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5. SUMMARY

The current study was carried out on a field scale during two growth seasons (2007/2008 and 2008/2009) on the barley plants which were irrigated with the saline water and were grown in the newly reclaimed soils which are located in the West district of Maghagha, El-Minia Governorate, Egypt. This study aims to investigate the effects of the irrigation with the saline water on some soil chemical properties, the growth and yield parameters of barley, and the chemical composition of the barley plants under application of some salinity stress alleviated amendments (farmyard manure, potassium fertilization, and putrescine).

The experimental field was surface irrigated from a well water. The experimental design was factorial in a completely randomized block with four replicates. The experimental design consisted of three salinity stress alleviated amendments (farmyard manure, potassium fertilization, and putrescine).

The experimental design included three levels of the farmyard manure (0.0, 10, 20 ton farmyard manure/feddan), three levels of the potassium fertilization (0.0, 24, 48 kg K_2O/feddan), and two levels of the putrescine (0.0 and 10 µM); which were applied singly or in combination, making a total number of eighteen treatments of all.

The obtained results of the current study can be summarized under the following main seven subjects:

5.1. Evaluation of the irrigation water quality for the barley production

1- Regarding the salinity problem related with the irrigation water quality according to Ayers and Westcot (1994); the electrical conductivity (EC) value of the well water is > 3.0 dS m^{-1} which lies under the degree of restriction on use of "severe" in the two growth seasons, which indicates that this well water may cause a severe salinity problem in the soil.

2- Concerning the infiltration problem related with the irrigation water quality according to Ayers and Westcot (1994); the SAR value of the well water is in the range of 3.0-6.0 SAR and the EC value of the well water is > 5.0 dS m^{-1} which lies under the degree of restriction on use of "None" in the two growth seasons, implying that this well water may not cause an infiltration problem in the soil.

3- Considering the specific ion toxicity related with the irrigation water quality according to Ayers and Westcot (1994); the SAR value of the well water is in the range of 3.0-9.0 SAR (surface irrigation) which lies under the degree of restriction on use of "Slight to Moderate" in the two growth seasons, suggesting that this well water may cause an increasing sodium toxicity problem.

The chloride concentration in the well water is >10.0 meq/l (surface irrigation) which lies under the degree of restriction on use of "severe" in the two growth seasons, indicating that this well water may cause a severe chloride toxicity problem.

4- Regarding the miscellaneous effects related with the irrigation water quality according to Ayers and Westcot (1994); the bicarbonate concentration in the well water is > 8.5 meq/l (overhead sprinkling only) which lies under the degree of restriction on use of "Severe" in the two growth seasons, implying that this well water may cause a continual problem of white scale formation on the leaves or fruit when the sprinklers are used.

The pH value of the well water is in the normal range of 6.5 - 8.4 in the two growth seasons, suggesting that this well water will not cause a nutritional imbalance or may not contain a toxic ion.

5- Concerning the chemical criteria of the irrigation water according to Ayers and Westcot (1994); the Ca/Mg ratio in the well water is > 1.0 in the two growth seasons, indicating that this well water may not cause a calcium

deficiency problem and a soil infiltration problem.

5.2. Changes in some soil chemical properties as affected by the irrigation with the saline water under application of some salinity stress alleviated amendments

5.2.1. Salinity buildup in the soil at the barley harvest

1- The electrical conductivity value of the soil at the barley harvest was increased under the irrigation with the saline water in the two growth seasons.

2- The electrical conductivity value of the soil at the barley harvest was significantly increased (p = 0.05) by increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/ feddan and the foliar application with the putrescine at the level of 10 µM putrescine did not show any significant effect (p = 0.05) on the electrical conductivity value of the soil at the barley harvest under the irrigation with the saline water in the two growth seasons.

5.2.2. Soil pH at the barley harvest

1- The soil pH value at the barley harvest was slightly decreased under the irrigation with the saline water in the two growth seasons.

2- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan significantly decreased the soil pH value at the barley harvest (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/ feddan and the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect (p = 0.05) on the soil pH value at the

barley harvest under the irrigation with the saline water in the two growth seasons.

