Effect of microbien and compost on growth and chemical composition of *Schefflera arboricola* L. under salt stress

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Abstract: A pot experiment was conducted during 2008 and 2009 seasons at National Research Centre, Dokki, Cairo, Egypt to study the effect of biofertilizer microbien which is Rhizobia sp (multi-strain) bio-fertilizer at 10 gm incolum /pot or compost (Nile compost) 100 gm/pot on the growth and chemical composition of *Schefflera arboricola* L. seedlings. Water salinized with NaCl and $CaCl_2$ (1:1) by weight (0, 1000 and 2000 ppm) were used for irrigation after 3 weeks from transplanting for six months. Results indicated that plants which treated with saline water had decreased all growth parameters. Total carbohydrates, N, P and K percentages were decreased at 2000 ppm saline water. On the other hand salinity levels increased Na percentage and proline concentration in shoots. Microbein or compost treatments gave the highest growth parameters, carbohydrates content, and N, P and K percentages. The interaction effects between biofertilizer microbien or compost and salinity levels showed a markedly decrease on Na percentage and proline concentration of shoots and increased all growth parameters , as well as N, P and K percentages increased at low level of salinity, similar trend was obtained for the uptake of concerned nutrients as previously mentioned for their concentrations. It can be concluded that microbien or compost application had decreased the hazard effect of salinity; also it had a favourable effect on growth and availability of chemical composition of Schefflera *arboricola* L. seedlings.
[El-Quesni, F.E.M., Sahar, M. Zaghloul and Hanan, S.Siam. Effect of microbien and compost on growth and chemical composition of *Schefflera arboricola* L. under salt st. Journal of American Science 2010;6(10):1073-1080]. (ISSN: 1545-1003).

Keywords: *Schefflera* – Mocrobien – compost – salinity

1. Introduction

Schefflera arboricola L. is a flowering plant in the family Araliaceae, native to Taiwan and Haiman. It is also goes by the common name "Dwarf Umbrella tree). It is evergreen shrub growing to 3-4 m height, often trailing stems scrambling over other vegetation. The leaves are palmately compound, with 7-9 leaflets, the leaflets 9-20 cm long and 4- 10 cm broad. The flowers are produced in a 20 cm pancil of small umbles, each umbel 7-10 mm diameter with 5-10 flowers. It is commonly grown as houseplant, popular for its tolerance of neglect and poor growing condition. Numerous cultivars have been selected for variation of leaf colour (creamy white to yellow edges or centers, and dwarf forms). Scheffleras are delicate plants, often used to decorate public places, shopping malls and waiting rooms. Smaller Scheffleras are better studied for homes and small offices Uphof (1959).

Soils are considered saline when they contain soluble salts in quantities quit sufficient to interfere with the growth of most crop species. In saline environment NaCl usually the most injurious and predominant salt but also other salts including Ca^{2+}, Mg^{2+} and $SO^{=}_4$ may be present. The excise accumulation of such these ions causes ion toxicity for plant growth which associated with excessive uptake of mainly Cl^- or Na^+, these ions lead to nutrient imbalance and thus disturbed the uptake of essential mineral nutrients (Greenway and Munns, 1980). Most of the newly reclaimed lands depend on underground water of various degrees of salinity irrigation. In addition, progressive salt accumulation becomes a serious problem in many tables.

Morphological symptoms are the results of interaction of all injuries effects of salinity, salt stress may inhibit cell division and/or cell elongation in the growing tissues of roots, stems and leaves (Zidan *et al*, 1990) which lead to reduce plant height, dry weight of the plant parts and number of leaves of gerbera plant (Jimenz *et al*, 1997). In woody trees species the salinity may lead to leaf burn and defoliation. Salt stress affects many aspects of plant metabolism which lead to reduction in plant growth osmotic inhibition, water uptake by root or specific ion effects. In addition, plants may accumulate Cl^- or Na^+ions which can eventually, reach toxic levels (Bezona *et al*, 1996). These effects may be associated

with changes in enzymatic activities, hormonal imbalance and morphological modifications.

