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Effect of sheep manure compost, sulfur and irrigation water quality on soil electrical conductivity (EC, ds/m) of maize plant

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Abstract:
The main objective of the present study was undertaken to investigate the effect of of sheep manure compost, sulfur and irrigation water quality on soil electrical conductivity (EC, ds/m) of maize plant. The study was carried out in a pot experiment at A farm in the Al-Fatih area, north of the City of Derna. The soil sample used in this study was a calcareous soil (typiccalciorthids), sheep manure compost was applied at a rate of 0, 3, 6, 9 and 12% by weight to the soil. Sulfur was applied to the soil at a rate of 0, 1, 2, 3 and 4% by weight. Two types of water were Tap water and drainage water. The tested plant was Maize (Zeya, L.) and it was cultivated for 60days from sowing. The irrigation with drainage water has a significant effect on increasing soil electrical conductivity (EC). The electrical conductivity (EC), increased significantly with increasing the rate application of sheep manure compost and sulfur while the pH was decrease.

Keywords: composted manure, wastewater, pollution.

أثر إضافة كمبوست روث الأغنام والكبريت وجودة مياه الري على التوصيل الكهربائي للتربة المزروعة بالذرة (EC، ديسيمين/متر)

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الملخص
يهدف هذا البحث إلى دراسة تأثير إضافة كمبوست روث الأغنام، والكبريت، وجودة مياه الري على قيم التوصيل الكهربائي للتربة(EC) ، ديسيمين/ متر (المزروعة بمحصول الذرة. وقد نُفِّذَت التجربة في أصص داخل أحد المزارع الواقعة بمنطقة الفاتح شمال مدينة درنة. استُخدم في التجربة تربة كلسية من نوع *(Typic Calciorthids)*، وتمت إضافة كمبوست روث الأغنام للتربة بنسب 0، 3، 6، 9 و12% من الوزن. كما أُضيف الكبريت بنسب 0، 1، 2، 3 و4% من الوزن. واعتمدت الدراسة نوعين من مياه الري: مياه الصنبور ومياه الصرف. زُرع محصول الذرة من النوع *(Zea mays L.)* لمدة 60 يوماً من تاريخ الزراعة.
أظهرت النتائج أن الري بمياه الصرف أدى إلى زيادة معنوية في قيم التوصيل الكهربائي للتربة. كما بينت أن ارتفاع معدلات إضافة الكمبوست والكبريت أدى إلى زيادة واضحة في قيم EC ، في حين سجلت قيم الحموضة (pH) انخفاضاً مع زيادة هذه الإضافات.

الكلمات المفتاحية: كمبوست الروث، مياه الصرف، التلوث.

Introduction

Soil salinity is one of the most critical environmental constraints affecting agricultural productivity in arid and semi-arid regions. In countries such as Libya, where water scarcity, high evapotranspiration, and limited rainfall dominate the climatic conditions, soils are often characterized by poor structure, low organic matter, and high concentrations of soluble salts. These factors collectively reduce soil fertility, decrease nutrient availability, and severely limit crop productivity. As a result, understanding the dynamics of soil electrical conductivity (EC)—a key indicator of salinity and soil chemical status—has become essential for guiding sustainable agricultural practices under such challenging environmental conditions.

Electrical conductivity reflects the total concentration of soluble salts in the soil solution and is widely used to evaluate soil texture, fertility, and suitability for crop production. High EC levels often indicate excessive salinity, which can restrict plant water uptake, disrupt nutrient absorption, and impair physiological functions. In arid soils, where natural salt accumulation is common, agricultural practices such as irrigation, fertilization, and organic amendments can further influence soil salinity. Irrigation water quality, in particular, plays a critical role; water with high salt content can significantly intensify salinity stress, especially in poorly drained soils. Thus, identifying appropriate soil amendments that can improve soil properties while minimizing salinity risks is vital for sustaining crop growth.

Organic amendments, such as composted manure, have long been used to enhance soil fertility, improve water retention, and support microbial activity. Sheep manure compost is increasingly considered a valuable resource in arid regions due to its availability and its capacity to supply nutrients and organic matter. However, composts frequently contain appreciable amounts of soluble salts, contributing to increased soil EC when applied at high rates. Similarly, elemental sulfur is commonly used to ameliorate calcareous soils by lowering soil pH and enhancing nutrient availability. Nevertheless, sulfur oxidation also contributes sulfate ions to the soil solution, which may elevate EC levels, especially under continuous irrigation.