5.2.3. Soil organic matter content at the barley harvest

1- There was a slight change in the soil organic matter content at the barley harvest under the irrigation with the saline water in the two growth seasons.
2- The soil organic matter content at the barley harvest was significantly slightly increased (p = 0.05) as the farmyard manure level was increased from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.
3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/ feddan and the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect (p = 0.05) on the soil organic matter content at the barley harvest under the irrigation with the saline water in the two growth seasons.

5.2.4. Nutrients concentration in the soil at the barley harvest

1- The available nitrogen and available phosphorus concentration in the soil at the barley harvest was decreased under the irrigation with the saline water in the two growth seasons.
2- There was an increase in the available potassium concentration in the soil at the barley harvest under the irrigation with the saline water in the two growth seasons.
3- The available nitrogen, available phosphorus, and available potassium concentration in the soil at the barley harvest was significantly increased (p = 0.05) as a result of increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

4- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan had no significant effect (p = 0.05) on the available nitrogen and available phosphorus concentration in the soil at the barley harvest under the irrigation with the saline water in the two growth seasons.
5- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the available potassium concentration in the soil at the barley harvest (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.
6- The foliar application with the putrescine at the level of **10** µM putrescine had no significant effect (p = 0.05) on the available nitrogen, available phosphorus, and available potassium concentration in the soil at the barley harvest under the irrigation with the saline water in the two growth seasons.

5.2.5. Accumulation of sodium and chloride in the soil at the barley harvest

1- The soluble sodium and soluble chloride concentration in the soil at the barley harvest was increased under the irrigation with the saline water in the two growth seasons.
2- The soluble sodium and soluble chloride concentration in the soil at the barley harvest was significantly increased (p = 0.05) as a result of increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.
3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan and the foliar application with the putrescine at the level of **10** µM putrescine had no significant effect (p = 0.05) on the soluble sodium and soluble chloride concentration in the soil at the barley harvest under the irrigation with the saline water in the two growth seasons.

5.3. Alleviation of the salinity stress on the barley growth using some salinity stress alleviated amendments

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan increased the plant height of barley at the heading stage as well as significantly increased the fresh and dry weight of the barley shoots at the heading stage ($p = 0.05$) compared to those of the control treatment under the irrigation with the saline water in the two growth seasons. Consequently, application of the farmyard manure to the soil alleviated the adverse effects of the irrigation with the saline water on the plant height of barley as well as fresh and dry weight of the barley shoots at the heading stage.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan slightly increased the plant height of barley as well as fresh and dry weight of the barley shoots at the heading stage compared to those of the control treatment under the irrigation with the saline water in the two growth seasons.

3- The foliar application with the putrescine at the level of 10 µM putrescine slightly increased the plant height of barley as well as fresh and dry weight of the barley shoots at the heading stage compared to those of the control treatment under the irrigation with the saline water in the two growth seasons. Thus, application of the potassium fertilization to the soil and the foliar application with the putrescine on the barley plants alleviated the drastic effects of the irrigation with the saline water on the plant height of barley as well as fresh and dry weight of the barley shoots at the heading stage.

5.4. Alleviation of the salinity stress on the barley yield and yield components using some salinity stress alleviated amendments

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan significantly increased the number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield (p = 0.05) compared to those of the control treatment under the irrigation with the saline water in the two growth seasons. Therefore, application of the farmyard manure to the soil alleviated the adverse effects of the irrigation with the saline water on the number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan slightly increased the number of barley spikes/m^2 and number of barley grains/spike as well as significantly increased the grain and straw yield of barley (p = 0.05) compared to those of the control treatment under the irrigation with the saline water in the two growth seasons. Consequently, application of the potassium fertilization to the soil alleviated the negative effects of the irrigation with the saline water on the number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield.

3- The foliar application with the putrescine at the level of 10 µM putrescine slightly increased the number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield compared to those of the control treatment under the irrigation with the saline water in the two growth seasons. Thus, the foliar application with the putrescine on the barley plants alleviated the drastic effects of the irrigation with the saline water on the number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield.

4- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect (p = 0.05) on the weight of 1000 barley grains under the irrigation with the saline water in the two growth seasons. Therefore, application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine solution on the barley plants did not alleviate the adverse effects of the irrigation with the saline water on the weight of 1000 barley grains.

