Bull. Fac. Agric., Cairo Univ., 66:76 – 90 (2015).

EFFECT OF SALINITY AND HUMIC ACID TREATMENTS ON GROWTH AND CHEMICAL COMPOSITION OF *CHORISIA SPECIOSA* PLANTS

(Received: 7.10. 2014)

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ABSTRACT

This investigation was carried out at Antoniades Research Branch, Horticulture Institute, Ministry of Agriculture, Alexandria, Egypt, during 2012 and 2013 seasons. The study was a trial to investigate the effect of different levels of salinity (0, 3000, 6000 and 9000 ppm) and different concentrations of humic acid sprayed on the leaves (0, 500, 1000 and 1500 ppm) and their combinations on the vegetative growth and some chemical constituents of *Chorisia speciosa* plants grown in plastic pots 30 cm filled with sandy soil. The results revealed that the salinity levels of irrigation were more effective than humic acid concentrations on all the studied characteristics of *Chorisia speciosa* plant. Additionally, using tap water (control) combined with humic acid at 1000 ppm gave the highest significant values of plant height, stem dry weight, leaf number, leaf dry weight, leaf area. Additionally, using tap water (control) combined with humic acid at 1500 ppm gave the highest significant values of stem diameter, root length, root dry weight, chlorophyll, proline and carbohydrates contents of the leaves. Generally, the obtained results recommend that irrigating the cultivated plants in the sandy soil three times per week with using irrigation salinity water level no more than 6000 ppm combined with humic acid at the rate of 1500 ppm improved the vegetative growth and some chemical constituents of *Chorisia speciosa* plants.

Key words: *Chorisia speciosa, humic acid, salinity irrigation water.*

1. INTRODUCTION

Chorisia speciosa, the Silk Floss tree or Kapok tree, is a decorative tree from the Bombacaceae family that originated in Brazil and Argentina (Santos, 1967 and Pio Correa, 1978). It grows up to 20 meters high and 20 meters wide. Its spectacular blooming attracts every eye. The plant blooms mostly in autumn. The large white, pink or red flowers are very attractive and measure up to 12 cm long. The foliage is semi-persistent and light green. The leaves fall off right before blooming, so the flowers cover the entire tree. The trunk is green and has large grey spikes covering it as it gets older. It is easy to cultivate, pruned before the next blooming season. This species has great economic and ornamental potentials, living preferentially in wet habitats, being frequent in river valleys and small depressions (Santos, 1967). Dias *et al.* (1992) classified this species as secondary in the ecological succession.

Salinity is one of major environmental factors determining plant productivity and plant distribution. Salinity affects more than 10% of Arab lands. In general, desertification and salinization are rapidly increasing on a global scale, leading to declining the average yields of most major crop plants. Several researchers reported that water salinity also has considerable effect on the growth of different ornamental tree species (Sapeta *et al*., 2013).

Humic substances have different effects on plants. Vaughan *et al.* (1985), showed evidence of stimulation of plant growth by humic substances and consequently increased yield by acting on mechanisms involved in cell respiration, photosynthesis, protein synthesis, water, and nutrient uptake, enzyme activities.

Results demonstrated that it is C rate dependent and particularly effective at low concentration (Chen and Aviad, 1990). Optimal concentrations capable to affect and stimulate plant growth have been generally found in the range of 50-300 mg l^{-1}, but positive effects have been also seen with lower concentrations (Chen *et al.*, 2004). Cavalcante *et al.* (2011) demonstrated that sprayed humic substances positively affect aerial parts and root systems of papaya seedlings, and seedling quality are improved by humic acid foliar spray. Khaled and Fawy (2011) stated that “economical levels of application should be determined and should not exceed 2 g humus/kg in soil and 0.1% in foliar”.

Additionally, *Chorisia speciosa* are known to be relatively tolerant to salinity (Genhua *et al.*, 2012). However, significant reduction in vegetative growth characteristics is expected to occur if the salinity level is increased above a certain critical level. This study was conducted with the aim of investigating the effect of different irrigation water salinity levels on the growth and chemical constituents of *Chorisia speciosa*, and to assess the possibility of using humic acid treatments to overcome the adverse effects of salinity on plant growth.

2. MATERIALS AND METHODS

The present study was carried-out at Antoniades Research Branch, Horticulture Research Institute, A.R.C. Alexandria, Egypt during the two successive seasons of 2012 and 2013.

On the 15*th* of March, 2012 and 2013 (in the first and second seasons, respectively) homogenous seedlings of *Chorisia speciosa* (30-35 cm height and 7-9 compound leaf/ plant in average) were planted individually in plastic pots (30 cm diameter) filled with 10 kg of sandy soil. The chemical constituents of the soil were measured as described by Jackson (1958) in Table (1). On the 15th of April (in both seasons), the saline irrigation water treatments were initiated. The different saline water concentrations were prepared, using sodium chloride (NaCl). The plants were irrigated three times per week using saline water concentrations of tap water (control), 3000, 6000 and 9000 ppm. In both seasons, the plants received the salinity levels monthly from 15 April till 15 August in both seasons. The plants also were sprayed with humic acid at the concentrations of 0, 500, 1000 and 1500 ppm, monthly from 15 May till 15 August in both seasons. Control plants were sprayed with tap water. The end of the experiment was on the 15*th* of September (in both seasons).

In both seasons, all plants received NPK chemical fertilization using fertilizer (Milagro Aminoleaf 20-20-20) at the rate of 3 g/ pot. Fertilization was repeated every 30 days throughout the growing season (from the 20*th* of April till the 15*th* of August). In addition, weeds were removed manually upon emergence.

Data recorded : (at the end of the season)

1. Vegetative growth parameters: Plant height (cm), leaf number per plant, leaf area (cm^2), leaf dry weight per plant (g), stem diameter (cm), stem dry weight (g), root length (cm) and root dry weight (g).

2. Chemical analysis determination

- Chlorophylls content were determined as SPAD unites of the fresh leaves of plants for the different treatments under the experiment at the end of the season using Minolta (chlorophyll meter) SPAD 502 according to Yadava (1986).
- Carbohydrate contents of the leaves were determined according to Dubios *et al.*(1956).
- Sodium and chloride contents % of dry matter in the leaves were determined according to Piper (1947).
- Relative Water Content of the leaves (%) in the fresh leaves were determined according to Barrs (1968) and Ritche (1974).
- Proline content (mg/g) in the leaves was determined according to Bates *et al.* (1973).