Given these interactions, it becomes necessary to investigate how compost, sulfur, and irrigation water quality collectively influence soil salinity and associated soil chemical properties. Maize (Zea mays L.), a moderately salinity-sensitive crop widely grown for food and feed, provides an appropriate biological indicator for understanding these effects. Its response to salinity is rapid and measurable, making it suitable for controlled experimental evaluation.

This study was conducted to assess the combined and individual effects of sheep manure compost, elemental sulfur, and irrigation water quality (tap water vs. drainage water) on soil electrical conductivity in a calcareous soil typical of eastern Libya. Understanding these interactions is crucial for developing soil management strategies that promote nutrient availability while preventing excessive salt accumulation. As agricultural lands in dry regions continue to face increasing pressures from environmental degradation and water scarcity, identifying sustainable soil amendment approaches becomes indispensable for supporting crop productivity and environmental health. Therefore, the findings of this study contribute to improved land management practices and provide valuable insights for farmers, researchers, and environmental planners working in arid and semi-arid ecosystems.

Litterateur Review

Additionally, sandy textures, poor soil structure, and low water-holding capacity are common characteristics of arid soils (Garcia, C. 2017). Traditionally used to increase the fertility of sandy soils in arid regions, farmyard manure is becoming more expensive and scarce. Due of its scarcity, the acceptability and medium-term performance of other inexpensive, widely accessible alternatives must be assessed on a field size. After two successive harvests, a field trial was set up to examine the effects of a single application of three organic residues on barley yield, nutrient uptake, and specific soil attributes. At rates of 0, 20, 40, and 60 t ha^{-1}, tests were conducted on municipal solid waste compost (MSWC), sewage sludge compost (SSC), and farmyard manure (FYM). When all three organic amendments were added, the soil's organic matter, cation exchange capacity, accessible P, Ca, Mg, and K, grain production (up to 51%), and nutritional levels of the barley plants all rose. In 2021, Houda Oueriemmi et al. As a result, these arid regions are unsuitable for the growth and development of plants.

Because organic materials include a lot of nutrients and other salts, their extracts may have a high electrical conductivity. The effects of top dressing compost dairy manure on soil chemical characteristics of Kentucky bluegrass were evaluated by Johnson, G.A. et al. (2006) and Kutuk et al. (2002). They discovered that compost applications at a quantity of 66 m^3. ha^{-1} or higher increased soil electrical conductivity (EC). According to Sabrah et al. (1993), the E.C. values rose when various organic materials, such as compost, were added to the soil at varying rates. According to Wong et al. (1999), adding manure compost considerably raised the salinity of the soil. They discovered that the soil that received 75 tonnes of compost per hectare had the highest E.C. value (2.51 dSm^{-1}). However, the application of cotton stalks or rice straw composts after wheat and corn harvesting resulted in a modest drop in the E.C. values of the cultivated sandy soil. On the other hand, soil treated with rice straw compost had higher E.C. values than soil treated with cotton stalks (El–Sharawy et al., 2003).

For many areas, especially Asian nations where salty soils are common, maize is one of the economically viable crops. Despite being a member of the moderately sensitive crop group, maize reacts to salinity more quickly than wheat and cotton (Kotuby-Amacher et al., 2000).
Therefore, the primary goal of this study was to determine how soil electrical conductivity (EC,ds/m) of maize plants is affected by compost made from sheep dung, sulphur, and irrigation water quality.
The water crisis is regarded as one of the primary obstacles to sustainable agriculture in the majority of arid and semiarid parts of the world, including Libya.
The amount of salts in soil (salinity of soil) is measured by soil electrical conductivity (EC). It is a great indicator of soil texture, accessible water capacity, and nutrient availability and loss. Crop yields, the soil's suitability for particular crops, the quantity of water and nutrients available for plant use, and the activity of soil microorganisms—which affects important soil processes like the release of greenhouse gases like carbon dioxide, nitrogen oxides, and methane—are all impacted. By altering the soil and water balance, too much salt prevents plants from growing. In dry and semiarid regions, excessively salted soils are a natural occurrence. Cropping, irrigation, and land management can all lead to a rise in salt levels. EC has been linked to quantities of nitrates, potassium, sodium, chloride, sulphate, and ammonia, while not being able to quantify particular ions or salt compounds directly. Determining EC can be a simple and affordable method of estimating the amount of nitrogen (N) available for plant usage in some non-saline soils. Because smaller clay particles carry more electrical current than larger silt and sand particles, soil EC can also be a useful method of determining the surface layer's texture (Adviento-Borbe et al., 2006).