5- The highest value of the barley grain yield (14.60 ardab/feddan) and the highest value of the barley straw yield (2.05 ton/feddan) were obtained when the barley plants were treated with 20 ton FYM/feddan and 48 kg K_2O/feddan as well as untreated with the putrescine under the irrigation with the saline water in the first growth season. In the second growth season, the highest value of the barley grain yield (15.63 ardab/feddan) and the highest value of the barley straw yield (2.18 ton/feddan) were obtained when the barley plants were treated with 20 ton FYM/feddan, 48 kg K_2O/feddan, and 10 µM putrescine under the irrigation with the saline water. Whereas, the lowest values of the barley grain yield (6.00 and 7.75 ardab/feddan) and the lowest values of the barley straw yield (0.84 and 1.05 ton/feddan) were obtained when the barley plants were untreated with the farmyard manure, potassium fertilization, and putrescine under the irrigation with the saline water in the first and second growth seasons, respectively.

5.5. Alleviation of the salinity stress on the nutrients concentration in the barley plants using some salinity stress alleviated amendments

5.5.1. Nutrients concentration in the barley plants at the heading stage

1- The nitrogen, phosphorus, and potassium concentration in the barley plants at the heading stage was significantly increased (p = 0.05) as a result of increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Consequently, application of the farmyard manure to the soil alleviated the impact effects of the irrigation with the saline water on the nitrogen, phosphorus, and potassium concentration in the barley plants at the heading stage.
2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan did not show any significant effect (p = 0.05) on the nitrogen and phosphorus concentration in the barley plants at the heading stage under the irrigation with the saline water in the two growth seasons. Thus, application of the potassium fertilization to the soil did not alleviate the harmful effects of the irrigation with the saline water on the nitrogen and phosphorus concentration in the barley plants at the heading stage.
3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the potassium concentration in the barley plants at the heading stage (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Therefore, application of the potassium fertilization to the soil alleviated the adverse effects of the irrigation with the saline water on the potassium concentration in the barley plants at the heading stage.
4- The foliar application with the putrescine at the level of **10** µM putrescine did not give any significant effect (p = 0.05) on the nitrogen, phosphorus, and potassium concentration in the barley plants at the heading stage under the irrigation with the saline water in the two growth seasons. Thus, the foliar application with the putrescine on the barley plants did not alleviate the negative effects of the irrigation with the saline water on the nitrogen,

phosphorus, and potassium concentration in the barley plants at the heading stage.

5.5.2. Nutrients concentration in the grains and straw of barley at the harvest

1- The nitrogen, phosphorus, and potassium concentration in the grains and straw of barley was significantly increased (p = 0.05) as the farmyard manure level was increased from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Consequently, application of the farmyard manure to the soil alleviated the drastic effects of the irrigation with saline water on the nitrogen, phosphorus, and potassium concentration in the grains and straw of barley.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan had no significant effect (p = 0.05) on the nitrogen and phosphorus concentration in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. Therefore, application of the potassium fertilization to the soil did not alleviate the adverse effects of the irrigation with the saline water on the nitrogen and phosphorus concentration in the grains and straw of barley.

3- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the potassium concentration in the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Thus, application of the potassium fertilization to the soil alleviated the impact effects of the irrigation with the saline water on the potassium concentration in the grains and straw of barley.

4- The foliar application with the putrescine at the level of 10 µM putrescine did not show any significant effect (p = 0.05) on the nitrogen, phosphorus,

and potassium concentration in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. Consequently, the foliar application with the putrescine on the barley plants did not alleviate the drastic effects of the irrigation with the saline water on the nitrogen, phosphorus, and potassium concentration in the grains and straw of barley.

5.6. Alleviation of the salinity stress on the nutrients uptake by the grains and straw of barley at the harvest using some salinity stress alleviated amendments

1- The nitrogen, phosphorus, and potassium uptake by the grains and straw of barley was significantly increased (p = 0.05) as a result of increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the nitrogen, phosphorus, and potassium uptake by the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

3- The foliar application with the putrescine at the level of 10 µM putrescine significantly increased the nitrogen, phosphorus, and potassium uptake by the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Therefore, application of the farmyard manure and potassium fertilization to the soilas well as the foliar application with the putrescine on the barley plants alleviated the negative effects of the irrigation with the saline water on the nitrogen, phosphorus, and potassium uptake by the grains and straw of barley.

