is poorly understood and has been variously attributed to hormone composition, presence of plant signaling materials or presence of molecules that responsible for transport and uptake of mineral nutrients (Calvo *et al*, 2014). However, Helaly and El-Hoseiny (2017) recommended that supplementations of K_2SiO_3 to the saline irrigation water accompanied with spraying yeast extract four times, 4 weeks intervals, from the middle of April induced salt tolerance and productivity of Williams banana plants, irrigated with pumped saline water. Therefore, the objectives of this research are to investigate the growth and chemical compositions of *M. azedarach* irrigated with saline water and sprayed with different levels of yeast extract.

2. Materials and methods

This study was carried out at Al- Marashda – Qena Agricultural Research Station, ARC, Egypt, during the two successive seasons of 2019 and 2020 to investigate the effects of salinity as NaCl and bio fertilizer as yeast on the growth and chemical composition of *Melia azedarach* L. seedlings. Fresh seeds were used from *M. azedarach* trees which were collected on March 15th, 2019 and 2020 from Woody Trees Department, Horticulture Research Institute, ARC, Egypt. After soaking in warm water (40–45ºC) for 24 h, the seeds were sown in 30 cm plastic pots, filled with the mixture of clay and sand (2:1 v/v). Some of the physical and chemical properties of the used soil are shown in Table (1), according to Jackson (1973). After 40 days of seeding, the seedlings (length of 8- 10 cm) were transplanted into 30 cm plastic pots (one seedling/ pot) containing the same previous mixture soil in which the seeds were planted. Each salinity level in irrigation

water was added regularly (100 ml/seedling/day) during the experimental period. Also, irrigation with salinity treatments were applied 5 times followed by one irrigation with tap water, and then repeated till the end of the experiment. Seedlings were left in the open field until salinization and bio- fertilizer treatments began in May 15th, 2019 and 2020. Four salinity levels were 0, 2000, 3000 and 4000 ppm of pure analytical NaCl solution was applied. However, the powder yeast used in this study was produced by the Egyptian Starch Yeast & Detergents Company and was a yellow dry powder. At the same time of salinity treatments, yeast extract was foliar sprayed with different concentrations (0, 5, 10 and 15%) at 30 days interval, while the control plants sprayed only with tap water. All *M. azedarach* seedlings were fertilized monthly with NPK 19:19:19 as kristalon at a rate of 1.5 g/ plant, in addition to manual weed resistance.

2.1. Experimental design and analysis

The layout of the experiment was sitting as completely randomized in a split- plot design with two factors (salinity and yeast extract with two controls) and included 16 treatments (4 levels of salinity x 4 levels of yeast extract) with 3 replicates, and each treatment consisted of nine pots. However, the research relied on the use of two-way analysis of variance, where the total differences between the experimental factors (salinity concentrations and yeast extracts) were calculated in the form of the sum of the square of the deviations, and the significance test "F" was performed. However, the growth parameters were recorded on November 15th 2019 and 2020 at the end of the growth period. These measurements were; stem length (cm), number of leaves/plant, stem diameter (mm), and the fresh and dry weight of the shoots and roots (g/ plant).

2.2. Chemical analysis

Pigments (chlorophyll a, b) content in the fresh leaves were determined according to Saric *et al*. (1967). Total carbohydrates (% D.W.) in leaves were determined according to Dubois *et al*. (1956). All data on the vegetative and chemical traits for the two seasons were statistically analyzed as described by Snedecor and Cochran (1980). Means of the studied characters were compared by L.S.D test at 0.05 level of significance. Free proline content in the dry leaves of *M. azedarach* was extracted in aqueous sulphosalicylic acid and measured using a spectrophotometer (UV- 2550, Shimadzu, Japan) according to Bates *et al*. (1973).

3. Results and discussions

3.1. Growth parameters

3.1.1. Stem length and diameter

Data presented in Tables (2 a & b) and (3 a & b) pointed out that *M. azedarach* transplants treated by salinity concentrations and yeast extract was significantly affecting values of stem length and diameter in the mean of seasons. Data in the same Table disclosed that seedlings grown as control plants gave the highest values of stem length and diameter in the mean of seasons. On the other hand, applied yeast extract at 15% resulted in the highest values of stem length and diameter compared to the other treatments. The differences of interaction between the salinity and yeast extract treatments were significant. The highest values of stem length and diameter of *M. azedarach* transplants as a result of 0 NaCl with spraying 15% yeast extract, while applied 4000 ppm NaCl with 0 yeast extract resulted in the lowest ones as average of seasons.