In recent years, the safe agricultural is one of the main attitudes in the world (El-kouny, 2002). Also, recently there has been an increasing awareness of the undesirable impact of mineral fertilizers on the environment, as well as the potentially dangerous effects of chemical residues in plant tissues on the health of human and animal consumers.

Inoculation and plant growth parameters induced by specific rhizobia species, this was proved by Mazher and El-Mesiry (1999) on *Leucaena Leucocphala* and Turky *et al* (2004) on *Foenicwum vulgare*. Nasef *et al* (2004) reported that the application of N at different levels and inoculation with biofertilizer led to an increase in total porasity improves soil aggregation and possible moving salt soil under irrigation water.

Balabel (1997) reported that inoculating orthoclase with *Bacillus circulans* (SDB) gave better effects on all vegetative and yield attributes, they also indicated that these effects were reflected on N, P and K content of tubers. El-Banna (2001) indicated that using *Basillus circulans* gave rise to increase the vegetative growth characters.

The plants tolerated the lower salinity levels especially when combined with biofertilizer application where it counteracted the reduction of salinity on vegetative growth, pigment contents, total sugars and some minerals Mazher and El-Mesiry (1999) and Turky *et al.,* (2004).

Composting of agricultural residues by supplying the natural microbial flora present on them, with their requirements of inorganic nutrients such as nitrogen and phosphorus and applying a proper moistening and turning resulted in the final product with high ability to improve soils and enhance plant growth reported by Lampkin (1990).

The optimum values of faba bean and peanut yield were obtained by applying compost (10 ton/fed) mixed with biofertilizer (El-Sedfy, 2002 and Awad *et al*, 2003). From the microbiological point of view, green manure has two main positive effects : i) it provides nutrients rich in organic carbon for the microbial biomass which converts unavailable nutrients in plant residues to ones available for crops, and ii) it enhances biodiversity of soil micro-organisms. This positive effect on soil microbial populations can be increased by inserting different green manure selections in crop rotation programs (Bezdicek and Granatstein, 1989).

2. Materials and Methods

This investigation was carried out under the greenhouse of the National research Centre, Dokki, Cairo, Egypt, during two successive seasons of 2008 and 2009. The investigated soil characterized by coarse sand 80.5 %, Fine sand 9.4%, silt 4.5 % and 5.6 % clay with pH 7.8, EC 1.4 dSm^{-1}, $CaCO_3$ 2.46 %, K^+, 0.3, Na^+ 2.3, Ca^{++}, 1.0, Mg^{++} 0.6, HCO^-_3 2.3, Cl^- 1.8, $SO^=4$ 0.1, meq L^{-1}. The seedlings of *Schefflera arboricola* L. were obtained from the nursery of the Forestry Department Horticulture Research Institute, Agricultural Research centre, the seedlings were planted at the first week of March during the two successive seasons, as one seedling /pot 30 cm in diameter filled with 10 kg soil, the average height of seedling was 18-20 cm.After planting seedlings were irrigated using tap water for 21 days, two salinity levels were prepared with two salts: sodium chloride (NaCl) and calcium chloride ($CaCl_2$) were mixed at 1:1 by weight for irrigation seedlings with previously prepared salinized. The untreated plants (control) were irrigated with tap water 250 ml of saline water was added to each pot twice a week throughout the course of the study (6 months), starting from March until one month before ending the experiment. Each pot was fertilized twice with 1.5 gm nitrogen as ammonium nitrate (33.5 %N) and 1.0 gm potassium as potassium sulphate (48.5 % K_2O). The fertilizers were applied at 30 and 60 days after planting.

Phosphorus as calcium superphosphate (15.5 % P_2O_5) was mixed with soil before planting at 3.0 gm/pot. Other agricultural processes were performed according to normal practice.

The biofertilizer was added (a fresh inocula was prepared by biofertilizer Lab. Ministry of Agriculture, Egypt) at 0 and 10 gm/pot and sown mixing with the soil during preparation. The compost fertilizer (Nile compost) was mixed well with the soil during preparation 100 g/pot, of the soil.

The statistical analysis of the experiment was a completely randomized design with 10 treatments, three salinity levels (0, 1000and 2000 ppm), biofertilizer and compost either alone or with combination with different salinity levels or with each other. E the greenhouse ach treatment included three replicates (3 pots).

