SUMMARY

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In order to meet demands of the large population in the world and Egypt, irrigation with low quality water such as brackish water and sea water is one of the solutions particularly in the newly reclaimed soils to increase agricultural production. Therefore, this work was carried out to study the following: (1) effect of salinity of sea water dilutions used for irrigation on some soil chemical properties such as soil salinity (EC), soil reaction (pH), soluble cations and anions and sodium adsorption ratio (SAR), (2) availability of some nutrients (P, Mn and Zn) in soil as affected by salinity of sea water dilutions used for irrigation and (3) effect of salinity of sea water dilutions used for irrigation on dry matter yield, phosphorus, manganese and zinc concentration and uptake by barley plants.

To fulfill these purposes, surface soil sample (0–15 cm depth) was taken from Al-Ekhsas, El-Saff, Giza Governorate. This soil was loam, Entisol.

The experimental work involved an incubation experiment and a greenhouse one carried out at Soils, Water and Environment Research Institute (SWERI), ARC, Giza. In both experiments, soil was irrigated with waters of different salinity levels prepared by diluting the Mediterranean Sea water by tap water at different rates i.e., 95, 90, 80, 73 and 60 %.

Each experiment was a factorial one in a complete randomized design with three replicates.

In the incubation experiment, soil was watered with either of the prepared diluted waters and moisture content was

maintained at 70 % of the saturation percentage (SP) using the proper dilutions of the sea water. The incubation experiment extended to 42 days within which the soil was sampled after 1, 21 and 42 days of incubation. The whole experiment was repeated three times in the first P was added at a rate of 10 mg kg^{-1} soil, in the second, Zn was added at a rate of 5 mg kg^{-1} soil and in the third, Mn was added at the rate of 5 mg kg^{-1} soil. Also, the greenhouse experiment was conducted on pots packed with 2 kg portions of air-dried soil (sieved through a 2 mm sieve). Each pot was seeded with twenty grains of barley plants (Hordium vulgare, Giza 127), then thinned to 15 seedling per pot after 8 days from sowing. Irrigation treatments were conducted as mentioned above. The aerial parts of barley plants were cut 1-cm above the surface of the soil after 45 and 90 days from sowing and plant materials. Dry matter yields of shoots and seeds of barley plants were weighed. Subsamples of the dried shoots and seeds were met digested and used for determinations P, Mn and Zn.

The obtained results could be summarized in the following:

I. The incubation experiment:

1- Increasing salinity of irrigation water increased soil salinity, the increase was more obvious with increasing salinity of the applied water.

2- Using the above-mentioned dilutions of sea water for soil irrigation increased soluble anions and cations in the soil. The dominant anion was Cl^- followed by $SO_4^{=}$ and then HCO_3^-.

The dominant cation was Na^+ followed by Mg^{++} then Ca^{++} and finally K^+.

3- Addition of P (at the rate of 10 µg g^{-1}), Mn (at the rate of 5 µg g^{-1}) or Zn (at the rate of 5 µg g^{-1}) with the above-mentioned dilutions of sea water increased soluble cations and anions in the soil as compared with the corresponding values of the initial soil which did not receive P, Mn or Zn.

4- Increasing salinity of irrigation water increased sodium adsorption ratio (SAR) of the soil (to more than 13) i.e., converted the non-sodic soil to a sodic one.

5- Increasing salinity of water used for irrigation slightly decreased the soil pH values.

6- Irrigation with the more diluted sea waters i.e., those of 5 and 10 % of sea water strength increased average values of available P in absence as well as in presence of applied P. On the other hand, the irrigation with the less diluted sea water i.e., those of 20, 30 and 40 % of the sea water strength caused average values of P of all the incubation periods to decrease i.e., the higher the salinity of the irrigation water, the lower the P concentration. This occurred whether the irrigated soil received P or not.

7- Available Zn in the soil increased seeded to fluctuate very slightly upon irrigation with the saline waters. Addition of Zn at the rate of 5 µg g^{-1} appeared to result in higher values of available Zn at all levels of salinity of the irrigation water.