The layout of the experimental design was split plot design with three replicates. Each replicate contained three plants. The main plots were the salinity levels while the sub plots were

Table (1): Some chemical analysis of the used sandy soil for the two successive seasons 2012 and 2013.

Season	pH	EC (dSm^{-1})	Soluble cations (mg/l)				Soluble anions (mg/l)		
			Ca^{++}	Mg^{++}	Na^{+}	K^{+}	HCO_3^{-}	Cl^{-}	SO_2^{--}
2012	7.87	1.51	3.1	4.2	6.4	1.1	3.5	6.5	2.4
2013	7.92	1.43	3.4	2.9	6.2	0.9	3.2	6.3	2.1

the concentrations of humic acid. The means of the individual factors and their interactions were compared by L.S.D test at 5% level of probability according to Snedecor and Cochran (1974).

3. RESULTS AND DISCUSSION

3.1. Vegetative growth

3.1.1. Plant height (cm)

Data presented in Table (2a) show that, in both seasons, irrigation with saline water decreased the height of *Chorisia speciosa* plants, compared to the plants irrigated with tap water (control). Plants irrigated with tap water had the highest mean values of plant height 41.12 and 43.54 cm in the first and second seasons, respectively. Moreover, raising the salt concentration caused steady significant reductions in plant height, with the highest concentration (9000 ppm) giving significantly the shortest plants (with mean heights of 29.62 and 32.45 cm in the two seasons, respectively) than those receiving any other salt concentration. Similar results were reported by Abd El-Aziz *et al.* (2006) on *Khaya senegalensis,* El- Juhany *et al.* (2008) on *Eucalyptus camaldulensis, Eucalyptus intertexta* and *Eucalyptus microtheca,* and Sharif and Khan (2009) on *Salvadora oleoides, Prosopis cineraria, Capparis decidue* and *Tamarix aphylla.* The reduction in plant height as a result of high salt concentration was explained by Yasseen *et al.* (1987) and St.Arnaud and Vincent (1990), as the decrease in plant height under saline conditions was probably due to the insufficient uptake of water and nutrients, as well as sodic toxicity.

Plant height was also significantly affected by spraying the plants with humic acid. In both seasons, plant height was increased gradually when the humic acid concentration was raised from 0 ppm (control) to 1000 ppm. However, a further increase in humic acid concentration from 1000 ppm to 1500 ppm resulted in a gradual decrease in plant height. Accordingly, it can be seen from the data in Table (2-a) that *Chorisia speciosa* plants sprayed with 1000 ppm humic acid were significantly taller (with mean plant heights of 37.41 and 40.04 cm in the first and second seasons, respectively) than the plants sprayed with any other humic acid concentration. The increase in height of *Chorisia speciosa* plants as a result of spraying with humic acid is similar to the increases in height that had been recorded on other ornamental plant species, by El-Khateeb *et al.* (2010) on *Calia secundiflora* and Cavalcante *et al.* (2011) on *Carica papaya*.

Regarding the interaction between the effects of irrigation water salinity and humic acid treatments on growth rate of the plant height of *Chorisia speciosa* plants, the results recorded in the two seasons show that, the highest values were obtained in the plants irrigated with tap water and sprayed with humic acid at 1000 ppm (with mean heights of 43.50 and 45.83 cm in the first and second seasons, respectively). On the other hand, the shortest plants (with mean heights of 26.25 and 28.50 cm in the first and second seasons, respectively) were the plants irrigated using the highest salt concentration 9000 ppm without humic acid treatment. It can also be seen from the data presented in Table (2a) that in many cases, spraying the plants with humic acid reduced the undesirable effect of salinity. Similar results were reported by Abd El-Aziz *et al.* (2006) on *Khaya senegalensis*, Sayed (2006) on *Ficus alii*, El-Juhany *et al.* (2008) on *Eucalyptus camaldulensis*, *Eucalyptus intertexta* and *Eucalyptus microtheca* and Sharif and Khan (2009) on *Salvadora oleoides*, *Prosopis cineria*, *Capparis decidue* and *Tamarix aphylla*.

3.1.2. Number of leaves per plant

The data presented in Table (2a) show the effect of saline water on the number of leaves formed on *Chorisia speciosa* plants. In both seasons, plants irrigated with tap water had the highest number of leaves 30.08 and 32.41 leaves/plant in the first and second seasons, respectively. Accordingly, the least number of leaves 22.33and 24.95 leaves/plant in the first and second seasons, respectively, was formed by plants that were irrigated using the highest salt concentration 9000 ppm. Similar results were reported by El-Juhany and Aref (2005) on *Conocarpus erectus,* Abd EI-Aziz *et al.* (2006) on *Khaya senegalensis* and El-Juhany *et al.* (2008) on *Eucalyptus camaldulensis, Eucalyptus intertexta* and *Eucalyptus microtheca.*

Concerning the effect of humic acid treatments on the number of leaves, the data recorded in the two seasons in Table (2a) show that humic acid treatment at 1000 ppm caused a significant increase in the number of leaves giving mean values of 27.62 and 29.91 leaves/plant in the first and second seasons, respectively, compared to that of the control plants (23.79 and 26.04 leaves/plant in the two seasons, respectively). The increase in the number of leaves of plants sprayed with humic acid at 1000 ppm supports the results reported by Fathy *et al.* (2010) on *Prunus armeniaca* and El-Khateeb *et al.* (2010) on *Calia secundiflora*.

The data in Table (2a) show that significant interaction was detected in both seasons between the effects of irrigation water salinity and humic acid treatments on the number of leaves formed by *Chorisia speciosa* plants. Combining irrigation using tap water with spraying the plants with humic acid at 1000 ppm gave the highest number of leaves of 31.66 and 33.66 leaves per plant in the first and second seasons, respectively. On the other hand, the least number of leaves per plant of 20.16 and 22.33 leaves per plant in the first and second seasons, respectively, were obtained on plants irrigated using the highest salt concentration 9000 ppm and sprayed without any humic acid concentration. Similar results were reported by El-Juhany and Aref (2005) on *Conocarpus erectus*, Abd El-Aziz *et al.* (2006) on *Khaya senegalensis*, Sayed (2006) on *Ficus alii* and El-Juhany *et al.* (2008) on *Eucalyptus camaldulensis*, *Eucalyptus intertexta* and *Eucalyptus microtheca*.