The following data were recorded, stem length cm, stem diameter (cm), number of leaves/plant, leaf area cm^2, and fresh and dry weight (g) of plant organs and root length cm.

Table (1) Chemical properties of the Nile compost used in study.

(Nile compost)	Macronutrients %			Micronutrients ppm				pH	C/N	OM
	N	P	K	Fe	Mn	Zn	Cu			
	1.35	0.52	0.85	161	310	61	35	7.5	14.1	132.9

Chemical constituents:

Chemical analysis was determined nitrogen, phosphorus and potassium according to the methods described by Cottenie *et al* (1982). Total proline content in leaves was determined using fresh material according to Bates *et al* (1973).Total carbohydrates percentages in leaves were determined according to Dubois *et al* (1956)

The physical and chemical properties of the soil were determined according to Chapman and Pratt (1961). All previous data were subjected to statistical analysis according to procedure outlined by Snedecor and Cochran (1980).

3. Results and Discussion

Growth characters

Data presented in Tables (2&3) indicate that the growth characters of *Schefflera arboricola* L plant; plant height, number of leaves /plant, leaf area, fresh and dry weight of leaves and dry weight of stem, had slightly increased than the control plants, whereas decreased than other treatments under salinity 1000 ppm. From the same Tables, salinity at 2000 ppm decreased stem diameter, number of leaves/plant and fresh and dry weight of leaves of *Schefflera arboricola* L plant, this could be attributed to the deleterious effect on the growth and physiological processes of growing plants as affected by soil moisture stress and nutrients balance disorder in root medium. Also, the reduction in fresh and dry weight of leaves may be due to the suppressing cell enlargement and division and also to the inhibition of enzyme activities by salts, especially sodium ions (Marschener, 1995). Moreover, salinity of the soil solution around root results in a general retardation of the enzymatic and photosynthetic processes (Amberger, 1997 and El-Sharawy *et al,* 1997).

Inoculation treatment increased number of leaves/plant, regarding the interaction between inoculation and salinity treatments, the data indicated that the mean number of leaves /plant , fresh and dry weight of different plant organs were increased than the obtained from plants irrigated with the two levels of saline water. This means that inoculation had an antagonistic effect to salinity irrigation treatments (Ghiath and Mudhar, 1980). Concerning root length slightly increased by the two levels of salinity treatments. Inoculation practice with microbien was effective , where it increased root length than plants treated with saline water.

Data in the same Tables demonstrated clearly that using compost, resulted an increase in plant height, leaf area, number of leaves/plant, fresh and dry weight for leaves, stems and roots than control plants and other treatments.

Compost with its content of humic substances and microbial fertilizers, has shown to improve soil physical, chemical and microbiological conditions, moisture content and reduce leaching of nutrients, water runoff and soil erosion (Amin *et al* , 1999).

Concerning the effect of compost treatments under salinity levels significantly increased plant height, stem diameter, root length, number of leaves/plant, leaf area, fresh and dry weight of leaves, stems, and roots. On the other hand, the same Tables demonstrated clearly that using biofertilizer (microbien) and compost, each alone or in combination, had a positive effect on the aforementioned growth characters. This might be related to the improvement of physical conditions of the soil provided energy for microorganisms activity and increase the availability and uptake of N, P, and K, which was positively reflected on the growth (Wani *et al,* 1988 and Romero *et al,* 2000).

Minerals content

Data presented in Tables (4 a, b, and c) revealed that nitrogen, phosphorus and potassium percentages were decreased in different plant organs, by increasing salinity concentration as compared with control plants. In this respect, the decrease in nitrogen percentage might be attributed to the inhibition of cell division and cell elongation. This inhibition in cell division and elongation might be as a result of the disturbance in nitrogen metabolism beside sugar synthesis, which might be affected by chlorophyll reduction **(**Nieman, 1962).

Such decrease in phosphorus percentage might be due to the raising of soil pH which lowers the availability of phosphorus (Ashour *et al,* 1970). With potassium percentage obtained reduction might be refer to the existence of some diagnostic effects between Na and K that might be responsible for the diminished K concentration under saline condition (Ayers and Eberhard, 1960).