MATERIALS AND METHODS

The pot experiment was carried out under greenhouse conditions to study the effect of water quality in relation to organic compost and Sulfur application as soil amendments on soil chemical properties, plant growth and some chemical properties of the irrigation waters are shown in Table (1)

Table (1): **Chemical properties of the irrigation waters**

Characteristics	Tap water	Drainage water
EC(ds/m)	**0.42**	**3.40**

Two soil amendments were used in the experiment; the sheep manure compost and Sulfur. Sheep manure compost was taken from one of the sheep farms in the Al- Wasita area in Al-Jabal Al-Akhdar. Total soluble salts: Electrical conductivity (EC) of soil: water extract, 1:2 (w/v) was measured using conduct meter according to Jackson (1973). The main chemical characteristics of the compost are presented in Table (2).

Table (2): **The main chemical characteristics of the compost are presented**

compost properties	Values
EC(1:5) ds/m	**5.4**

Collected datawere statistically examined using means comparison and ANOVA to meet Steel and Torrie's criteria for significance (1982). The Draper and Smith (1981) approach was used to fit the data using correlation coefficients and single linear regressions. Soil Analysis: The following techniques were used to analyse soil samples: Particle-size distribution: Black (1965) states that the hydrometer method was used for mechanical examination.

Research Area

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RESULTS AND DISCUSSION

The experimental soil collected is characterized by a highly calcareous soil .The electrical conductivity (EC) of soil water extract (1:1) presented in Table (1) was converted to EC measured on the saturation extract (ECe) using the following approximate and tentative relationship which are approximate provide the samples do not contain significant amounts of gypsum: ECe = 2.2 x EC) The obtained ECe value was 5.06 dS/m. from the above mentioned results, such soil is considered as slightly saline soil. (United States Salinity Laboratory Staff, 1954) Nitrogen content is very low in such soil. For this reason, the nitrogen is probably the first limiting factor for crop production under such condition. Also, the organic matter content is very low (0.44%) and the addition of organic materials to this soil will improve its properties and fertility.

Table (3) summarize some criteria for evaluating water quality. According to these criteria - The tap water is low salinity and low sodium water. This type of water can be used for irrigation with most crops on most soils, with little salinity problem

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Table (3): **Classification of irrigation water salinity**

Salinity class	EC range (ds/m)	TDS (ppm)	Cl (ppm)
Low salinity water	<0.250	<200	<60
Medium salinity water	0.250-0.750	200-500	60-200
Higher salinity water	0.750-2.250	500-1500	200-600
Very higher salinity	>2.250	>1500	>600

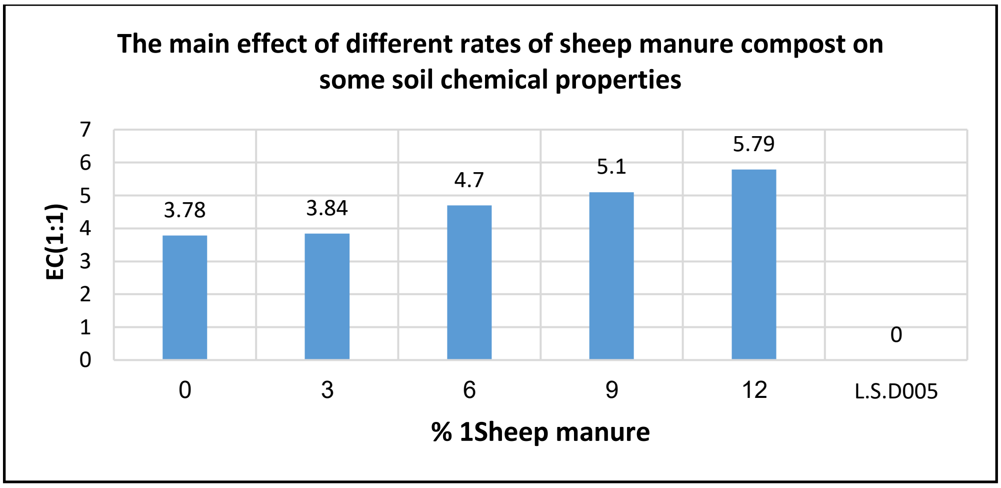
TDS = total dissolved solids.