5.7. Accumulation of sodium and chloride in the barley plants

5.7.1. Sodium and chloride concentration in the barley plants at the heading stage

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect (p = 0.05) on the sodium and chloride concentration in the barley plants at the heading stage under the irrigation with the saline water in the two growth seasons. Thus, application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants did not alleviate the negative effects of the irrigation with the saline water on the sodium and chloride concentration in the barley plants at the heading stage.

2- The sodium was accumulated in the barley plants at the heading stage; however, the chloride was not accumulated in the barley plants at the heading stage under the irrigation with the saline water in the two growth seasons.

5.7.2. Sodium and chloride concentration in the grains and straw of barley at the harvest

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine did not give any significant effect (p = 0.05) on the sodium and chloride concentration in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. Consequently, application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants did not alleviate the adverse effects of the irrigation

with the saline water on the sodium and chloride concentration in the grains and straw of barley.

2- The sodium was accumulated in the grains and straw of barley, while, the chloride was not accumulated in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. The sodium concentration in the barley straw was higher than the sodium concentration in the barley grains in the two growth seasons. Therefore, the accumulation of sodium in the barley straw was more than the accumulation of sodium in the barley grains. In this respect, the accumulation of sodium in the barley grains may cause detrimental effects on the human health, whereas, the accumulation of sodium in the barley straw may have harmful effects on the animal health.

5.7.3. Sodium and chloride uptake by the grains and straw of barley at the harvest

1- The sodium and chloride uptake by the grains and straw of barley was significantly increased (p = 0.05) as the farmyard manure level was increased from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the sodium and chloride uptake by the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

3- The foliar application with the putrescine at the level of **10** µM putrescine significantly increased the sodium and chloride uptake by the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Thus,

application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants did not alleviate the adverse effects of the irrigation with the saline water.

4- The sodium and chloride uptake by the barley straw was higher than the sodium and chloride uptake by the barley grains in the two growth seasons.

5.7.4. K^+/Na^+ and Na^+/Cl^- ratio in the grains and straw of barley at the harvest

5.7.4.1. K^+/Na^+ ratio in the grains and straw of barley at the harvest

1- The K^+/Na^+ ratio in the grains and straw of barley was significantly increased (p = 0.05) as a result of increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan compared to that of the control treatment under the irrigation with the saline water in the two growth seasons.

2- Increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan significantly increased the K^+/Na^+ ratio in the grains and straw of barley (p = 0.05) compared to that of the control treatment under the irrigation with the saline water in the two growth seasons. Consequently, application of the farmyard manure and potassium fertilization to the soil alleviated the negative effects of the irrigation with the saline water on the K^+/Na^+ ratio in the grains and straw of barley.

3- The foliar application with the putrescine at the level of 10 µM putrescine did not show any significant effect (p = 0.05) on the K^+/Na^+ ratio in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. Therefore, the foliar application with the putrescine on the barley plants did not alleviate the impact effects of the irrigation with the saline water on the K^+/Na^+ ratio in the grains and straw of barley.

4- Generally, application of the farmyard manure and potassium fertilization to the soil improved the K^+/Na^+ ratio in the grains and straw of barley and alleviated the negative effects of sodium on the nutritional balance in the barley plants under the irrigation with the saline water. However, the foliar application with the putrescine on the barley plants did not improve the K^+/Na^+ ratio in the grains and straw of barley and did not alleviate the drastic effects of sodium on the nutritional balance in the barley plants under the irrigation with the saline water.

5.7.4.2. Na^+/Cl^- ratio in in the grains and straw of barley at the harvest

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect ($p = 0.05$) on the Na^+/Cl^- ratio in the grains and straw of barley under the irrigation with the saline water in the two growth seasons. Thus, application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants did not alleviate the drastic effects of the irrigation with saline water on the Na^+/Cl^- ratio in the grains and straw of barley.

