Effect of Nile Compost application on growth and chemical constituents of *Jatropha curcas* grown under different salinity levels of diluted sea water

1Azza A.M. Mazhar, 1Nahed G. Abdel-Aziz, 2Shaymaa I. Shedeed, 2Sahar M. Zaghloul

1Ornamental Plants and Woody Trees Department, National Research Centre, Dokki, Giza, Egypt.  
2Plant Nutrition Department, National Research Centre, Dokki, Giza, Egypt.

**Abstract:** A pot experiment was conducted during 2009 and 2010 seasons in the National Research Centre, Dokki, Giza, Egypt (Research and Production Station, Nubaria). The aim of this work was to study the effect of Nile compost application at rates of (0, 100 and 200g/pot) on growth and chemical constituents of *Jatropha curcas* under three levels of salinity of diluted sea water (2000, 4000 and 6000 mgL⁻¹) and tap water served as control. Salinity treatments have a depressing effect on various growth parameters (i.e. plant height, stem diameter, root length, leaves number/plant, leaf area and fresh and dry weight of all plant organs. The same tendency was observed regarding chlorophyll a, b, carotenoids content and total carbohydrate percentage as well as the percentage of N, P and K. Such depressive effect was increasingly prominent with increasing salinity level. On the other hand, proline content and percentage of Na increased by increasing salinity levels. This means that, all previous growth parameters and chemical constituents, except the percentage of Na and proline content, tended to increase by increasing the rates of Nile compost up to 200g as compared to the untreated ones. Hence, it could be recommended to treat plants, grown in regions irrigated with saline water, with Nile compost to overcome destructive effect of salinity.

**Key words:** Woody Trees – Organic matter – Salinity.

**INTRODUCTION**

*Jatropha curcas* is a species of flowering plant in the spurge family, *Euphorbiaceae*, that is native to the American tropics, most likely Mexico and central America (Janick and Robert, 2008). *Jatropha curcas* grows in tropical and subtropical regions. The plant can grow in wastelands and grow on almost any terrain, even on gravelly, sandy and saline soils. Complete germination is achieved within 9 days. *Jatropha curcas* starts yielding from 9 – 12 months time, the best yield are obtained only after 2 – 3 years time (Juhasz et al., 2009).

In Egypt and in some other countries, there is insufficient fresh water to develop all potential arable land. So, the use of saline water in agriculture is a subject of vital importance for arid and semi-arid zones to meet the increasing food demand. Saline environment induces morphological, anatomical, physiological adaptation in plants to overcome, avoid or neutralize the effect of salinity (Ashour et al., 2004). Valia et al. (1995) on *Moringa oleifera* indicated that fresh and dry weights, chlorophyll a and b content decreased with increase in soil sodicity. Yadav et al., (2003) on *Albizia lebbek* and *Melia azadirach* found that potassium content decreased, while sodium content in leaves increased as soil salinity increased. Ramoliya et al., (2006) assessed the effects of salinization of soil on *Prosopis cineraia* seedlings. Elongation of stem and root was retarded by increasing salt stress. N content significantly decreased in all tissues (leaf, stem and root) in response to salinization of soil. P content significantly decreased in leaves as soil salinity increased.

Compost is a plant residue, animal residue or amixture of both that has been decomposed and recycled as a fertilizer and soil amendment. Compost is a key ingredient in organic farming. At its most essential, the process of composting requires simply piling up waste outdoors and waiting a year or more. Modern, methodical composting is a multi-step, closely monitored process with measured inputs of water, air and carbon & nitrogen rich materials. Compost can be rich in nutrients. It is used in gardens, land scaping, horticulture and agriculture. In ecosystems, compost is useful for erosion control, land reclamation, wetland construction as landfill cover (Heckman, 2006).