Data presented in Table (4) show the main effect of different rates of sheep manure compost on some soil chemical properties. The results indicate that soil electrical conductivity (EC).

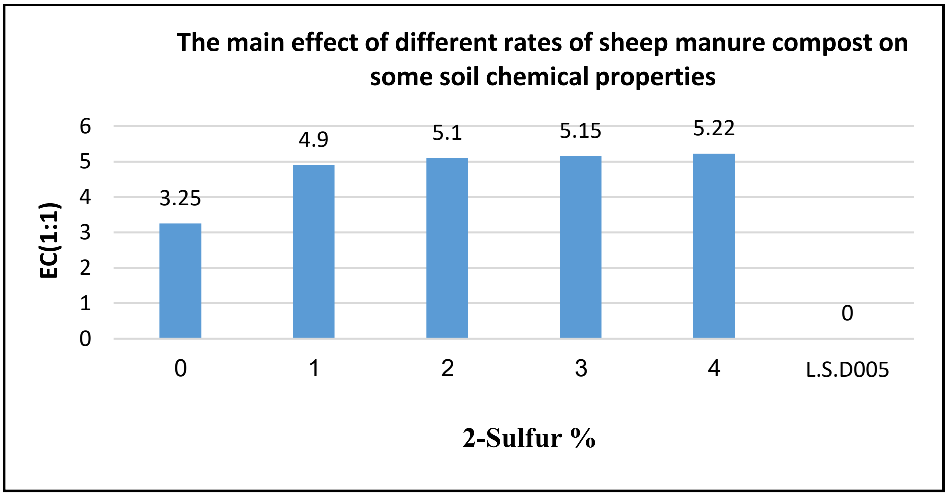
Table (4): **The main effect of different rates of sheep manure compost on some soil chemical properties**

Treatment	**EC(1:1)**
1-Sheep manure %	
0	3.78
3	3.84
6	4.7
9	5.1
12	5.79
L.S.D005	**0.10*** **
2-Sulfur %	
0	3.25
1	4.90
2	5.10
3	5.15
4	5.22
L.S.D005	**0.14*** **
3-Water quality	
Tap	4.08
Drainage	5.36
L.S.D005	**0.11*** **

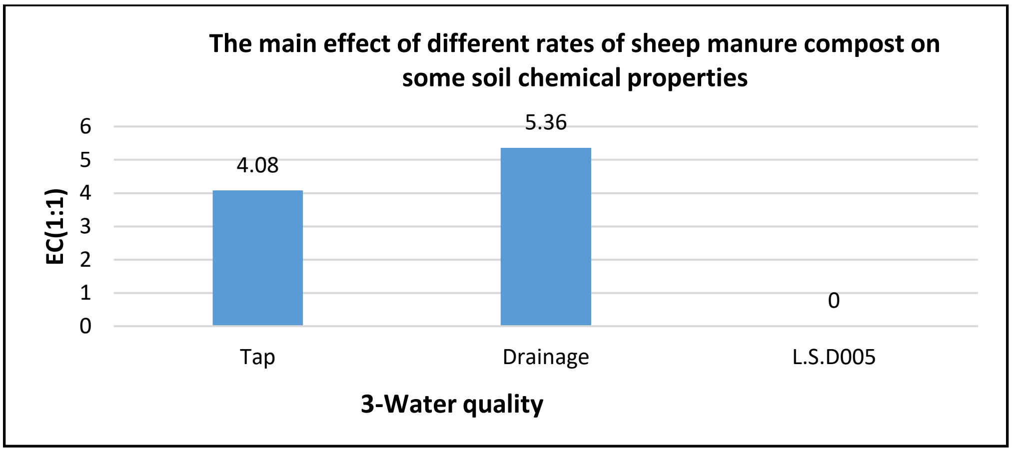
The effect of sulfur on some chemical properties of soil are presented in table (5). the result show that EC soluble cations significantly increased with sulfur application to soil. The data present in Table (6). Show the effect of irrigation water quality on the soil chemical properties. The results indicate that the irrigation with drainage water has a significant effect on increasing soil electrical conductivity (EC), then with the tap water. This is may be due to the high salt content of the drainage water and salt accumulation in soil.