3.1.3. Leaves dry weight (g) per plant

The results recorded in the two seasons (Table 2a) show that the heaviest dry weights of leaves were 26.89 and 30.11 g/plant in the first and second seasons, respectively, were obtained from plants irrigated with tap water. Irrigation with water containing any salt concentration decreased the dry weight of leaves significantly. Moreover, the recorded values decreased steadily with raising the salt concentration. Accordingly, the least values (17.91 and 21.17 g/plant) in the first and second seasons, respectively, were obtained from plants irrigated with the highest salt concentration 9000 ppm. This reduction in the dry weight of leaves as a

Table (2a): Means of vegetative growth characteristics of *Chorisia speciosa* plants as influenced by Salinity (S), Humic acid (HA) and their combinations (S × HA) in the two seasons of 2012 and 2013.

Treatments		Plant height (cm)		Number of leaf per plant		Leaf dry weight (g) per plant	
Salinity (ppm)	**Humic acid (ppm)**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
0	0	37.50	39.91	27.66	30.16	24.05	27.42
	500	42.00	44.41	30.66	33.16	27.58	31.02
	1000	43.50	45.83	31.66	33.66	28.74	31.61
	1500	41.50	44.00	30.33	32.66	27.20	30.42
Mean		**41.12**	**43.54**	**30.08**	**32.41**	**26.89**	**30.11**
3000	0	33.25	35.25	24.83	26.83	20.72	23.41
	500	36.50	38.50	27.00	29.00	23.27	26.02
	1000	38.91	41.58	28.66	31.00	25.25	28.41
	1500	35.75	38.25	27.16	28.83	22.69	25.81
Mean		**36.10**	**38.39**	**26.91**	**28.91**	**22.98**	**25.91**
6000	0	29.75	32.41	22.50	24.83	18.00	21.02
	500	33.50	36.00	25.00	27.33	20.93	24.02
	1000	35.25	37.91	26.16	28.50	22.31	25.42
	1500	33.50	36.33	24.83	27.50	20.96	24.22
Mean		**33.00**	**35.66**	**24.62**	**27.04**	**20.55**	**23.67**
9000	0	26.25	28.50	20.16	22.33	15.25	18.01
	500	29.50	32.75	22.33	25.16	17.84	21.42
	1000	32.00	34.83	24.00	26.50	19.76	23.02
	1500	30.75	33.75	22.83	25.83	18.79	22.22
Mean		**29.62**	**32.45**	**22.33**	**24.95**	**17.91**	**21.17**
Mean (HA)	0	31.68	34.02	23.79	26.04	19.50	22.46
	500	35.37	37.91	26.25	28.66	22.41	25.62
	1000	37.41	40.04	27.62	29.91	24.01	27.12
	1500	35.37	38.08	26.29	28.70	22.41	25.67
L.S.D. at 0.05	**S**	**1.94**	**1.41**	**1.12**	**0.88**	**1.41**	**1.02**
	H A	**0.70**	**0.58**	**0.55**	**0.36**	**0.56**	**0.43**
	HA×S	**2.28**	**1.73**	**1.47**	**1.07**	**1.70**	**1.26**

result of salinity treatments is similar to that obtained by El-Juhany and Aref (2005) on *Conocarpus erectus*, and Abd El-Aziz *et al.* (2006) on *Khaya senegalensis.*

The data presented in Table (2a) also show that spraying *Chorisia speciosa* plants with humic acid at 1000 ppm significantly increased the dry weight of leaves giving values of 24.01 and 27.12 g/plant in the first and second seasons, respectively, compared to the control (19.50 and 22.46 g/plant in the first and second seasons, respectively).

Regarding the interaction between the effect of irrigation water salinity and humic acid treatments on the dry weight of leaves of *Chorisia speciosa,* the data presented in Table (2a) showed that the heaviest dry weights of leaves of 28.74 g and 31.61 g/plant in the first and second seasons, respectively, were obtained in plants irrigated with tap water and sprayed with humic acid at 1000 ppm, whereas the least dry weights of leaves of 15.25 and 18.01 g/plant in the first and second seasons, respectively, were obtained when the plants were irrigated using the highest salt concentration 9000 ppm without any humic acid treatment.

This reduction in the dry weight of leaves as a result of salinity treatments is similar to that obtained by El-Juhany and Aref (2005) on *Conocarpus erectus*, Abd El-Aziz *et al.* (2006) on *Khaya senegalensis* and Sayed (2006) on *Ficus alii*.

3.1.4. Leaves area (cm^2)

The results recorded in the two seasons (Table 2b) show that irrigation with saline water decreased the leaf area of *Chorisia speciosa* plants, compared to the plants irrigated with tap water (control). In both seasons, plants irrigated with tap water (control) had the largest leaves with mean areas of 1874.11 and 2016.39 cm^2 in the first and second seasons, respectively. The leaves area was decreased steadily with raising the salt concentration. Accordingly, the smallest leaf with mean areas of 475.09 and 515.44 cm^2 in the first and second seasons, respectively, formed on plants that were irrigated using the highest salt concentration 9000 ppm. Similar results were reported by Awan *et al.* (2002a) on *Eucalyptus camaldulensis,* and Awan *et al.* (2002b) on *Dalbergia sissoo.*

The data presented in Table (2b) show that, the different humic acid treatments had a significant effect on leaves area of *Chorisia speciosa* plants. Plants sprayed using humic acid at 1000 ppm forming significantly larger leaves (with a mean area of 1301.65 and 1384.84 cm^2 in the first and second seasons, respectively, than those formed by the control plants (806.79 and 878.48 cm^2). Similar increases in leaf area as a result of humic acid treatments were reported by Fathy *et al.* (2010) on *Prunus armeniaca.*

The data presented in Table (2b) also show that a significant interaction was detected between the effect of irrigation water salinity and humic acid treatments on the area of *Chorisia speciosa* leaves. The largest leaves with mean areas of 2062.12 and 2206.89 cm^2 in the first and second seasons, respectively, were obtained by plants irrigated with tap water and sprayed with humic acid at 1000 or 1500 ppm, respectively. On the other hand, the smallest leaves (with areas of 403.57 and 452.57 cm^2 in the first and second seasons, respectively) were obtained on plants irrigated using the highest salt concentration 9000 ppm combined with control (without humic acid treatment). Similar results were reported by Awan *et al.* (2002a) on *Eucalyptus camaldulensis*, and Awan *et al.* (2002b) on *Dalbergia sissoo*.