**MATERIALS AND METHODS**

This study was carried out at Research and Production Station, Nubaria of National Research Centre during two successive summer seasons of 2009 and 2010. The main objective of this research was to study the effect of adding different rates of compost to sandy soil irrigated with different levels of diluted sea water on growth and chemical constituents of *Jatropha curcas* seedlings. The investigated soil is characterized by sand 55.93%, silt 5.35% and clay 38.72% with pH 7.91, EC 0.76 dS m⁻¹, CaCO₃ 2.3%, OM 1.58%, soluble Ca ²⁺ 2.8,
The vegetative growth:

Data presented in Tables (1-4) indicate that significant increases occurred in all growth parameters by reducing the level of salinity in irrigation water. The highest values of plant height, number of leaves / plant, root length, leaf area, stem diameter and fresh & dry weight of all plant organs were obtained from the plants irrigated with tap water, while the lowest values occurred by irrigation with the highest level of salinity (6000 mg L⁻¹). Moreover, the differences between the concerned salinity concentrations were significant. Numerically, plant height, number of leaves / plant and root length were decreased by (9.25, 13.84 and 24.88%), (18.05, 24.89 and 38.24%) and (9.03, 14.75 and 20.69%) as a result of irrigation with saline waters having the concentrations of 2000, 4000 and 6000 mg L⁻¹, respectively in comparison with the tap water irrigated plant. These results are ascribed to the high salinity levels which could be reduce by its reducing the synthesis of DNA, RNA and protein and hence which might lead to a disturbance in metabolism, cell division and elongation. In this respect, Mansour (1994) mentioned that increasing salinity level decreased water permeability and osmotic potential. However, Mengal and Kirkaby (1979) attributed the undesirable effect of high salinity levels on plant growth to disturbance in mineral balance or utilization. Evans and Malmberg (1989) reported that several of the physiological changes that are characteristic of plant senescence may be attributed are also common to salt stress and include losses of chlorophyll, protein and nucleic acids, a decline in membrane integrity and disruption of cell homeostasis. Dunlap and Binzel (1996) reported that increasing salinity concentrations can reduce the endogenous level of IAA in root. Also, they mentioned that the function of this hormone is impaired in salt stressed plants, and the alternation of IAA metabolism in the roots under salt stress may account for the reduction in growth potential via decreasing availability of water and increasing tissue water deficient. The results also reveal that, leaves, stems and roots fresh and dry-weights were gradually significantly decreased by increasing salinity level. Leaves, stems and root fresh weights were decreased by (8.60, 17.38 and 31.09%), (23.85, 31.15 and 41.74%) and (10.25, 23.58 and 36.71%), while leaves, stem and roots dry weight were decreased by (12.94, 25.66 and 44.36%) and (11.99, 28.74 and 46.07%) as a result of irrigation with waters having the concentrations of 2000, 4000 and 6000 mg L⁻¹ respectively in comparison with the tap water irrigated plant. The effect of salinity on fresh and dry weights might be attributed to the inhibitory effects induced by salinity on many metabolic processes inducing enzyme activities, protein and nucleic acid synthesis and the activities of the mitochondria and chloroplasts. Sharama (1995) and Ashraf and O'leary (1996) pointed out that CO₂ uptake was paralleled by a reduction in transpiration and stomatal conductance. The change in stomatal resistance under saline conditions may be responsible for reducing photosynthesis and water use efficiency.

RESULTS AND DISCUSSION

The vegetative growth:

Data presented in Tables (1-4) indicate that significant increases occurred in all growth parameters by reducing the level of salinity in irrigation water. The highest values of plant height, number of leaves / plant, root length, leaf area, stem diameter and fresh & dry weight of all plant organs were obtained from the plants irrigated with tap water, while the lowest values occurred by irrigation with the highest level of salinity (6000 mg L⁻¹). Moreover, the differences between the concerned salinity concentrations were significant. Numerically, plant height, number of leaves / plant and root length were decreased by (9.25, 13.84 and 24.88%), (18.05, 24.89 and 38.24%) and (9.03, 14.75 and 20.69%) as a result of irrigation with saline waters having the concentrations of 2000, 4000 and 6000 mg L⁻¹, respectively in comparison with the tap water irrigated plant. These results are ascribed to the high salinity levels which could be reduce by its reducing the synthesis of DNA, RNA and protein and hence which might lead to a disturbance in metabolism, cell division and elongation. In this respect, Mansour (1994) mentioned that increasing salinity level decreased water permeability and osmotic potential. However, Mengal and Kirkaby (1979) attributed the undesirable effect of high salinity levels on plant growth to disturbance in mineral balance or utilization. Evans and Malmberg (1989) reported that several of the physiological changes that are characteristic of plant senescence may be attributed are also common to salt stress and include losses of chlorophyll, protein and nucleic acids, a decline in membrane integrity and disruption of cell homeostasis. Dunlap and Binzel (1996) reported that increasing salinity concentrations can reduce the endogenous level of IAA in root. Also, they mentioned that the function of this hormone is impaired in salt stressed plants, and the alternation of IAA metabolism in the roots under salt stress may account for the reduction in growth potential via decreasing availability of water and increasing tissue water deficient. The results also reveal that, leaves, stems and roots fresh and dry-weights were gradually significantly decreased by increasing salinity level. Leaves, stems and root fresh weights were decreased by (8.60, 17.38 and 31.09%), (23.85, 31.15 and 41.74%) and (10.25, 23.58 and 36.71%), while leaves, stem and roots dry weight were decreased by (12.94, 25.66 and 44.36%) and (11.99, 28.74 and 46.07%) as a result of irrigation with waters having the concentrations of 2000, 4000 and 6000 mg L⁻¹ respectively in comparison with the tap water irrigated plant. The effect of salinity on fresh and dry weights might be attributed to the inhibitory effects induced by salinity on many metabolic processes inducing enzyme activities, protein and nucleic acid synthesis and the activities of the mitochondria and chloroplasts. Sharama (1995) and Ashraf and O'leary (1996) pointed out that CO₂ uptake was paralleled by a reduction in transpiration and stomatal conductance. The change in stomatal resistance under saline conditions may be responsible for reducing photosynthesis and water use efficiency.
Data in the same Tables (1-4) demonstrate clearly that using compost resulted an increase in plant height, number of leaves / plant, root length, stem diameter, leaf area and fresh & dry weight of all plant organs than control plants and other treatments. Compost through its content of humic substances improved soil physical, chemical and microbiological conditions, moisture content and reduced leaching of nutrients, water runoff and soil erosion (Amin et al., 1999). The previous characters gradually increased by increasing Nile compost rate. Nile compost encouraged all the plant growth parameters through the stimulation effect on the meristematic activity of tissues, where these organic manures are rich in N, P, K and other minerals which are required for propellant growth (Safia et al., 2001). As a result of these prospects, it may be concluded that compost improved the structure of sandy soil and consequently encouraged the plant to achieve good growth. Moreover, the slow released nutrients from compost permit the plants to get benefit of them, and thus improved plant growth. Similar results were obtained by Vendrame et al., (2005) on some ornamental plants and Atif et al., (2008) on Zinnia elegans.

The compost treatments under salinity levels could significantly increase all the previous by mentioned growth parameters, compared to that without compost. Results demonstrated clearly that using compost alone or in combination with salinity treatments, had a positive effect on the aforementioned growth characters. This might be related to improvement in physical conditions of the soil and the provided energy for microorganism activity and increase the availability and uptake of N, P, K which were positively reflected on the growth (Romero et al., 2000). Furthermore, Albassam (2001) reported that high nitrate in irrigation solution is necessary to decrease salt concentration and convert inactive reductase to active form.