The two-way interaction effects of sheep manure compost by sulfur on EC were highly significant. This interaction can be considered as an effect of increasing the compost at a constant rate of sulfur, as an effect of increasing the sulfur rate at a constant rate of the compost or both over the types of irrigation waters.
Most of the study factor combinations increased all of the studied soil properties. Also, the interaction effects between sheep manure compost and water quality on the tested soil properties were significantly positive EC and Ca differences associated with the interaction of sulfur by irrigation water quality were significant.



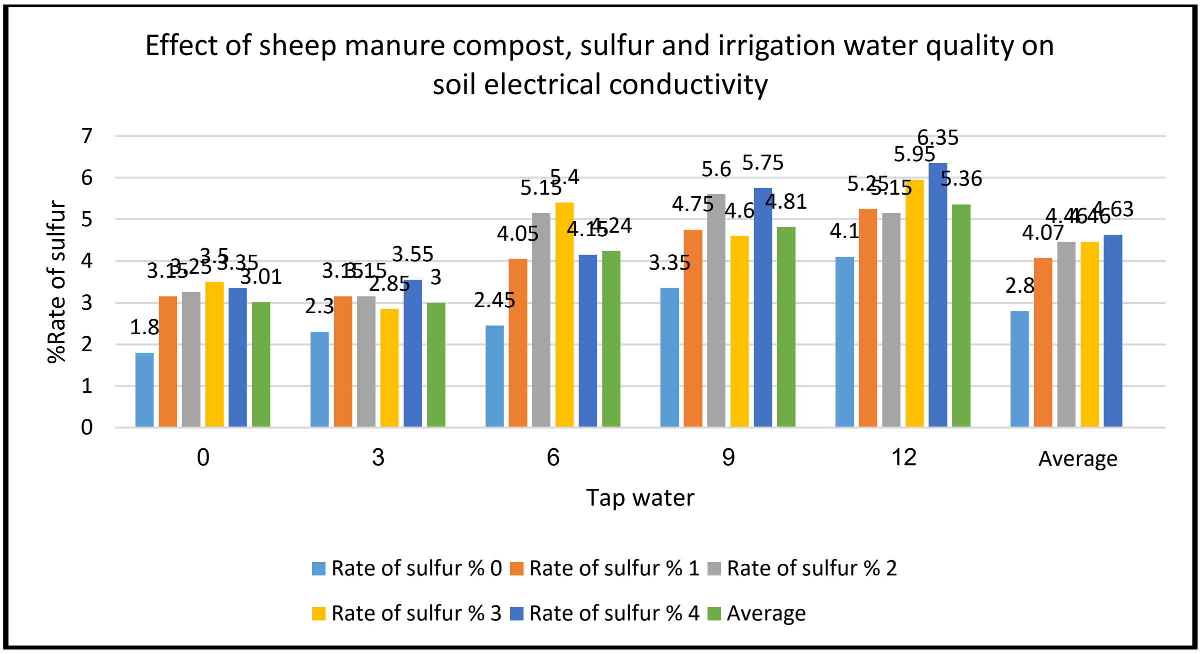
The three-way interaction effects of sheep manure compost, sulfur and irrigation water quality on the tested soil properties were Significant for EC. Ca