The concerned elements under study were decreased as the salinity level of irrigation water increased. The diminishing values of nutrients uptake by plants irrigated with saline water were mainly due

to the depressive effect of high level of salinity on plant dry weight. Similar findings were also reported by Saker et al (1992), who reported that K concentration and uptake were reduced due to composition of saline irrigation water used which tended to encourage the accumulation of Na, and in turn depressed concentration of K in Schefflera plant.

The reduction in P uptake of different plant organs at 2000 ppm of salinity could be referred to decreasing the solubility and available P in soil irrigated with saline water. On the other hand, inoculation with microbien increased N, P and K percentages compared with uninoculation plants. As regarding the interactions of inoculation and stress, inoculation and salinity at 1000 ppm had the pronounced effect or increasing N, P and K percentages except microbien + 2000 ppm salinity in shoots compared with control plants.

In roots, nitrogen, phosphorus and potassium percentages were decreased in roots and leaves by increasing salinity concentration, as compared with control plants.

Sodium percentages a gradual increase was found with the increase of salinity level. The greatest absorption and accumulation of sodium by plants 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 salts in plant organs (Strongnov, 1962).Inoculation with microbien or compost under two salinity levels increased sodium percentages and sodium uptake in different plant organs as compared with control plants.

Results in (Tables 4 a, b and c) illustrate that a positive effect of compost occurred on N, P and K concentration and uptake in schefflera plants, at different plant organs , as compared with control plants. The interactive of compost to plants irrigated with saline water increased the uptake of N, P and K by schefflera plant due to the beneficial effect of compost for improving the nutritional status particularly when added microbien.

Finally, it could be concluded that the data presented in this work demonstrated the great importance of the appropriate role of compost and microbien improving soil characters and enhancing its productivity of schefflera as well as promotes the uptake of N, P and K by schefflera plants under the conditions of saline irrigation water. It is of a great insignificance to point out that the use of compost and microbien in general, is of the minimum or no polluting effect on soil environment, comparing to the chemical fertilizers.

Table (2) Effect of microbien and compost on growth parameters of *Schefflera arboricola* plants irrigated with saline water (mean of two seasons 2008 and 2009).

Growth characters / Treatments	Plant height cm	Stem diameter cm	Number of leaves/ plant	Leaf area cm^2	Fresh weight of leaves gm	Dry weight of leaves gm
Control	37.33	0.86	14.0	2.28	32.55	13.65
1000 ppm NaCl+ $CaCl_2$	44.00	0.86	15.0	4.35	40.20	16.10
2000 ppm NaCl+ $CaCl_2$	38.50	0.80	13.0	3.32	29.16	12.75
10 g Microbien	56.00	1.05	18.0	6.50	53.20	18.93
100 g compost	66.00	1.15	19.0	7.50	60.15	26.67
10 g Microbien+1000 ppm NaCl+ $CaCl_2$	46.00	0.95	16.0	4.90	44.28	17.35
10 g Microbien+2000 ppm NaCl+ $CaCl_2$	41.00	0.85	14.0	3.80	36.35	20.43
100 g compost+1000 ppm NaCl+ $CaCl_2$	52.15	0.98	17.0	5.62	48.12	21.24
100 g compost+2000 ppm NaCl+ $CaCl_2$	43.25	0.91	15.0	4.35	40.18	16.17
10 g Microbien + 100 g compost	69.36	1.33	21.0	8.10	63.48	27.85
LSD 5%	2.50	0.04	0.89	0.48	1.37	5.74

Table (3) Effect of microbien and compost on fresh and dry weights and root length of *Schefflera arboricola* plants irrigated with saline water (mean of two seasons2008 and 2009).