8- Increasing salinity of water irrigation increased available Mn, however, the dilution corresponding to 10 % of the sea water strength resulted in the highest value of available Mn.

Addition of Mn at the rate of 5 μg g^{-1} caused the increase in available Mn content more obvious.

II. The greenhouse experiment:

1- Dry matter yield after 45 and 90 days of sowing increased slightly in the soil irrigated by 5 % of sea water dilution treatment than the control (tap water treatment) indicating that low level of salinity (5.58 dS m^{-1} at 5 % of sea water dilution treatment) enhanced dry matter yield of barley plants. While, increasing irrigation water salinity to 10, 20, 30 and 40 % sea water dilutions significantly decreased it.

2- Addition of P at the rate of 10 μg g^{-1} or Zn at the rate of 5 μg g^{-1} with the same levels of sea water dilutions increased dry matter yield after 45 and 90 days at 5 % and 10 % of sea water dilutions. While, it significantly decreased at 20, 30 and 40 % of sea water dilutions. However, the values of dry matter yield obtained from addition of P were higher than those in the initial soil treatments.

3- Addition of Mn with increasing the salinity of irrigation water by sea water dilutions as mentioned above decreased dry matter yield of barley plants after 45 and 90 days of sowing. However, the results of dry matter yield were higher than those in the initial soil treatments due to the effect of Mn added.

4- Phosphorus concentration and uptake by plant shoots after 45 days of sowing significantly decreased due to irrigation with 5, 10, 20, 30 and 40 % of sea water dilutions compared with the control (tap water treatment).

5- Phosphorus concentration in barley shoots and seeds after 90 days of sowing significantly increased due to irrigation with 5, 10, 20 and 30 % of sea water dilutions, while it significantly decreased at 40 % of sea water dilution compared with the control (tap water treatment). While, P uptake by plants significantly increased at 5, 10 and 20 % of sea water dilutions, and it significantly decreased at 30 % and 40 % of sea water dilutions compared with the control (tap water) treatment. 5 % of sea water dilution treatment gave the highest value of P uptake by plants and 40 % of sea water dilution treatment gave the lowest one.

6- Addition of P with the above-mentioned dilutions of sea water treatments significantly increased P concentration and uptake by plants than those values of the initial soil treatments.

7- Manganese concentration and uptake by plant shoots after 45 days of sowing significantly increased due to irrigation with 5, 10, 20, 30 and 40 % of sea water dilutions compared with the control (tap water treatment).

8- Manganese concentration in barley shoots and seeds after 90 days of sowing significantly increased due to irrigation with 5, 10, 20 and 30 % of sea water dilutions. While, Mn uptake by shoots increased with increasing the strength of sea water up to 10 %. In case of seeds, Mn uptake significantly increased with increasing level of sea water strength with exception the irrigated with the dilution corresponding to 30 %.

9- Addition of Mn with the above-mentioned dilutions of sea water treatments significantly increased Mn concentration and uptake by plants than those values of the initial soil treatments.

10- Zinc concentration and uptake by plant shoots after 45 days of sowing significantly increased due to irrigation with 5, 10, 20, 30 and 40 % of sea water dilutions compared with the control (tap water treatment).

11- Zinc concentration in barley shoots and seeds after 90 days of sowing significantly increased due to irrigation with 5, 10, 20, 30 and 40 % of sea water dilutions. While, Zn uptake by plants significantly increased up to 20 % of sea water dilutions then, it significantly decreased at 30 and 40 % of sea water dilutions compared with the control (tap water) treatment.

12- Addition of Zn with the above-mentioned dilutions of sea water treatments significantly increased Zn concentration and uptake by plants than those values of the initial soil treatments.

From the above-mentioned results, it could be concluded that we can use sea water dilutions until 20 % + 80 % tap water with nutrients such as P, Mn and Zn for irrigation.