3.1.2. Number of leaves

The effect of salinity and yeast application on number of leaves and shoot fresh weight of *M. azedarach* was presented in Tables (4 a & b). The results pointed out that *M. azedarach* transplants treated by salinity concentrations and yeast extract were significantly affecting values of leaves number in the mean of seasons. Data in the same Tables pointed out that increasing salt concentration coincide with decreasing of leaves

number of *M. azedarach* seedlings. Meanwhile, increasing yeast extract concentration resulted in increasing values of leaves number as average of seasons. Seedlings grown as control plants (0 NaCl) gave the highest values of leaves number of *M. azedarach.* On the other hand, using yeast extract at 15% level resulted in the highest values of leaves number of *M. azedarach*. The differences of interaction between the salinity concentrations and yeast extract treatments were significant for leaves number of *M. azedarach*. The highest values of leaves number of *M. azedarach* transplants was recorded with 0 NaCl plus 15% yeast extract treatment, while applied 4000 ppm NaCl with 0 yeast extract resulted in the lowest ones as average of seasons.

3.1.3. Shoot fresh weight

The effect of saline waters and yeast application on shoot fresh weight of *M. azedarach* was presented in Tables (5 a & b). The results pointed out that *M. azedarach* transplants treated by salinity concentrations and yeast extract were significantly affecting values of shoot fresh weight in the mean seasons. The same Tables pointed out that increasing salt concentration coincide with decreasing of shoot fresh weight of *M. azedarach* seedlings. Meanwhile, increasing yeast extract concentration resulted in increasing values of shoot fresh weight as average of two seasons. Control plants (0 NaCl) gave the highest values of shoot fresh weight of *M. azedarach.* On the other hand, using yeast extract at 15% level resulted in the highest values of shoot fresh weight of *M. azedarach*. The differences of interaction between the salinity and yeast extract treatments were significant for shoot fresh weight of *M. azedarach*. The highest values of shoot fresh weight of seedlings were recorded with 0 NaCl plus 15% yeast extract treatment, while 4000 ppm NaCl with 0 yeast extract resulted in the lowest ones as average of seasons.

3.1.4. Dry weight of shoots

The dry weight of shoots and root fresh weight of *M. azedarach* plants was influenced significantly by the concentrations of salinity and yeast extract (Tables 6 a & b). The higher the concentration of salinity treatment, the lower the values of shoot dry weight of *M. azedarach* seedling in both seasons. On the other hand, the addition of yeast extract resulted in an increment in the shoot dry weight of seedlings and the increase was steadily with the increase in the concentration of yeast extract. The shoot dry weight of *M. azedarach* plants is associated with salinity and yeast extract applications. The highest value of shoot dry weight was 15.93 g in the soil without salinity plus 15% yeast extract, while the lowest one 4.43 g under water salinity of 4000 ppm without yeast extract.

3.1.5. Root fresh weight

The root fresh weight of *M. azedarach* was influenced significantly by the concentrations of salinity and yeast extract (Tables 7 a & b). The higher the concentration of salinity treatment, the lower the values of root fresh weight of *M. azedarach* seedling in both seasons. On the other hand, the addition of yeast extract resulted in an increment in the root fresh weight of seedlings and the increase was steadily with the increase in the concentration of yeast extract. In the soils with yeast as biofertilizer plus 4000 ppm salinity, the root fresh weight of *M. azedarach* plants was 4.5 g, corresponding, while it was 13.9 g in soil without salinity with 15% biofertilizer as average of two seasons.

3.1.6. Root dry weight

The impact of saline waters and yeast application on root dry weight of *M. azedarach* was shown in Tables (8 a & b). Root dry weight of *M. azedarach* plants was influenced significantly by salinity of soil and yeast extract. It was obviously proved that the greatest value (5.86 g) of root dry weight was achieved in the control plants without salinity levels, while in the soil with 4000 ppm salinity the lowest value of 4.16 g was obtained as average of two seasons. On the other hand, using yeast extract at 15% level resulted in the highest value 6.36 g of root dry weight of *M. azedarach*. The differences of

interaction between the salinity concentrations and yeast extract treatments were significant for root dry weight of *M. azedarach*.