Growth characters / Treatments	Fresh weight of stem (gm)	Dry weight of stem (gm)	Fresh weight of root (gm)	Dry weight of root (gm)	Root length cm
Control	16.00	10.10	26.11	10.89	27.00
1000 ppm NaCl+ $CaCl_2$	21.80	12.10	33.40	13.10	36.00
2000 ppm NaCl+ $CaCl_2$	17.11	10.26	30.08	12.09	30.00
10 g Microbien	29.50	15.70	41.00	17.00	46.00
100 g compost	34.50	18.60	45.17	19.20	49.00
10 g Microbien+1000 ppm NaCl+ $CaCl_2$	23.00	13.80	35.94	15.27	40.60
10 g Microbien+2000 ppm NaCl+ $CaCl_2$	19.12	11.25	29.12	13.75	37.00
100 g compost+1000 ppm NaCl+ $CaCl_2$	30.00	12.20	37.00	16.89	42.80
100 g compost+2000 ppm NaCl+ $CaCl_2$	21.85	12.20	31.50	14.62	39.00
10 g Microbien + 100 g compost	37.85	20.15	48.30	21.38	52.10
LSD 5%	1.09	1.02	4.08	0.66	1.44

Table (4) Effect of microbien and compost on N, P and K concentration and uptake in shoots, roots and leaves of *Schefflera arboricola* plants irrigated with saline water (Mean of two seasons 2008 and 2009).

A- Stems

Mineral content / Treatments	N		P		K		Na	
	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot
Control	0.62	62.62	0.45	45.45	1.07	108.07	0.25	25.25
1000 ppm NaCl+ $CaCl_2$	0.60	72.60	0.44	53.24	1.02	123.42	0.31	37.51
2000 ppm NaCl+ $CaCl_2$	0.54	55.40	0.40	41.04	0.91	93.37	0.39	40.01
10 g Microbien	0.73	114.61	0.51	80.07	1.51	337.07	0.28	43.96
100 g compost	0.78	145.08	0.55	102.30	1.66	308.76	0.32	59.52
10 g Microbien+1000 ppm NaCl+ $CaCl_2$	0.64	88.32	0.47	64.86	1.30	179.40	0.29	40.02
10 g Microbien+2000 ppm NaCl+ $CaCl_2$	0.59	66.38	0.42	47.25	1.10	123.75	0.33	37.13
100 g compost+1000 ppm NaCl+ $CaCl_2$	0.68	102.68	0.50	75.50	1.39	209.89	0.26	39.26
100 g compost+2000 ppm NaCl+ $CaCl_2$	0.63	76.23	0.44	53.68	1.28	156.16	0.099	12.08
10 g Microbien + 100 g compost	0.83	167.25	0.59	118.89	1.73	348.60	0.25	50.38
LSD 5%	0.02	5.32	0.02	3.07	0.04	9.72	0.02	2.69

B - Roots

Mineral content / Treatments	N		P		K		Na	
	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot
Control	0.45	49.00	0.27	29.40	0.30	32.67	0.35	38.12
1000 ppm NaCl+ CaCl2	0.41	53.71	0.29	37.99	0.27	35.37	0.76	99.56
2000 ppm NaCl+ CaCl2	0.37	44.73	0.23	27.81	0.23	27.81	0.91	110.02
10 g Microbien	0.49	83.30	0.36	61.20	0.31	52.70	0.40	68.00
100 g compost	0.56	107.52	0.39	74.88	0.35	67.20	0.44	84.48
10 g Microbien+1000 ppm NaCl+ CaCl2	0.34	51.92	0.32	48.86	0.29	44.28	0.67	102.31
10 g Microbien+2000 ppm NaCl+ CaCl2	0.31	42.63	0.27	37.13	0.25	34.38	0.77	105.88
100 g compost+1000 ppm NaCl+ CaCl2	0.39	65.87	0.35	59.12	0.26	43.91	0.48	81.07
100 g compost+2000 ppm NaCl+ CaCl2	0.34	49.71	0.29	42.40	0.21	30.70	0.59	86.26
10 g Microbien + 100 g compost	0.63	134.69	0.43	91.93	0.38	81.24	0.45	96.12
LSD 5%	0.02	5.25	0.01	3.51	0.019	2.97	0.033	3.23