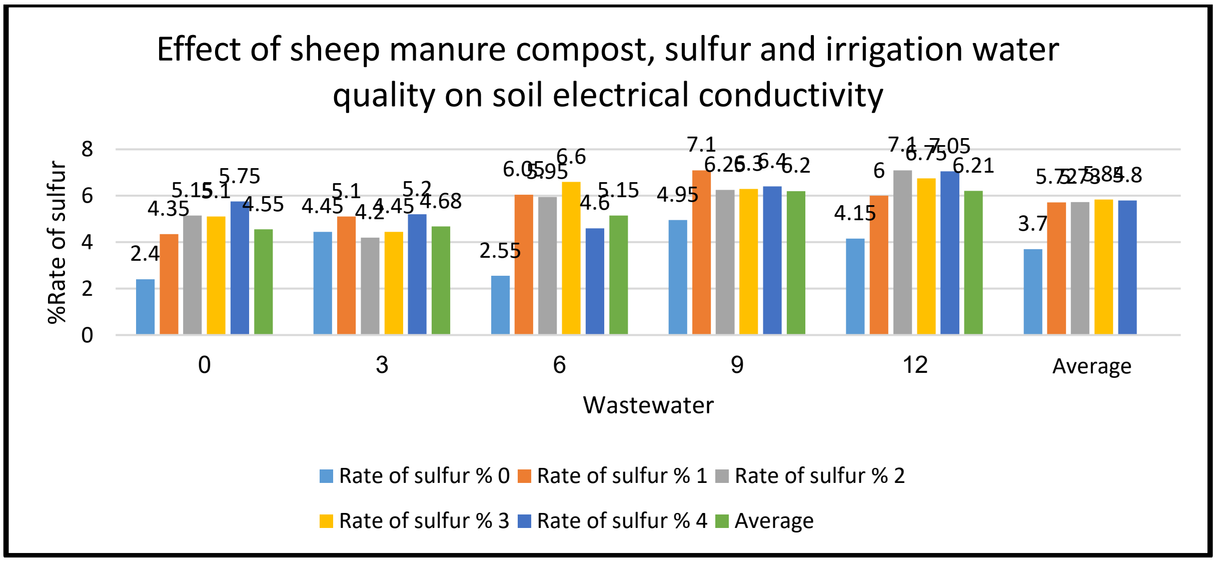


Soil Salinity, Regarding the accumulation of salts in soil, the treatment of using zero % sulfur at zero % compost was selected as a reference control treatment (table6). under the irrigation with tap water and 2.4 ds/m under the irrigation with the drainage water. increases in the EC values were observed under the irrigation with tap water or drainage water as the sulfur rate shifted from zero % 0 the EC values were increased as the sheep manure compost increased in general, for all of sulfur rate treatment, the EC values were increased as sheep manure application increased. The maximum EC value (6.35 dS/m) was obtained at the highest rates of sulfur and refuse compost under the irrigation with tap water. Also, the maximum EC value of 7.05 dS/m was obtained at the highest rates of sulfur and sheep manure compost under the irrigation with the drainage water. The role of sulfur is attributed to its effects on releasing Ca^{++} and SO^{--}_4. ions due to sulfur transformation in the presence of $CaCO_3$. Also, the role of sheep manure compost in increasing soil salinity is mainly due to its high content of soluble salts (EC = 5.4, dS/m) as shown in Table 2. Contamination of soils with salts is one form of soil pollution primarily agricultural in origin. Salts accumulate in soils because more salts move into the plant rooting zone than move out. This mainly due to application of salt-laden irrigation waters or it may be caused by irrigating poorly drained soils.

Table (6): **Effect of sheep manure compost, sulfur and irrigation water quality on soil electrical conductivity(EC,ds/m).**

Compost %	Rate of sulfur %					Average
	0	1	2	3	4	
Tap water						
0	1.80	3.15	3.25	3.50	3.35	3.01
3	2.30	3.15	3.15	2.85	3.55	3.00
6	2.45	4.05	5.15	5.40	4.15	4.24
9	3.35	4.75	5.60	4.60	5.75	4.81
12	4.10	5.25	5.15	5.95	6.35	5.36
Average	2.80	4.07	4.46	4.46	4.63	
Wastewater						
0	2.40	4.35	5.15	5.10	5.75	4.55
3	4.45	5.10	4.20	4.45	5.20	4.68
6	2.55	6.05	5.95	6.60	4.60	5.15
9	4.95	7.10	6.25	6.30	6.40	6.20
12	4.15	6.00	7.10	6.75	7.05	6.21
Average	3.70	5.72	5.73	5.84	5.80	





Conclusion

The aforementioned results elucidate that the irrigation with tap water or drainage water in the presence of different rates of sheep manure compost or sulfur or both indicated a salt accumulation at the end of maize growth season. The electrical conductivity (EC) values of soil, were increased than its original EC value. Also, the EC of soil irrigated with drainage water was higher than the EC of the soil irrigated with tap water.