As shown in our results, increasing salt concentrations resulted in significant reduction of the growth parameters of *M. azedarach* seedlings. These results was in accordance with different studies (Cha-um *et al*., 2004; Chaves *et al.*, 2009; El-Shazly *et al*., 2015; Gupta *et al*., 2014; Soliman *et al*., 2018; Ma *et al*., 2020). Responses to salinity are very similar since both induce water stress that leads to a slowdown in growth, a decrease in stomatal aperture, and a nutrient deficiency as K^+ and Ca^{++}. The adversely effects of salinity on the length of seedlings was also reported by other investigators such as Khalil (2013) and Zou *et al*. (2013). They attributed the obvious reduction in seedling growth under salinity stress conditions to decrease in the water absorbing potential of seedlings under such conditions. Also, Anderson and Brodbeck (1988) revealed that leaf growth is highly sensitive to water deficiency, which appears with salt stress condition, and the first change as a result of the lack of water is the slow growth of the leaf. Moreover, this response to salinity can be probably attributed to the osmotic component resulting from high concentrations of dissolved salts in the soil solutions that reduced the osmotic potential of the solution, then decreasing the availability of water for the plants (García *et al.*, 2011; Mesquita *et al*., 2018). The present study showed that the growth parameters was gradually increased with increasing the yeast levels. These findings was in accordance with that of Mostafa (2015). Also, Xi *et al*. (2019) found that application yeast extract has a beneficial effect on seedling growth of *Pinus sylvestris* and *Armeniaca sibirica* trees. Application of yeast extract increased the vegetative growth, yield, and quality of vegetables such as cucumber (Shehata *et al.*, 2012), turnip (Shafeek *et al*., 2015) and soybean (Dawood *et al*., 2013), and also led to an increase in elemental content, such as N, P, K, Fe, and Zn, in vegetables.

3.2. Chemical analysis

3.2.1. Chlorophyll a and b contents

The impact of saline waters and yeast application on chlorophyll a and b contents of *M. azedarach* leaves was shown in Tables (9 a & b) and (10 a &b). In our study we found that salt - induced growth reduction was associated by a significant decrease in the chlorophyll a and b contents. The highest values of chlorophyll a and b in leaves of *M. azedarach* seedlings were achieved when subjected to the soil without salt application, while the growing of seedlings with 4000 ppm salinity recorded the lowest one. The plants of *M. azedarach* evaluated at the end of experiment, showed a drastic reduce in chlorophyll a and b content of leaves with increasing salt levels. The exogenous application of yeast extract showed an increase in values of chlorophyll a and b content of *M. azedarach* and this increase was higher in seedlings which were sprayed with yeast extract at 15%, in the average of two seasons. However, the interaction between salinity and yeast extract was not significant for chlorophyll a and b content in leaves. Data also showed that using 0 NaCl plus 15% yeast extract recorded the highest value of chlorophyll a and b, while using 0 yeast extract with 4000 ppm NaCl achieved the lowest ones as average of seasons. In this respect, Cha-um *et al*. (2004) concluded that chlorophyll concentration in the leaf tissues of neem seedlings was decreased under salt stress conditions. They added that the degradation of chlorophyll content in the leaf tissues under salt stress directly reduced the net photosynthetic rate, then the low growth efficiency. Also, Delfine *et al*. (1998) reported that, reduction in CO_2 concentration in the leaf tissues of plants under salt stress consistently result in low photosynthetic rate. On the other hand, Chaves *et al*. (2009) found that during exposure to salt stress, besides dehydration, plants experience

ionic stress, then leads to leaf senescence and photosynthesis impairment. Shimul *et al.* (2014) pointed out that total tomato (var. BARI Tomato 14) leaf chlorophyll content and photosynthetic activities were significantly reduced with increasing salinity. In this connection, Sudhir and Murthy (2004) reported that reduction in leaf content of chlorophyll has been related to salt-induced increasing chloropyllase activity.