2- Finally, the Na^+/Cl^- ratio in the barley straw was higher than the Na^+/Cl^- ratio in the barley grains in the two growth seasons, suggesting that the high Na^+/Cl^- ratio in the barley straw helps the barley plants to tolerate the salinity stress.

6. CONCLUSIONS

From the obtained results of the current study, the following conclusions could be drawn:

1- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine increased the plant height of barley at the heading stage, fresh and dry weight of the barley shoots at the heading stage, number of barley spikes/m^2, number of barley grains/spike, barley grain yield, and barley straw yield, nitrogen uptake by the grains and straw of barley, phosphorus uptake by the grains and straw of barley, and potassium uptake by the grains and straw of barley; however; they had no significant effect (p = 0.05) on the weight of 1000 barley grains under the irrigation with the saline water. Therefore, application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants improved the growth, yield, yield components of barley, and nutrients uptake by the grains and straw of barley under the irrigation with the saline water.

2- The highest value of the barley grain yield (14.60 ardab/feddan) and the highest value of the barley straw yield (2.05 ton/feddan) were obtained when the barley plants were treated with 20 ton FYM/feddan and 48 kg K_2O/feddan as well as untreated with the putrescine under the irrigation with the saline water in the first growth season. In the second growth season, the highest value of the barley grain yield (15.63 ardab/feddan) and the highest value of the barley straw yield (2.18 ton/feddan) were obtained when the barley plants were treated with 20 ton FYM/feddan, 48 kg K_2O/feddan, and 10 µM putrescine under the irrigation with the saline water.

3- The sodium was accumulated in the grains and straw of barley, while, the chloride was not accumulated in the grains and straw of barley under the irrigation with the saline water. The sodium concentration in the barley straw was higher than the sodium concentration in the barley grains. Thus, the accumulation of sodium in the barley straw was more than the accumulation of sodium in the barley grains. In this respect, the accumulation of sodium in the barley grains may cause detrimental effects on the human health, whereas, the accumulation of sodium in the barley straw may have harmful effects on the animal health.

4- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan, increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan, and the foliar application with the putrescine at the level of 10 µM putrescine increased the sodium and chloride uptake by the grains and straw of barley under the irrigation with the saline water. Consequently; application of the farmyard manure and potassium fertilization to the soil as well as the foliar application with the putrescine on the barley plants did not alleviate the adverse effects of the irrigation with the saline water.

5- Increasing the farmyard manure level from 0.0 up to 20 ton FYM/feddan and increasing the potassium fertilization level from 0.0 up to 48 kg K_2O/feddan increased the K^+/Na^+ ratio in the grains and straw of barley, however, the foliar application with the putrescine at the level of 10 µM putrescine had no significant effect (p = 0.05) on the K^+/Na^+ ratio in the grains and straw of barley under the irrigation with the saline water. Thus, application of the farmyard manure and the potassium fertilization to the soil improved the K^+/Na^+ ratio in the grains and straw of barley and alleviated the negative effects of sodium on the nutritional balance in the barley plants under the irrigation with the saline water. Whereas, the foliar

application with the putrescine on the barley plants did not improve the K^+/Na^+ ratio in the grains and straw of barley and did not alleviate the drastic effects of sodium on the nutritional balance in the barley plants under irrigation with the saline water.

6- Finally, the Na^+/Cl^- ratio in the barley straw was higher than the Na^+/Cl^- ratio in the barley grains, suggesting that the high Na^+/Cl^- ratio in the barley straw helps the barley plants to tolerate the salinity stress.

7. RECOMMENDATION

From the previous conclusions of the current study, the following recommenditions could be drawn:

It is recommended to apply 20 ton farmyard manure/feddan to the soil, 48 kg K_2O (as potassium sulphate 48% K_2O)/feddan to the soil, and 10 µM putrescine as a foliar application when barley is to be irrigated with the saline water (the electrical conductivity of the used well water ranged between 7.08 and 7.53 dS m^{-1}) and cultivated in the newly reclaimed soils under the conditions of El-Minia Governorate, Egypt.

Application of the above salinity stress alleviated amendements (farmyard manure, potassium fertilization, and putrescine) with their recommended levels will help the barley plants to tolerate the salinity stress and will improve the barley yield in the newly reclaimed soils under the conditions of El-Mina Governorate, Egypt.