Generally, a significant increase in most of the chemical properties of soil irrigated with drainage water than that irrigated with tap water were observed with sheep manure compost or sulfur application. The aforementioned results elucidate that the irrigation with tap water or drainage water in the presence of different rates of sheep manure compost or sulfur or both indicated a salt accumulation at the end of maize growth season. The electrical conductivity (EC) values of soil, were increased than its original EC value. Also, the EC of the soil irrigated with drainage water was higher than the EC of the soil irrigated with tap water.

Recommendations

1. **Use Sheep Manure Compost with Caution at High Rates**
   Although sheep manure compost improves soil fertility, the study showed that increasing its application rate significantly elevates soil electrical conductivity (EC). Therefore, compost additions should not exceed moderate levels, especially in calcareous soils already prone to salinity buildup.
2. **Avoid Excessive Sulfur Applications in Salinity-Sensitive Soils**
   Elemental sulfur contributed to increased soluble salts due to sulfate formation during oxidation. To prevent excessive salinity, sulfur should be applied based on soil testing and only at rates sufficient for pH adjustment, not as a routine amendment.
3. **Prioritize High-Quality Irrigation Water Whenever Possible**
   Drainage water caused a marked increase in soil EC compared with tap water. Farmers should avoid using drainage or saline water for irrigation unless no other source is available. If saline water must be used, it should be accompanied by proper salinity-management practices.
4. **Implement Regular Soil Monitoring Programs**
   Routine measurement of EC, pH, and major cations is essential for tracking the long-term impacts of compost and sulfur applications. Monitoring allows early detection of salinity buildup before it affects plant growth or soil health.
5. **Adopt Irrigation Management Strategies to Reduce Salt Accumulation**
   Periodic leaching with good-quality water, improving soil drainage, and using irrigation systems that minimize surface evaporation (e.g., drip irrigation) can help reduce the accumulation of salts in the root zone.
6. **Combine Organic Amendments with Soil Conditioning Practices**
   Since both compost and sulfur increased EC when applied alone, combining them with practices such as deep tillage, gypsum application (when appropriate), and organic mulching can help moderate salt accumulation and improve soil structure.
7. **Select Crop Varieties with Moderate Salinity Tolerance**
   Maize showed measurable sensitivity to salinity changes. In areas where saline water is unavoidable, moderately salt-tolerant cultivars or alternative crops should be considered to sustain productivity.
8. **Encourage Farmer Training on Soil Salinity Management**
   Farmers should receive training on interpreting EC readings, identifying early symptoms of salt stress in crops, and applying amendments correctly to avoid unintended salinity increases.
9. **Develop Local Guidelines for Compost and Sulfur Use**
   The study highlights the need for region-specific guidelines that consider local soil types, climate, and water quality. Extension agencies should prepare technical bulletins advising farmers on safe amendment rates.
10. **Promote Research on Long-Term Effects of Organic Amendments**
    Since this study was conducted in pots over 60 days, long-term field studies are recommended to evaluate cumulative salt effects, nutrient dynamics, and plant responses under real agricultural conditions.

References:

1. Adviento-Borbe, M.A.A.; J.W. Doran; R.A. Drijber; and A. Dobermann. 2006. Soil electrical conductivity and water content affect nitrous oxide and carbon dioxide emissions in intensively managed soils. Journal of Environmental Quality, 35:1999-2010
2. Black,C.A.(ed.)(1965) Method of analysis Part 1and 2,Agronomy Monograph No.9 Madison ,Wisconsin.
3. Citak, S. and Sonmez, S. (2011). Effects of chemical fertilizer and different organic manures application on soil pH, EC and organic matter content. Journal: Food, Agriculture and Environment (JFAE), 9 (3-4):739-741.
4. Draper, N. and H.Smith (1981).Applied Regression Analysis.John Wily. New York,USA.