It can also be seen that in many cases, the humic acid treatments counteracted (at least partly) the adverse effect of the salinity treatments on leaf area. For example, in the plants that were irrigated using the highest salt concentration 9000 ppm, a steady increase in leaf area was recorded as the humic acid concentration was gradually raised, *i.e.* in both seasons, plants that were irrigated with saline water at 9000 ppm and sprayed with humic acid gave larger leaves than plants receiving the same salinity treatment, but without humic acid.

3.1.5. Stem diameter (cm)

The data recorded on the stem diameter of *Chorisia speciosa* plants in the two seasons (Table 2b) show that irrigation with saline water decreased stem thickness, compared to that of plants irrigated with tap water (control). In both seasons, plants irrigated with tap water had the thickest stems, with mean diameters of 3.66 and 4.09 cm in the first and second seasons, respectively. Raising the salt concentration in irrigation water caused a steady reduction in stem diameter. This reduction in stem diameter was significant (compared to the control), even at the highest salt concentration 9000 ppm, which gave stem diameters of 2.63 and 3.00 cm in the first and second seasons, respectively. Similar results were reported by Abd El-Aziz *et* *al.* (2006) on *Khaya senegalensis.*

In contrast to the effect of salinity treatments, humic acid treatments improved stem diameter of *Chorisia speciosa* plants, compared to the control. Moreover, plants sprayed with 1500 ppm humic acid significantly affected thickest stems (with mean diameters of 3.42 and 3.69 cm in the first and second seasons, respectively), compared to the those of control plants, or plants sprayed with any other humic acid concentration. Similar increases in stem diameter had been reported by El-Khateeb *et al.* (2010) on *Calia secundiflora* and Fathy *et al.* (2010) on *Prunus armeniaca*.

Regarding the interaction between the effects of irrigation water salinity and humic acid treatments on stem diameter of *Chorisia speciosa* plants, the results recorded in the two seasons in Table (2b) show that significant differences were detected between the values obtained from plants receiving the different treatment combinations. The highest values (3.83 and 4.29 cm in the first and second seasons, respectively) were obtained in the plants irrigated with tap water and sprayed with humic acid at 1500 ppm. On the other hand, the thinnest stems (with diameters of 2.24 and 2.57 cm in the first and second seasons, respectively) were obtained in the plants irrigated using the highest salt concentration 9000 ppm without humic acid treatment. It can also be seen that in some cases, the humic acid treatments helped to overcome the adverse effect of the salinity treatments on stem thickening. Similar results were reported by El-Bagoury *et al.* (1999) on *Casuarina equisetifolia* and Abd El-Aziz *et al.* (2006) on *Khaya senegalensis*.

3.1.6. Stem dry weight (g)

Data presented in Table (2b) show that, in both seasons, irrigation with saline water significantly decreased dry weights of the stems of *Chorisia speciosa* plants, compared to plants

Table (2b): Means of vegetative growth characteristics of *Chorisia speciosa* plants as influenced by Salinity (S), Humic acid (HA) and their combinations (S × HA) in the two seasons of 2012 and 2013.

	Treatments	**Leaf area (cm^2)**		**Stem diameter (cm)**		**Stem dry weight (g)**	
Salinity (ppm)	**Humic acid (ppm)**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
0	0	1693.90	1823.44	3.39	3.77	31.46	34.98
	500	1721.90	1861.80	3.68	4.07	34.12	38.45
	1000	2062.12	2173.42	3.75	4.23	36.21	38.91
	1500	2018.51	2206.89	3.83	4.29	34.61	38.72
Mean		**1874.11**	**2016.39**	**3.66**	**4.09**	**34.10**	**37.76**
3000	0	660.56	715.17	2.94	3.18	27.52	30.22
	500	1073.22	1152.28	3.23	3.41	30.13	32.27
	1000	1367.23	1478.09	3.48	3.56	32.65	33.75
	1500	709.54	773.49	3.63	3.65	31.49	33.91
Mean		**952.64**	**1029.76**	**3.32**	**3.45**	**30.44**	**32.54**
6000	0	469.13	522.75	2.59	2.94	24.45	27.51
	500	812.01	892.06	2.93	3.28	27.51	30.51
	1000	1028.36	1123.75	3.13	3.43	29.40	31.82
	1500	535.03	592.40	3.30	3.52	28.15	31.92
Mean		**711.13**	**782.74**	**2.99**	**3.29**	**27.38**	**30.44**
9000	0	403.57	452.57	2.24	2.57	21.19	24.16
	500	365.91	418.15	2.57	2.97	24.34	27.56
	1000	748.91	764.12	2.78	3.19	26.33	29.30
	1500	381.97	426.92	2.94	3.28	26.38	29.88
Mean		**475.09**	**515.44**	**2.63**	**3.00**	**24.56**	**27.72**
Mean (HA)	0	806.79	878.48	2.79	3.11	26.15	29.22
	500	993.26	1081.07	3.10	3.43	29.03	32.20
	1000	1301.65	1384.84	3.28	3.60	31.15	33.44
	1500	911.26	999.92	3.42	3.69	30.16	33.61
L.S.D. at 0.05	**S**	**76.16**	**46.34**	**0.22**	**0.16**	**0.93**	**1.72**
	H A	**17.44**	**14.93**	**0.10**	**0.05**	**0.73**	**0.52**
	HA×S	**81.75**	**52.88**	**0.26**	**0.17**	**1.56**	**1.93**

irrigated with tap water (control). Plants irrigated with tap water had the heaviest mean dry weight of stems 34.10 and 37.76 g per plant in the first and second seasons, respectively. The dry weight of the stems showed a gradual reduction as the salt concentration was increased. Accordingly, the least dry weights of stem 24.56 and 27.72 g per plant in the first and second seasons, respectively, were recorded in plants receiving the highest salt concentration 9000 ppm. These results are in agreement with the fmdings of Aslam *et al.*(2002) on *Eucalyptus camaldulensis,* Franklin *et al.* (2002) on jack pine *(Pinus banksiana),* Gupta *et al.* (2002) on *Ziziphus rotundifolia* and Z. *nummularia,* El-Feky (2004) on *Erythrina indica* and *Tecoma stans,* and Abd El-Aziz *et al.* (2006) on *Khaya senegalensis.*

The results recorded in the two seasons in Table (2b) show that, spraying the plants with humic acid increased the dry weight of the stems. In both seasons, spraying plants with 1000 ppm humic acid gave the heaviest dry weight of stem (31.15 and 33.44 g/plant) in the first and second seasons, respectively. These values were significantly higher than those of the control plants, or the plants receiving any other humic acid concentration. Increases in the dry weight of the stems as a result of humic acid treatments were reported by Hussein (2009) on *Cryptostegia grandiflora.*