The chemical constituents:
Photosynthetic Pigments: It is clear from Table (5) that, increasing the salt concentration of the irrigation water gradually decreased the content of photosynthetic pigments (chlorophyll a,b, a+b and carotenoids). These results are in agreement with those obtained by Batanouny et al., (1988) who mentioned that the lowered photosynthetic ability under salt stress condition was due to stomata closure, inhibition of chlorophyll synthesis, a decrease of carboxylase and due to high chlorophyllase activity. Data at the same Table (5) also showed that all photosynthetic pigments followed the same trend as the growth parameters. Generally, compost caused an increase in pigments content in leaves of Jatropha curcas as compared with the untreated one. The increase seemed more obvious by increasing rate of the applied compost. Organic fertilizer play a direct role in plant growth as they are sources of plant nutrients which being liberated in available forms during mineralization, moreover, they improve soil properties, increase soil content of such essential elements and promote water use efficiency by plants. Thus, it is quite expected to enhance photosynthesis. Concerning the effect of combination, seedlings treated with 200 g compost and irrigated with tap water produced the greatest pigment contents in fresh leaves. The increment effect of chlorophyll a, b, a+b and carotenoids by 117.5, 54.8, 86.5 and 48.1 % respectively, compared with seedlings treated with 0.0 g compost that was irrigated with 6000 mg L\(^{-1}\) which produced the lowest value.

Total carbohydrate percentage: The results of total carbohydrate percentage presented in Table (6) show that growing seedlings under salinity conditions led to a reduction total carbohydrate percentage in leaves and roots compared to control at both seasons. The lowest values (18.4 and 20.3 %) resulted from the highest level of salinity. These results agree with those obtained by Bernst in et al., (1972) who stated that, the obtained reduction in total carbohydrate percentage as salinity levels increased, might have relation to respiration processes since the free sugars were the main sugar pattern involved in the mechanism of respiration.

As for the effect of compost application on total carbohydrate percentage, it is clear from data that total carbohydrate percentage in the two growing seasons, were increased by using compost application, especially by using the higher rate of compost (200g). This may be attributed to the effect of compost as a source of essential nutrients besides improving the physical and chemical properties of the soil (Escalada and Ratilla, 1998).

Regarding the effect of interaction, compost application was also effective on total carbohydrate percentage of salinized water irrigated plant, where total carbohydrate percentage were greatly induced. These trends point out that compost treatments under non saline or saline conditions resulted in an increase in seedlings growth. This stimulatory effect was accompanied by the observed increases in total carbohydrate percentage.

Proline content: From the data given in Table (7) it can be concluded that irrigation with saline water at all levels increased proline content in the leaves and roots as compared with the unstressed plants. Following this, Ackerson (1984) argued that, cellular osmotic adjustment occurs in response to stress via an active or passive accumulation of solutes. It has been assumed that salt stress enhanced the production of proline, which causes osmotic adjustment (Al-Bahrany, 1994). With regard to the effect of compost application on proline contents, it is evident that a decrease attributed to the ability of applied compost supplying to the soil is used for the materials might surpass the need for the field to retain these materials on the field in order to build up the soil
fertility. The data of interaction effect among the two studied factors (salinity levels x compost rates) on proline content show that high proline values were found when using 6000 mg L\(^{-1}\) salinity with untreated compost treatment.

Nutrient percentages: Data of nitrogen, phosphorus, potassium and sodium percentage in the two successive seasons are presented in Tables (8-11). Increasing salinity of the irrigation water was associated with increasing concentrations of both N and P % in leaves, but on the other hand, increasing salinity of the irrigation water caused decreases in N and P % in roots of the grown beside of K % in both leaves and roots. In close agreement with these results were the findings reported Matthiola incana (Nahed et al., 2011). In this respect, the adverse effect of salinity on N concentration might be explained on the assumption that the excess Cl in saline water antagonized the uptake of nitrate by the affected plants (Talaat, 1995). On the other hand, Na percentage showed an opposite trend, it increased by increasing salinity concentrations. Additionally, the reduction in P content under saline conditions should be explained on the fact that Na salts raised the pH of the soil, which in turn reduced the availability of P to the plant (Sonneveld and Voogt, 1983). In this context, Gamea et al., (1996) found an increase in Na concentration and a decrease in K concentration in leaves and roots with salinity. These results may be due to a possible antagonism between K and Na. This antagonism could be due to the direct competition between K and Na at the site of ion uptake at plasmalemma (Epstein and Rains, 1987). Moreover, Na was also found to replace K in the activation of few enzymes which depend on a univalent action (Jeffrey, 1987). In this respect, Flowers et al., (1997) pointed out that osmotic adjustment is essential for a plant to survive in saline environments. The increase in Na concentration in plants with the salinity may be a result of the ability of plants to use Na to maintain an adequate osmotic potential gradient between the plant tissues and the external solution (Glenn, 1987).