5. El–Sharawy, M. A. O.; Aziz, M. A. and Ali, L. K. M. (2003). Effect of the application of plant residues compost on some soil properties and yield of wheat and corn plants. Egypt. J. Soil Sci., 43(3): 421–434.
6. Garcia, C.; Hernandez, T.; Coll, M.; Ondono, S. Organic amendments for soil restoration in arid and semiarid areas: A review. AIMS Environ. Sci. 2017, 4, 640–676.
7. Garcia, C.; Hernandez, T.; Coll, M.; Ondono, S. Organic amendments for soil restoration in arid and semiarid areas: A review. AIMS Environ. Sci. **2017**, 4, 640–676.
8. Hassin AL. Makhlof Hassan Abd El-mawla Mohammed Gomoa L. Ahmed and Muftah A. Emhammed.(2022) Integrated Effect of Fertilizers on Soil pH, EC and Organic Matter Content .SEBHA UNIVERSITY JOURNAL OF PURE & APPLIED SCIENCES VOL.21 NO. 4 2022 DOI: 10.51984/JOPAS.V21I4.2428
9. Houda Oueriemmi, Petra Susan Kidd, Carmen Trasar-Cepeda, Beatriz Rodríguez-Garrido,Rahma Inès Zoghlami , Kaouther Ardhaoui , Ángeles Prieto-Fernández, Mohamed Moussa(2021). Evaluation of Composted OrganicWastes and Farmyard Manure for Improving Fertility of Poor Sandy Soils in arid Regions.
10. Jackson, M. L. (1973). Soil Chemical Analysis. Prentice Hall, New Delhi. Jarrett, A. R. and Fritton, D. D. (1978). "Effect of entrapped soil aim on infiltration. Transactions of ASAE, 21: 901–956.
11. Johnson,G.A; Davis,J.G.;Qian,Y,I and Doesken, K.C. (2006). Topdressin turf with composted manure improves soil quality and protects water quality. Soil.Scie, Amer.J.70:2114-2121.
12. Kotuby-Amacher, J., Koenig, R., & Kitchen, B. (2000). Salinity and plant tolerance. Electronic Publication AG-SO-03, Utah State University Extension, Logan. https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.885.9915&rep=rep1&type=pdf
13. Kutuk, C.; Cayci, G.; Baran, A. and Baskan, O. (2002). Effect of humic acid on some soil properties. Bildiri Ozetleri, ISD, Ana Sayfaya Donus.Ankara Univ, 06110- Ankara Turkey. (http://www.google.com)
14. Mohamed Ahmed Youssef Abdel–Rahem,(2006), Effect Of Organic Materials On Some Physical And Chemical Properties In Assiut Valley Land Degree : M.Sc. In Soil Science
15. Sabrah, R. E. A.; Ghoneim, M. F.; Rabie, R. R. and Abdel–Magid, H. M. (1993). Effect of soil conditioners and irrigation regime on the growth and nutrient uptake by Alfalfa plants. Egypt. J. Soil Sci., 33 (1): 73–84.
16. Steel,R.G.D and T.H.Torrie (1982)Principles and procedures of statistics.McGraw International Book Company,3rd Ed.,London,P.633.
17. United States Salinity Laboratory Staff, (1954). Diagnosis and improvement of saline and alkali soil.U.S Dept.Agric.Handb.60 U.S.Gov.Printing Office.Washington, D.C.160P
18. Wong, J. W. C.; Ma. K. K.; Fang. K. M. and Cheung, C. (1999). Utilization of manure compost for organic farming in Hong Kong. Bioresource Technology, 67: 43–46.
19. Zengin, G., Locatelli, M., Ceylan, R., & Aktumsek, A. (2015). Anthraquinone profile, antioxidant and enzyme inhibitory effect of root extracts of eight *Asphodeline* taxa from Turkey. *Journal of Enzyme Inhibition and Medicinal Chemistry.* https://doi.org/10.3109/14756366.2015.1063623
20. Zengin, G., Uysal, A., Gunes, E., & Aktumsek, A. (2014). Survey of phytochemical composition and biological effects of three extracts from a wild plant (*Cotoneaster nummularia* Fisch. et Mey.): A potential source for functional food ingredients and drug formulations. *PLOS ONE, 9*(1), e87435.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.