Regarding the interaction between the effect of irrigation water salinity and humic acid treatments, the results recorded in the two seasons show that the heaviest stem dry weights of 36.21 and 38.91 g per plant in the first and second seasons, respectively) were those of plants irrigated with tap water and sprayed with humic acid at 1000 ppm. On the other hand, the lowest stem dry weights (21.19 and 24.16 g per plant in the first and second seasons, respectively) were obtained in the plants irrigated using the highest salt concentrations 9000 ppm without humic acid treatment. These results are in agreement with the findings of Aslam *et al.* (2002) on *Eucalyptus camaldulensis,* Franklin *et al.* (2002) on *Pinus banksiana*, Gupta *et al.* (2002) on *Ziziphus rotundifolia* and *Ziziphus nummularia*, El-Feky (2004) on *Erythrina indica* and *Tecoma stans,* and Abd El-Aziz *et al.* (2006) on *Khaya senegalensis*.

3.1.7. Root length (cm)

Data presented in Table (2c) show that all the tested irrigation water salinity treatments significantly decreased the root length (cm) of *Chorisia speciosa*, compared to that of plants irrigated with tap water (control). In both seasons, plants irrigated with tap water had the highest mean root length 42.25 and 45.45 cm in the first and second seasons, respectively. Raising the salt concentration caused a steady reduction in the root length, which reached its lowest values of 31.00 and 34.97 cm in the first and second seasons, respectively, in the plants irrigated using the highest salt concentration at 9000 ppm. Similar results were reported by El-Feky (2004) on *Erythrina indica* and *Tecoma stans* and Abd El-Aziz *et al.* (2006) on *Khaya senegalensis.*

The data in Table (2c) also indicate that humic acid treatments had a significant effect on the root length. As with the other vegetative growth parameters, spraying the plants with humic acid at 1500 ppm gave the tallest root length 38.52 and 43.06 cm in the first and second seasons, respectively. A similar increase in the root length as a result of humic acid treatments was recorded by Ashish *et al.* (2010) on *Jatropha curcas*.

Regarding the interaction between the effects of irrigation water salinity and humic acid treatments on root length of *Chorisia speciosa* plants, the results recorded in the two seasons, showed that, the highest values were obtained in plants irrigated with tap water and sprayed with humic acid at 1500 ppm (with mean length of 44.33 and 47.75 cm in the first and second seasons, respectively). On the other hand, the shortest roots (with mean length of 26.91 and 30.66 cm in the first and second seasons, respectively) were those irrigated using the highest salt concentration at 9000 ppm without humic acid treatment. It can also be seen from the data presented in Table (2c) that in many cases, spraying the plants with humic acid reduced the undesirable effect of salinity.

3.1.8. Root dry weight (g)

Data presented in Table (2c) show that irrigation of *Chorisia speciosa* plants with saline water significantly decreased the dry weights of roots, compared to the plants irrigated with tap water (control). In both seasons, plants irrigated with tap water had the highest dry weights of roots 37.00 and 42.38 g/plant in the first and second seasons, respectively. Steady significant reductions in the dry weight of roots were recorded as the salt concentration in the irrigation water was increased, with the highest salt concentration at 9000 ppm giving the lowest mean values in both seasons 26.62 and 31.56 g/plant in the first and second seasons, respectively.

Regarding the effect of humic acid treatments on the dry weight of roots, data in Table (2c) show that spraying *Chorisia speciosa* plants with humic acid at 1500 ppm significantly increased the recorded values, compared to the control. The highest dry roots 33.63 and 39.05 g/plant in the first and second seasons, respectively, were those of plants sprayed with humic acid at 1500 ppm. A similar increase in the dry weight of roots was recorded by Zaghloul *et al.* (2009) on *Thuja orientalis*, El-Khateeb *et al.* (2010) on *Calia secundiflora* and Cavalcante *et al.* (2011) on *Carica papaya*.

Regarding the interaction between the effects of irrigation water salinity and humic acid treatments, the data presented in Table (2c) show that the highest values (38.50 and 44.34 g per plant in the first and second seasons, respectively) were obtained in the plants irrigated with tap water and sprayed with humic acid at 1500 ppm. On the other hand, the least dry weight of roots (22.58 and 27.01 g per plant in the first and second seasons, respectively) were obtained from plants irrigated using the highest salt concentration 9000 ppm, with no humic acid treatment. Similar results were reported by Sayed (2006) on *Ficus alii*.

Table (2c): Means of vegetative growth characteristics of *Chorisia speciosa* plants as influenced by Salinity (S), Humic acid (HA) and their combinations (S× HA) in the two seasons of 2012 and 2013.

Treatments		Root length (cm)		Root dry weight (g)	
Salinity (ppm)	**Humic acid (ppm)**	**2012**	**2013**	**2012**	**2013**
0	0	38.33	42.25	33.55	38.92
	500	42.66	45.08	37.71	42.33
	1000	43.66	46.75	38.27	43.94
	1500	44.33	47.75	38.50	44.34
Mean		**42.25**	**45.45**	**37.00**	**42.38**
3000	0	34.00	37.41	29.27	34.21
	500	36.66	40.83	32.57	36.50
	1000	38.00	43.08	34.75	38.59
	1500	39.50	44.91	34.55	39.91
Mean		**37.04**	**41.56**	**32.78**	**37.30**
6000	0	30.58	34.41	26.14	31.41
	500	34.33	37.75	29.56	34.38
	1000	35.91	39.50	31.20	36.17
	1500	36.50	41.25	32.11	37.07
Mean		**34.33**	**38.22**	**29.75**	**34.75**
9000	0	26.91	30.66	22.58	27.01
	500	30.50	34.25	26.07	30.78
	1000	32.83	36.66	28.45	33.58
	1500	33.75	38.33	29.37	34.89
Mean		**31.00**	**34.97**	**26.62**	**31.56**
Mean (HA)	0	32.45	36.18	27.88	32.88
	500	36.04	39.47	31.48	35.99
	1000	37.60	41.50	33.16	38.07
	1500	38.52	43.06	33.63	39.05
L.S.D. at 0.05	**S**	**1.60**	**1.14**	**1.70**	**1.61**
	H A	**0.85**	**0.42**	**0.93**	**0.46**
	S × HA	**2.17**	**1.34**	**2.34**	**1.79**