### Table 1: Effect of Nile compost and different salinity levels of diluted sea water on plant height (cm), number of leaves/plant and root length (cm) of Jatropha curcas seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Plant height (cm)</th>
<th>Number of leaves/plant</th>
<th>Root length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L(^{-1})</td>
<td>0</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Tap water</td>
<td>98.7</td>
<td>132.7</td>
<td>151.1</td>
</tr>
<tr>
<td>2000</td>
<td>93.6</td>
<td>126.1</td>
<td>130.5</td>
</tr>
<tr>
<td>4000</td>
<td>90.1</td>
<td>120.3</td>
<td>125.6</td>
</tr>
<tr>
<td>6000</td>
<td>76.7</td>
<td>110.0</td>
<td>119.7</td>
</tr>
<tr>
<td>Mean</td>
<td>89.8</td>
<td>122.2</td>
<td>131.7</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>2.1</td>
<td>2.5</td>
<td>1.1</td>
</tr>
<tr>
<td>Salinity (A)</td>
<td>0.03</td>
<td>2.1</td>
<td>1.1</td>
</tr>
<tr>
<td>Compost (B)</td>
<td>0.01</td>
<td>1.3</td>
<td>0.01</td>
</tr>
<tr>
<td>(A)*(B)</td>
<td>0.05</td>
<td>3.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

### Table 2: Effect of Nile compost and different salinity levels of diluted sea water on stem diameter (cm) and leaf area (cm\(^2\)) of Jatropha curcas seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>stem diameter (cm)</th>
<th>leaf area (cm(^2))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L(^{-1})</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>3.37</td>
<td>4.15</td>
</tr>
<tr>
<td>2000</td>
<td>3.15</td>
<td>3.56</td>
</tr>
<tr>
<td>4000</td>
<td>3.00</td>
<td>3.41</td>
</tr>
<tr>
<td>6000</td>
<td>2.65</td>
<td>3.30</td>
</tr>
<tr>
<td>Mean</td>
<td>3.04</td>
<td>3.61</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>0.03</td>
<td>3.12</td>
</tr>
<tr>
<td>Salinity (A)</td>
<td>0.01</td>
<td>1.97</td>
</tr>
<tr>
<td>Compost (B)</td>
<td>0.05</td>
<td>4.03</td>
</tr>
<tr>
<td>(A)*(B)</td>
<td>0.05</td>
<td>4.03</td>
</tr>
</tbody>
</table>

Concerning the effect of Nile compost application on N, P and K concentrations, it is clear to from the results that, the percentages of N, P and K gradually increased by increasing compost rate. On the other hand, Jatropha curcas seedlings exhibited a decrease in the percentage of Na ions when treated with the two different rates of compost (100 or 200 g). This may be due to the ability of organic matter in rendering soil nutrients more available through chelation of these elements by humic substance. This helps to increase the respiration rate, the metabolism and the growth of the plant thus causing the plant required to more nutrients from soil and fertilizers (El-Sheekh and Hegazy, 1998). Furthermore, the combination between salinity levels and compost rates were almost of positive effects on the percentages of N, P and K. On the other hand, the interaction decreased Na % in leaves and roots compared with untreated plants and salinity treatments.
Generally, it may be concluded that the use of organic manure (compost) in combination with salinity are very important to improve growth and chemical constituents. Hence, it could be recommended to apply compost to plants grown in regions irrigated with saline water, to overcome destructive effect of salinity.