3.2.2. Carbohydrates content

In our study we found that salt -induced growth reduction was associated by a significant decrease in the contents of carbohydrate. The data presented in Tables (11 a & b) illustrated that raising NaCl from 0 to 4000 ppm caused a significant reduction in carbohydrates content in leaves of *M. azedarach* seedlings. The exogenous application of yeast extract showed an increase in values of carbohydrates content in leaves of *M. azedarach* and this increase was higher in seedlings which were sprayed with yeast extract at the higher level, in the average of two seasons. However, the interaction between salinity and yeast extract was not significant for carbohydrates content in leaves. Soliman *et al.* (2000) reported that the high own content of yeast extract from nutrients as well as amino acids, vitamins and phytohormones resulted in enhancing the biosyntheses of pigments and total carbohydrates in rice plants. Generally, the plant-associated microbes, especially plant growth-promoting microorganisms as yeast can affect the growth, nutritional status, development, and fitness of the host plants (Pascale *et al*., 2020).

3.2.3. Free proline content

The content of free proline in the dry leaves of *M. azedarach* plants was influenced by salinity and yeast levels (Fig 1). The data illustrated that raising NaCl from 0 to 4000 ppm caused a significant increasing in free proline content in leaves of *M. azedarach* seedlings. Also, the exogenous application of yeast extract showed a significant reduction in values of free proline content in leaves of *M. azedarach* and this decrease was higher in seedlings which were sprayed with yeast extract at 15%, in the average of two seasons. The interaction between salinity and yeast levels was different for the free proline and the highest values was noticed for seedlings that received salinity at 4000 ppm with no yeast extract. Amino acids such as cysteine, arginine, and methionine, which constitute about 55% of total free amino acids, decrease when exposed to salinity stress, whereas proline concentration rises in response to salinity stress (El-Shintinawy and El-Shourbagy, 2001). Proline accumulation is a well-known measure adopted for alleviation of salinity stress (Matysik *et al.*, 2002; Ben Ahmed *et al.,* 2010). Mesquita *et al.* (2018) pointed out that the increase of salt stress inhibited the emergence of new leaves, reflecting negatively on the expansion of leaf area, and thereby damaging the physiological and biochemical processes of the neem seedlings. These results were in accordance with that of Rebequi *et al.* (2009) and Mesquita *et al.* (2012). The increase in proline content in plant tissues with the increase in salinity retards protein synthesis, and consequently accumulates free amino acids, including proline (Yurekli *et al*., 1996; El-Leboudi *et al*., 1997).

Table 1. Some of the physical and chemical properties of the used media in the study.

Physical properties							
Clay%	Coarse sand%		Fine sand%		Silt %	Soil texture	
40.75	9.32		17.68		32.25	Clay loam	
Chemical properties							
EC (dS/m^{-1})	pH	N (ppm)	P (ppm)	K (ppm)	Mg (ppm)	OM%	$CaCO_3$%
1.63	7.73	51.24	14.43	266.25	31.55	1.22	1.35

Table 2a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the stem length of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	286.264	3	95.421	227.759**
Yeast extract (B)	399.684	3	133.228	317.998**
A x B	108.164	9	12.018	28.686**
Exp. error	13.407	32	0.419	
Total	15556.560	48		

s.o.v. source of variations , s.s. sum of squares, d.f. degrees of freedom, m.s. mean square

Table 2b. impact of saline waters and yeast application on stem length (cm) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	15.83	18.63	20.50	28.40	20.84
2000	13.87	17.73	18.97	24.30	18.71
3000	13.00	15.93	17.00	18.47	16.10
4000	11.73	14.87	15.73	15.50	14.46
Mean(A)	13.61	16.79	18.05	21.67	
LSD 5%	A=0.353	B=0.591	AB=1.183		

Table 3a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the stem diameter of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	12.662	3	4.221	139.715**
Yeast extract (B)	40.412	3	13.471	445.922**
A x B	0.977	9	0.109	3.592**
Exp. error	0.967	32	0.030	
Total	1399.100	48		

Table 3b. impact of saline waters and yeast application on stem diameter (mm) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	4.333	6.100	6.533	7.100	6.017
2000	3.900	5.267	6.200	6.500	5.467
3000	3.767	4.833	5.500	6.133	5.058
4000	3.467	4.433	5.133	5.467	4.625
Mean(A)	3.867	5.158	5.842	6.300	
LSD 5%	A=0.121	B=0.154	AB=0.307		

Table 4a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on no. of leaves of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	59.856	3	19.952	120.012**
Yeast extract (B)	131.038	3	43.679	262.732**
A x B	4.366	9	0.485	2.918*
Exp. error	5.320	32	0.166	
Total	9704.020	48		