3.2.Chemical constituents

3.2.1. Chlorophyll content (SPAD unites)

The results presented in Table (3a) show that the highest content of total chlorophylls was obtained in the plants irrigated with tap water 44.52 and 50.04 SPAD in the first and second seasons, respectively. Raising the salt concentration in irrigation water resulted in steady significant reductions in the total chlorophyll content, which reached its lowest values of 39.98 and 45.41 SPAD in the first and second seasons, respectively, in plants receiving the highest salt concentration 9000 ppm. The decrease in the total chlorophyll content as a result of raising the salt concentration in irrigation water are in agreement with the results reported by El-Feky (2004) on *Erythrina indica* and *Tecoma stans,* and Helmy (2004) on *Senna occidentalis.*

The results of leaf chemical analysis in Table (3a) also show that the tested humic acid treatments had clear effect on the total chlorophyll content. The recorded mean values ranged from 44.91 and 49.93 SPAD in the first and second seasons, respectively, in plants sprayed with humic acid at 1500 ppm to 38.42 and 44.18 SPAD in the first and second seasons, respectively, in the plants sprayed with humic acid at 0 ppm. Similar results were reported by Tejada and Gonzalez (2003) on asparagus, and Ferrara *et al.* (2008) on grape.

The data presented in Table (3a) also show that significant interaction was detected between the effect of irrigation water salinity and humic acid treatments of *Chorisia speciosa* leaves. In the first season, the highest total chlorophylls content of 45.99 SPAD was formed by plants irrigated with tap water and sprayed with humic acid at 1000 ppm. In the second season, the highest chlorophyll mean 51.75 SPAD was formed by the plants irrigated with tap water and sprayed with humic acid at 1500 ppm. On the other hand, the least chlorophyll contents 35.44 and 41.54 SPAD in the first and second seasons, respectively) were obtained in the plants irrigated using the highest salt concentration at 9000 ppm combined with humic acid at 0 ppm treatment. The decrease in the total chlorophyll content as a result of raising the salt concentration in irrigation water is in agreement with the results reported by El-Feky (2004) on *Erythrina indica* and *Tecoma stans*, and Helmy (2004) on *Senna occidentalis*.

3.2.2. Carbohydrate content (%)

The data resulting from leaf chemical analysis in Table (3a) show that, the total carbohydrates % in the dried leaves of *Chorisia speciosa* plants was decreased steadily with raising the salt concentration in the irrigation water. The highest mean of carbohydrate content 17.51 and 18.03 % in the first and second seasons, respectively, were found in the leaves of the control plants, whereas the least mean values 15.68 and 16.31 % in the first and second seasons, respectively, were found in the plants irrigated with water containing the highest salt concentration at 9000 ppm. Decreases in the carbohydrate % with increasing the salinity level have been reported by El-Feky (2004) on *Erytherina indica* and *Tecoma stans.* The reduction in the carbohydrate content in the leaves of plants irrigated using saline water may be attributed to the reduction in the total chlorophylls content as a result of the salinity treatments (as previously mentioned). This reduction in the chlorophyll content leads to a reduction in the rate of photosynthesis which occurs within the leaf tissues, leading in turn to a reduction in the synthesis and accumulation of carbohydrates.

The results in Table (3a) also show that most of the tested humic acid concentrations increased the mean total carbohydrates % in the leaves of *Chorisia speciosa* plants, compared to the control. Among the plants receiving the different humic acid treatments, plants sprayed with 1500 ppm humic acid had the highest carbohydrates % in leaves of 17.73 and 18.05 % in the first and second seasons, respectively. Increases in the carbohydrates % in the leaves of plants receiving humic acid treatments were also reported by Hussein (2009) on *Cryptostegia grandiflora.*

Concerning the interaction between the effects of saline irrigation water and humic acid treatments on the carbohydrate content % of leaves. In the first season, the highest total carbohydrate content of 18.55 % was formed by plants irrigated with tap water and sprayed with humic acid at 1500 ppm , In the second season, the highest carbohydrates content of 18.93 % was formed by plants irrigated with tap water and sprayed with humic acid at 1000 ppm. On the other hand, the lowest carbohydrate contents 14.00 and 14.74 % in the first and second seasons, respectively) were obtained on plants irrigated using the highest salt concentration at 9000 ppm combined with humic acid at 0 ppm treatment.

3.2.3. Proline content (mg/g)

Results of leaf samples taken from plants receiving different irrigation water salinity treatments in Table (3a) show that with increasing the level of salinity in water, the proline contents (mg/g) in dry leaves was generally increased. Accordingly, plants irrigated with the highest salt concentration at 9000 ppm had the highest mean of proline values of 2.25 and 2.25 mg/g in the first and second seasons, respectively. On the other hand, the plants irrigated with tap water had the lowest mean proline values of 1.10 and 1.14 mg/g in the first and second seasons, respectively. Similar results were reported by Kumar *et al.* (2003) on *Morus alba*, and Woodward and Bennett (2005) on *Eucalyptus camaldulensis.* The considerable enhancement of proline accumulation in plants irrigated using high salt concentrations may lead to the conclusion that proline plays a role in plant tolerance to salinity. This role was explained by Greenway and Munns (1980), who mentioned that proline can be considered as a stabilizer of osmotic pressure within the cell. Also, Maraim (1990) and Marcum and Murdoch (1994) concluded that proline can make a substantial contribution to cytoplasmic osmotic adjustment.

As for the effect of different combinations of saline irrigation water and humic acid concentrations, it is clear from data in Table (3a) that considerable differences in the proline (mg/g) were detected in the leaves of plants receiving the different combinations of water salinity and humic acid treatments. The highest mean values of 2.32 and 2.31 mg/g dry matter in the first and second seasons, respectively, were obtained in plants irrigated with saline water at 9000 ppm, and receiving no humic acid treatment. On the other hand, the lowest proline values of 0.99 and 1.05 mg/g dry matter in the first and second seasons, respectively, were obtained from plants irrigated with tap water and sprayed with humic acid at 1500 ppm. Similar results were reported by Campos *et al.* (2012) on *Jatropha curcas*.

Table (3a): Means of chemical constituents characteristics of *Chorisia speciosa* plants as influenced by salinity (S), humic acid (HA) and their combinations (S ×HA) in the two seasons of 2012 and 2013.