### Table 3: Effect of Nile compost and different salinity levels of diluted sea water on leaves, stems and roots fresh weight (g) of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Leaves fresh weight (g)</th>
<th>Stems fresh weight (g)</th>
<th>Roots fresh weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatments</strong></td>
<td>Test</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>Tap water</td>
<td>177.3</td>
<td>235.7</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>170.3</td>
<td>196.7</td>
</tr>
<tr>
<td></td>
<td>4000</td>
<td>161.9</td>
<td>183.7</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>143.5</td>
<td>167.3</td>
</tr>
<tr>
<td>Mean</td>
<td>163.3</td>
<td>195.9</td>
<td>233.6</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>Salinity (A)</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Compost (B)</td>
<td>2.1</td>
<td>2.4</td>
</tr>
<tr>
<td></td>
<td>(A)*(B)</td>
<td>5.2</td>
<td>5.9</td>
</tr>
</tbody>
</table>

### Table 4: Effect of Nile compost and different salinity levels of diluted sea water on leaves, stems and roots dry weight (g) of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Leaves dry weight (g)</th>
<th>Stems dry weight (g)</th>
<th>Roots dry weight (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatments</strong></td>
<td>Test</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>Tap water</td>
<td>39.18</td>
<td>58.80</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>36.95</td>
<td>45.24</td>
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<td></td>
<td>4000</td>
<td>33.99</td>
<td>41.51</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>29.70</td>
<td>35.80</td>
</tr>
<tr>
<td>Mean</td>
<td>34.96</td>
<td>45.34</td>
<td>56.65</td>
</tr>
<tr>
<td>LSD at 5%</td>
<td>Salinity (A)</td>
<td>2.31</td>
<td>2.03</td>
</tr>
<tr>
<td></td>
<td>Compost (B)</td>
<td>1.12</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>(A)*(B)</td>
<td>3.36</td>
<td>2.71</td>
</tr>
</tbody>
</table>

### Table 5: Effect of Nile compost and different salinity levels of diluted sea water on chlorophyll (a), chlorophyll (b), chlorophyll (a+b) and carotenoids (mg/g F.W) of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Chlorophyll (a) mg/g</th>
<th>Chlorophyll (b) mg/g</th>
<th>Chlorophyll (a+b) mg/g</th>
<th>Carotenoids mg/g</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Treatments</strong></td>
<td>Test</td>
<td>0</td>
<td>100</td>
<td>200</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>Tap water</td>
<td>0.813</td>
<td>0.871</td>
<td>0.981</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>0.711</td>
<td>0.835</td>
<td>0.917</td>
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<tr>
<td></td>
<td>4000</td>
<td>0.651</td>
<td>0.771</td>
<td>0.853</td>
</tr>
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<td></td>
<td>6000</td>
<td>0.451</td>
<td>0.631</td>
<td>0.685</td>
</tr>
<tr>
<td>Mean</td>
<td>0.657</td>
<td>0.777</td>
<td>0.859</td>
<td>0.560</td>
</tr>
</tbody>
</table>

### Table 6: Effect of Nile compost and different salinity levels of diluted sea water on total carbohydrate percentage in leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Carbohydrate % in leaves</th>
<th>Carbohydrate % in roots</th>
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</thead>
<tbody>
<tr>
<td><strong>Treatments</strong></td>
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</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>Tap water</td>
<td>21.7</td>
</tr>
<tr>
<td></td>
<td>2000</td>
<td>19.6</td>
</tr>
<tr>
<td></td>
<td>4000</td>
<td>18.0</td>
</tr>
<tr>
<td></td>
<td>6000</td>
<td>15.9</td>
</tr>
<tr>
<td>Mean</td>
<td>18.8</td>
<td>22.2</td>
</tr>
</tbody>
</table>