Table 4b. impact of saline waters and yeast application on number of leaves / plant of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	12.33	15.20	16.67	17.70	15.48
2000	12.23	14.30	15.57	16.47	14.64
3000	11.47	13.37	14.43	15.50	13.69
4000	10.57	11.43	13.33	14.57	12.48
Mean(A)	11.65	13.58	15.00	16.06	
LSD 5%	A=0.104	B=0.375	AB=0.750		

Table 5a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the stem fresh weight of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	316.960	3	105.655	149.468**
Yeast extract (B)	1200.659	3	400.22	566.182**
A x B	29.0	9	3.222	4.558**
Exp. error	22.620	32	0.707	
Total	30799.25	48		

Table 5b. impact of saline waters and yeast application on stem fresh weight (g)/ plant of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	20.07	26.00	30.73	36.27	28.27
2000	18.77	23.67	26.60	32.93	25.49
3000	17.27	22.13	24.63	30.90	23.73
4000	15.37	20.07	23.03	26.40	21.22
Mean(A)	17.87	22.97	26.25	31.63	
LSD 5%	A=1.052	B=0.681	AB=1.364		

Table 6a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the stem dry weight of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	122.811	3	40.937	290.247**
Yeast extract (B)	341.422	3	113.807	806.907**
A x B	9.533	9	1.059	7.510**
Exp. error	4.513	32	0.141	
Total	4413.220	48		

Table 6b. impact of saline waters and yeast application on stem dry weight (g)/ plant of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	7.533	9.933	11.90	15.93	11.33
2000	6.200	8.433	9.300	14.47	9.600
3000	5.433	7.067	8.433	12.20	8.283
4000	4.433	6.233	7.167	10.20	7.008
Mean(A)	5.900	7.917	9.200	13.20	
LSD 5%	A=0.408	B=0.306	AB=0.616		

Table 7a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the roots fresh weight of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	99.792	3	33.264	402.183**
Yeast extract (B)	170.695	3	56.898	687.940**
A x B	9.363	9	1.040	12.579**
Exp. error	2.647	32	0.083	
Total	3438.260	48		

Table 7b. impact of saline waters and yeast application on root fresh weight (g)/ plant of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	7.133	8.867	10.90	13.90	10.20
2000	6.167	7.333	9.200	11.53	8.558
3000	5.467	6.300	8.167	9.433	7.342
4000	4.500	5.467	7.067	8.300	6.333
Mean(A)	5.817	6.992	8.833	10.79	
LSD 5%	A=0.412	B=0.210	AB=0.420		

Table 8a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the roots dry weight of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	19.391	3	6.464	94.015**
Yeast extract (B)	52.147	3	17.382	252.835**
A x B	1.762	9	0.196	2.847*
Exp. error	2.200	32	0.089	
Total	1234.850	48		

Table 8b. impact of saline waters and yeast application on root dry weight (g) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	4.100	5.367	6.533	7.467	5.867
2000	3.733	4.767	5.267	6.500	5.067
3000	3.100	4.133	4.867	6.133	4.558
4000	3.200	3.633	4.467	5.367	4.167
Mean(A)	3.533	4.475	5.283	6.367	
LSD 5%	A=0.232	B=0.215	AB=0.435		

Table 9a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the chlorophyll (a) content of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	0.297	3	0.099	33.976**
Yeast extract (B)	0.471	3	0.157	53.786**
A x B	0.022	9	0.002	0.833
Exp. error	0.093	32	0.003	
Total	34.050	48		

Table 9b. impact of saline waters and yeast application on chlorophyll a (mg/ gm-1 F.W) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	0.840	0.867	0.877	1.167	0.938
2000	0.767	0.800	0.837	0.980	0.846
3000	0.717	0.740	0.753	0.930	0.785
4000	0.683	0.653	0.677	0.883	0.724
Mean(A)	0.752	0.765	0.786	0.990	
LSD 5%	A=0.036	B=0.037	AB=N.S		

Table 10a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on the chlorophyll (b) content of *M. azedarach* during two seasons of 2019 and 2020 in Qena Governorate.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	0.084	3	0.028	44.889**
Yeast extract (B)	0.134	3	0.045	71.556**
A x B	0.021	9	0.002	3.704**
Exp. error	0.020	32	0.001	
Total	11.0280	48		