Treatments		Chlorophyll content (SPAD unites)		Carbohydrates content (%)		Proline content (mg/g)	
Salinity (ppm)	**Humic acid (ppm)**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
0	0	42.55	47.99	16.17	17.21	1.18	1.22
	500	43.94	49.36	17.34	17.74	1.13	1.17
	1000	45.99	51.08	18.00	18.93	1.09	1.14
	1500	45.62	51.75	18.55	18.25	0.99	1.05
Mean		**44.52**	**50.04**	**17.51**	**18.03**	**1.10**	**1.14**
3000	0	38.37	44.13	15.11	15.74	1.72	1.73
	500	40.47	45.57	15.92	16.28	1.59	1.64
	1000	45.88	49.66	17.60	18.42	1.55	1.59
	1500	46.93	50.87	18.02	18.75	1.52	1.55
Mean		**42.91**	**47.55**	**16.66**	**17.30**	**1.59**	**1.63**
6000	0	37.31	43.08	14.71	15.33	2.08	2.13
	500	40.03	45.12	15.47	16.12	2.01	2.07
	1000	44.37	48.77	16.63	16.72	1.97	2.02
	1500	44.56	49.46	17.08	17.76	1.93	1.98
Mean		**41.56**	**46.60**	**15.97**	**16.48**	**2.00**	**2.05**
9000	0	35.44	41.54	14.00	14.74	2.32	2.31
	500	39.72	45.14	15.36	16.11	2.24	2.24
	1000	42.21	47.31	16.08	16.94	2.24	2.21
	1500	42.56	47.67	17.28	17.45	2.22	2.20
Mean		**39.98**	**45.41**	**15.68**	**16.31**	**2.25**	**2.24**
Mean (HA)	0	38.42	44.18	15.00	15.75	1.82	1.85
	500	41.04	46.30	16.02	16.56	1.74	1.78
	1000	44.61	49.20	17.08	17.75	1.71	1.74
	1500	44.91	49.93	17.73	18.05	1.67	1.69
L.S.D.at 0.05	**S**	**1.12**	**1.01**	**0.54**	**0.52**	**0.03**	**0.03**
	HA	**0.70**	**0.71**	**0.47**	**0.25**	**0.01**	**0.01**
	HA×S	**1.64**	**1.59**	**0.97**	**0.68**	**0.03**	**0.03**

3.2.4. Relative Water Content of leaves (%)

Results of leaf samples taken from plants receiving different irrigation water salinity treatments in Table (3b) show that, with increasing the level of salinity in water, the relative water content % in fresh leaves was generally decreased. Accordingly, the plants irrigated with the highest salt concentration at 9000 ppm had the lowest mean relative water content values of 56.35 and 55.14 % in the first and second seasons, respectively. On the other hand, plants irrigated with tap water had the highest mean relative water content values of 81.95 and 75.12 % in the first and second seasons, respectively. The considerable enhancement of relative water content accumulation in plants irrigated using high salt concentrations may lead to the conclusion that relative water content plays a role in plant tolerance to salinity. This role was explained by Greenway and Munns (1980), who mentioned that relative water content can be considered as a stabilizer of osmotic pressure within the cell.

As for the effect of different combinations of saline irrigation water and humic acid concentrations, it is clear from data in Table (3b) that considerable differences in the relative water content (%) were detected in the leaves of plants receiving the different combinations of water salinity and humic acid treatments. The highest mean values of 84.40 and 76.47 % in the first and second seasons, respectively, were obtained in plants irrigated with tap water, and receiving humic acid at 1500 ppm. On the other hand, the lowest relative water contents 54.85 and 52.59 % in the first and second seasons, respectively, were obtained from plants irrigated with saline water at 9000 ppm and sprayed without humic acid. Similar results were reported by Sapeta *et al.* (2013) on *Jatropha curcas*.

3.2.5. Sodium percentage in leaves (%)

The results presented in Table (3b) show that Na % in the dried leaves of *Chorisia speciosa* plants was increased steadily with raising the salt concentration in the irrigation water. Accordingly, the least Na contents of 0.35 and 0.35 % in the first and second seasons, respectively, were found in the leaves of the control plants, whereas the highest contents of 1.85 and 1.90 % in the first and second seasons, respectively, were found in plants irrigated with water containing the highest salt concentration at 9000 ppm. Increases in the Na contents with increasing the salinity level have been reported by Franklin *et al.* (2002) on *Pinus banksiana*, El-Feky (2004) on *Erytherina indica* and *Tecoma stans*, and Cassanitia *et al.* (2009) on ornamental shrubs.

The results in Table (3b) also show that the mean Na % content of the leaves was slightly reduced by spraying the plants with 1500 ppm humic acid which gave a sodium contents of 1.08 and 1.10 % in the first and second seasons, respectively, compared to the control. The highest values (1.36 and 1.39 % in the first and second seasons, respectively) were recorded in plants sprayed with humic acid at 0 ppm (control).

Regarding the interaction between the effects of saline irrigation water and humic acid concentrations on the Na % of leaves, the data presented in Table (3b) show that the highest values of 2.06 and 2.07 % in the first and second seasons, respectively, were obtained from plants irrigated with saline water at 9000 ppm and sprayed without humic acid. On the other hand, the lowest values of 0.25 and 0.23% in the first and second seasons, respectively, were obtained from plants irrigated with tap water and sprayed with humic acid at 1500 ppm. Increases in the Na contents with increasing the salinity level have been reported by Franklin *et al.* (2002) on *Pinus banksiana*, El-Feky (2004) on *Erytherina indica* and *Tecoma stans*, and Cassanitia *et al.* (2009) on a number of ornamental shrubs.

3.2.6. Chloride percentage in leaves (%)

From the data presented in Table (3b), it can be seen that chloride % in the dried leaves of *Chorisia speciosa* plants was increased steadily with raising the salt concentration in the irrigation water. Accordingly, the lowest Cl^- values (0.10 and 0.10 % in the first and second seasons, respectively) were found in control plants, whereas the highest values (0.62 and 0.64 % in the first and second seasons, respectively) were found in plants irrigated with water containing the highest salt concentration at 9000 ppm. Similar increases in the leaf Cl^- contents with increasing the salinity level were reported by Helmy (2004) on *Senna occidentalis*, and Cassanitia *et al.* (2009) on ornamental shrubs.

The results in Table (3b) also show that the mean leaf Cl^- % was reduced steadily with raising humic acid concentration. Accordingly, the highest Cl^- values (0.45 and 0.46 % in the

Table (3b): Means of chemical constituents characteristics of *Chorisia speciosa* plants as influenced by salinity (S), humic acid (HA) and their combinations (S ×HA) in the two seasons of 2012 and 2013.