C -Leaves

Mineral content / **Treatments**	**N**		**P**		**K**		**Na**	
	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot	%	Uptake mg/pot
Control	0.84	114.66	0.35	47.78	0.60	81.90	0.07	9.56
1000 ppm NaCl+ $CaCl_2$	0.81	130.41	0.34	54.74	0.53	85.33	0.14	22.54
2000 ppm NaCl+ $CaCl_2$	0.73	93.08	0.30	38.25	0.42	53.56	0.16	20.40
10 g Microbien	0.95	182.40	0.44	84.48	0.65	124.80	0.11	21.12
100 g compost	1.12	287.50	0.48	123.22	0.72	184.82	0.10	25.67
10 g Microbien+1000 ppm NaCl+ $CaCl_2$	0.89	154.42	0.38	65.93	0.56	97.16	0.12	20.82
10 g Microbien+2000 ppm NaCl+ $CaCl_2$	0.78	109.98	0.33	46.53	0.46	64.86	0.13	18.33
100 g compost+1000 ppm NaCl+ $CaCl_2$	0.95	201.78	0.42	89.21	0.60	127.44	0.09	19.12
100 g compost+2000 ppm NaCl+ $CaCl_2$	0.84	135.83	0.35	56.60	0.49	79.23	0.11	17.79
10 g Microbien + 100 g compost	1.25	348.13	0.55	153.18	0.78	217.23	0.08	22.28
LSD 5%	0.02	13.52	0.019	11.71	0.02	6.11	0.01	0.96

The decrease in N, P and K content associated with an increase in proline content which might indicate disturbance:

The decrease in N, P and K content associated with an increase in proline content which might indicate disturbance in protein metabolism. The interaction effects between microbien or compost under two salinity levels showed decreased in proline concentration, this could be due to the influence effect of microbien or compost on decreasing the hazard effect created by salinity treatments.

From the above mentioned results, it can be concluded that microbein or compost application had decreased the hazard effect of saline water. In addition, had favorable effect on growth of Schefflera plant.

Total carbohydrate percentage:

Data presented in (Table 5) showed that total carbohydrate percentage decreased by increasing salinity concentration compared with control plants. In this concern, Kabanov *et al* (1973) on pea plant mentioned that high salinity level caused a depression of photosynthetic activities resulting in

CO_2 fixation. Inoculation with microbien or compost increased total carbohydrate percentage compared with control plants. This may be indicate the indirect effect of rhizobia on sugars; it increased plant growth, consequently sugar metabolism increased.

Regarding the interaction effect, showed that the plants treated with microbien + compost gave highest value of total carbohydrate percentages, followed by plants treated with microbein under the two salinity levels.

Proline concentration:

Salt stress increased the proline content (Table5) in leaves tissues with a gradual increase in its percentage, increased in the irrigation water. Similar results were obtained by Greenway and Munns(1980) who mentioned that proline concentration increased under salinity stress to make plants more adapted to this unsuitable conditions, Proline is considered as a cell stabilizer for osmotic potential and some enzymes synthesis. Inoculation with microbien or compost decreased proline concentration compared with untreated plants.

The decrease in N, P and K content with an increase in proline concentration which might indicate a disturbance in protein metabolism. The interaction effects between microbien or compost under two salinity levels showed a decreased in proline concentration, thus could be due to the influence effect of microbein or compost on decreasing the hazard effect created by salinity treatment.

From the above mentioned results, it can be concluded that microbien or compost application had decreased the hazard effect of saline water. In addition had a favourable effect on growth of Schefflera plant

Table (5) Effect of microbien and compost on Proline and total Carbohydrate on leaves of *Schefflera arboricola* plants irrigated with saline water (Mean of two seasons 2008 and 2009).

Chemical composition / Treatments	Proline (μmg^{-1})	Carbohydrate %
Control	3.11	11.30
1000 ppm NaCl+ $CaCl_2$	7.00	10.28
2000 ppm NaCl+ $CaCl_2$	8.33	9.44
10 g Microbien	2.81	23.31
100 g compost	2.73	17.28
10 g Microbien+1000 ppm NaCl+ $CaCl_2$	5.31	18.97
10 g Microbien+2000 ppm NaCl+ $CaCl_2$	4.31	18.48
100 g compost+1000 ppm NaCl+ $CaCl_2$	5.66	16.27
100 g compost+2000 ppm NaCl+ $CaCl_2$	4.43	14.68
10 g Microbien + 100 g compost	2.85	20.01

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8/18/2010