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Table 7: Effect of Nile compost and different salinity levels of diluted sea water on proline content (µmg⁻¹) on leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Proline (µmg⁻¹) in leaves</th>
<th>Proline (µmg⁻¹) in roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>6.71</td>
<td>5.02</td>
</tr>
<tr>
<td>2000</td>
<td>7.26</td>
<td>6.00</td>
</tr>
<tr>
<td>4000</td>
<td>8.51</td>
<td>7.11</td>
</tr>
<tr>
<td>6000</td>
<td>9.11</td>
<td>7.89</td>
</tr>
<tr>
<td>Mean</td>
<td>7.90</td>
<td>6.51</td>
</tr>
</tbody>
</table>

Table 8: Effect of Nile compost and different salinity levels of diluted sea water on nitrogen percentage in leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>N % in leaves</th>
<th>N % in roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>0.060</td>
<td>0.099</td>
</tr>
<tr>
<td>2000</td>
<td>0.090</td>
<td>0.112</td>
</tr>
<tr>
<td>4000</td>
<td>0.096</td>
<td>0.120</td>
</tr>
<tr>
<td>6000</td>
<td>0.106</td>
<td>0.123</td>
</tr>
<tr>
<td>Mean</td>
<td>0.088</td>
<td>0.113</td>
</tr>
</tbody>
</table>

Table 9: Effect of Nile compost and different salinity levels of diluted sea water on phosphorus percentage in leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>P % in leaves</th>
<th>P % in roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>0.015</td>
<td>0.016</td>
</tr>
<tr>
<td>2000</td>
<td>0.016</td>
<td>0.017</td>
</tr>
<tr>
<td>4000</td>
<td>0.017</td>
<td>0.019</td>
</tr>
<tr>
<td>6000</td>
<td>0.019</td>
<td>0.020</td>
</tr>
<tr>
<td>Mean</td>
<td>0.017</td>
<td>0.018</td>
</tr>
</tbody>
</table>

Table 10: Effect of Nile compost and different salinity levels of diluted sea water on potassium percentage in leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>K % in leaves</th>
<th>K % in roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>3.17</td>
<td>3.50</td>
</tr>
<tr>
<td>2000</td>
<td>3.00</td>
<td>3.20</td>
</tr>
<tr>
<td>4000</td>
<td>2.23</td>
<td>3.11</td>
</tr>
<tr>
<td>6000</td>
<td>2.17</td>
<td>2.80</td>
</tr>
<tr>
<td>Mean</td>
<td>2.64</td>
<td>3.15</td>
</tr>
</tbody>
</table>

Table 11: Effect of Nile compost and different salinity levels of diluted sea water on sodium percentage in leaves and roots of *Jatropha curcas* seedlings during 2009 and 2010 (mean of two seasons).

<table>
<thead>
<tr>
<th>Characters</th>
<th>Na % in leaves</th>
<th>Na % in roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatments</td>
<td>Compost (g)</td>
<td>Compost (g)</td>
</tr>
<tr>
<td>Salinity mg L⁻¹</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>Tap water</td>
<td>1.72</td>
<td>1.60</td>
</tr>
<tr>
<td>2000</td>
<td>1.76</td>
<td>1.65</td>
</tr>
<tr>
<td>4000</td>
<td>1.91</td>
<td>1.72</td>
</tr>
<tr>
<td>6000</td>
<td>1.96</td>
<td>1.81</td>
</tr>
<tr>
<td>Mean</td>
<td>1.84</td>
<td>1.70</td>
</tr>
</tbody>
</table>

REFERENCES


Juhasz, A.C.P., S. Pimenta, B. Soares, O. Soares, B.M. de Lourdes, D. Rabella and H. de Oliveira, 2009. Floral biology and artificial polinization in physic nut in the north of Minas Gerais state, Brazil (Biologia floral
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