Table 10b. impact of saline waters and yeast application on chlorophyll b (mg/ gm-1 F.W) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	5	10	15	Mean (B)
0	0.457	0.500	0.577	0.620	0.538
2000	0.413	0.453	0.520	0.563	0.487
3000	0.390	0.423	0.497	0.523	0.458
4000	0.360	0.390	0.447	0.460	0.414
Mean(A)	0.405	0.442	0.510	0.542	
LSD 5%	A=0.016	B=0.015	AB=N.S		

Table 11a. Analysis of variance test of two way for the effect of salinity and yeast levels and their interactions on total carbohydrates content of *M. azedarach* during two seasons of 2019 and 2020.

S.O.V.	S.S.	D.F.	M.S.	F
NaCl Salt (A)	1.162	3	0.387	71.526**
Yeast extract (B)	6.212	3	2.071	382.295**
A x B	0.042	9	0.005	0.859
Exp. error	0.173	32	0.005	
Total	488.290	48		

Table 11b. impact of saline waters and yeast application on total carbohydrates (% D.W) of *M. azedarach* as average of 2019 and 2020 seasons.

NaCl Salt (ppm)	Yeast extract (%)				
	0	0.5	1.0	1.5	Mean (B)
0	2.943	3.170	3.463	3.883	3.365
2000	2.743	3.080	3.310	3.700	3.208
3000	2.580	2.890	3.217	3.593	3.070
4000	2.483	2.767	3.113	3.420	2.946
Mean(A)	2.688	2.977	3.276	3.649	
LSD 5%	A=0.039	B=0.054	AB=N.S		

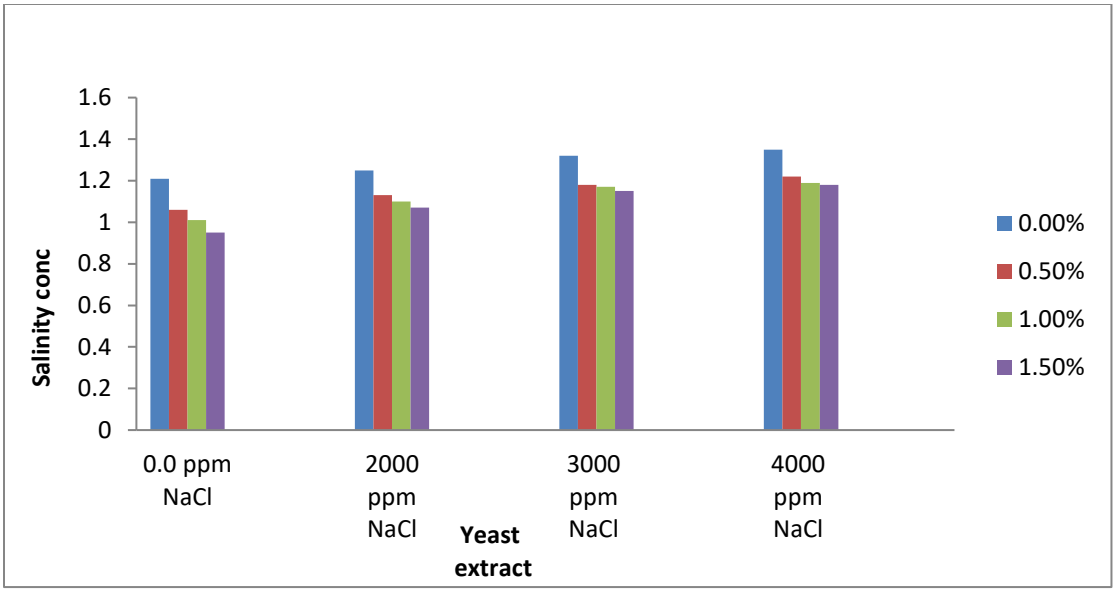

Fig 1. Impact of saline waters and yeast application on free proline (mg/g D.W) in leaves of *M. azedarach* as average of 2019 and 2020 seasons.

4. Conclusions

These results assure the possibility of growing M. azedarach seedlings at the same conditions of salt stress by the use of some bio fertilizers as yeast. Accordingly, these trees can be planted in newly reclaimed soils and afforestation programs in areas that affected by salinity with spraying by yeast extracts at 15%.

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