Treatments		Chlorophyll content (SPAD unites)		Carbohydrate content (%)		Proline content (mg/g)	
Salinity (ppm)	**Humic acid (ppm)**	**2012**	**2013**	**2012**	**2013**	**2012**	**2013**
0	0	76.60	73.76	0.47	0.48	0.15	0.15
	500	83.13	74.80	0.37	0.39	0.11	0.12
	1000	83.68	75.44	0.31	0.31	0.09	0.09
	1500	84.40	76.47	0.25	0.23	0.07	0.06
Mean		**81.95**	**75.12**	**0.35**	**0.35**	**0.10**	**0.10**
3000	0	72.75	69.38	1.18	1.23	0.39	0.41
	500	73.79	70.75	1.15	1.166	0.38	0.38
	1000	75.22	71.45	1.08	1.10	0.36	0.36
	1500	75.76	72.16	0.98	1.02	0.32	0.34
Mean		**74.38**	**70.93**	**1.09**	**1.13**	**0.36**	**0.37**
6000	0	63.21	61.07	1.74	1.80	0.58	0.60
	500	64.79	62.16	1.63	1.66	0.53	0.56
	1000	65.18	63.18	1.42	1.54	0.47	0.49
	1500	65.82	64.37	1.43	1.43	0.42	0.45
Mean		**64.75**	**62.69**	**1.55**	**1.61**	**0.50**	**0.52**
9000	0	54.85	52.59	2.06	2.07	0.70	0.70
	500	56.65	55.19	1.88	1.94	0.64	0.65
	1000	56.74	56.00	1.78	1.85	0.60	0.62
	1500	57.19	56.78	1.67	1.74	0.56	0.58
Mean		**56.35**	**55.14**	**1.85**	**1.90**	**0.62**	**0.64**
Mean (HA)	0	66.85	64.20	1.36	1.39	0.45	0.46
	500	69.59	65.72	1.26	1.29	0.41	0.43
	1000	70.20	66.52	1.15	1.20	0.38	0.39
	1500	70.79	67.44	1.08	1.10	0.34	0.36
L.S.D.at 0.05	**S**	**2.53**	**1.00**	**0.055**	**0.032**	**0.020**	**0.015**
	HA	**0.43**	**0.52**	**0.038**	**0.019**	**0.013**	**0.007**
	HA×S	**2.63**	**1.34**	**0.080**	**0.039**	**0.020**	**0.015**

first and second seasons, respectively) were recorded in the leaves of the control plants, whereas the plants sprayed with the highest humic acid concentration 1500 ppm had the lowest Cl^- values (0.34 and 0.36 % in the first and second seasons, respectively).

Regarding the interaction between effect of saline irrigation water and humic acid concentrations on the Cl %, the data in Table (3b) show that the highest mean values of 0.70 and 0.70 % in the first and second seasons, respectively, were obtained in plants irrigated with saline water at 9000 ppm and sprayed with tap water, while the least mean values 0.07 and 0.06 % in the first and second seasons, respectively, were recorded in plants irrigated with tap water and sprayed with humic acid at 1500 ppm. Similar increases in the Cl^- contents with increasing the salinity level were reported by Helmy (2004) on *Senna occidentalis*, Cassanitia *et al.* (2009) on a number of ornamental shrubs.

Conclusions

The results reported about the vegetative growth parameters and chemical compositions of *Chorisia speciosa* showed that the best spraying treatments of humic acid were 1000 and 1500 ppm and irrigation with tap water (control). It can also been seen from the data that spraying the plants with humic acid reduced the undesirable effect of salinity Thus, it can be concluded that the plants irrigated with water of lower quality (water drainage) with salinity at level of concentration 6000 ppm, the damage caused by the increasing salinity can be reduced by spraying the plants once amonth with humic acid at a rate of 1500 ppm. In some cases, the humic acid treatments helped to overcome the adverse effect of the salinity.

Generally, the results obtained to irrigate *Chorisia speciosa* plants 3 times per week with the use of the water level of salinity of irrigation of no more than 6000 ppm along with acid humic at a rate of 1000 ppm gave improvements good vegetative growth and some chemical components of plants *Chorisia speciosa* planted in sandy soil.

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تأثير معاملات الملوحة وحمض الهيوميك على النمو والتركيب الكيميائى لنباتات الكوريزيا

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ملخص

أجريت هذه الدراسة خلال مواسم 2012 و 2013 على نباتات الكوريزيا المزروعة في الأواني البلاستيكية قطر 30 سم في فرع بحوث أنطونيادس، معهد بحوث البساتين في وزارة الزراعة، الاسكندرية، مصر. يهدف هذا البحث لدراسة تأثير مستويات مختلفة من الملوحة (0، 3000، 6000 و 9000 جزء في المليون) وكذلك نسب مختلفة من حمض الهيوميك (رشا على الأوراق) بتركيزات (0، 500، 1000 و 1500 جزء في المليون) على النمو الخضري وبعض المكونات الكيميائية لنباتات الكوريزيا المزروعة في التربة الرملية. أوضحت النتائج أن مستوى ملوحة ماء الري كان أكثر فعالية من نسب حمض الهيوميك على الخصائص التى درست على نباتات الكوريزيا. أعطى استخدام ماء الصنبور (كنترول) مع حمض الهيوميك بتركيز 1000 جزء في المليون أعلى القيم لكل من طول النبات، الوزن الجاف للساق، عدد الأوراق، الوزن الجاف للأوراق، مساحة الأوراق. كما أوضحت النتائج أن استخدام ماء الصنبور (كنترول) مع حمض الهيوميك بتركيز 1500 جزء فى المليون أعطى أعلى القيم لكل من قطر الساق، طول الجذر، الوزن الجاف للجذر، محتوى الأوراق من الكلوروفيل، محتوى الأوراق من البرولين ومحتوى الكربوهيدرات فى الأوراق.

عموما، ينصح بري نباتات الكوريزيا المزروعة في التربة الرملية ثلاث مرات كل أسبوع مع استخدام مستويات ملوحة بماء الري لا تزيد عن 6000 جزء في المليون متداخلة مع حمض الهيوميك بمعدل 1500 جزء في المليون أدى إلى تحسن جيد على النمو الخضري وبعض المكونات الكيميائية لنباتات الكوريزيا المزروعة في التربة الرملية.

المجلة العلمية لكلية الزراعة – جامعة القاهرة – المجلد (66) العدد الاول (يناير 2015)76-90.