Research

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Advances in Applied Science Research
ISSN 0976-8610

2021
Vol.12 No.10:13

Effects of Saline Water and Irrigation Interval on Soil Physicochemical Properties

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Received date: December 02, 2021; **Accepted date:** December 15, 2021**; Published date:** Dec 22, 2021

Citation: Sheferia B, Alem M, Seid A (2021) Effects of Saline Water and Irrigation Interval on Soil Physicochemical Properties Adv App sci res Vol.12 No.10.

Abstract

The declining availability of fresh water has become a worldwide problem, which maintains the development of alternative, secondary quality water resources for agricultural use. In this study, the effects of different irrigation intervals at different salinity levels of irrigation water impacts on soil physico-chemical properties were investigated using three irrigation intervals (I1 =3days, I2= 4days and I3= 5 days) with four salinity levels (S1= 4dS m-1, 5dS m-1 and 6 dS m-1) in a factorial combination using CRD with three replications. Statistical analysis showed that salinity, irrigation interval and their interaction highly significance effects (p<0.001) on electrical conductivity of soil. Irrigation with highest salinity level (S4) with five days of irrigation interval resulted in the salt accumulation in the root zone from 0.41 µS m-1 (before sowing) up to 13.73 µS/m at the end of growing period and exchangeable Sodium of 0.2 cmol/Kg was found before sowing while 0.82cmol/kg was found after harvesting. Therefore, based on soil salinity and crop yield, irrigation interval 3 days at lower levels of irrigation water salinities (up to 3 dS m-1) is suitable for soybean production in the study area. The study also showed that salinity and irrigation interval significantly affects soil nutrients (p< 0.001) despite their interaction were not significantly effects on soil nutrients. Increased the concentration of salt in irrigation water reduce availability of nutrients in the soil. Soil which was irrigated by salinity level four (S4=6dS/m) had lowest Organic Matter, Organic Carbon, N, P & K content. Highest Organic Matter, Organic Carbon, N and P content were observed at soils which were irrigated by fresh water. This indicated that need for give attention for management of soil besides achieving Soybean yield production when saline water is used for irrigation

Key words: Salinity, Irrigation interval, Soil Physico-Chemical properties, CRD

Introduction

Water quality is deteriorating and water salinity is increasing due to uncontrolled discharges of untreated or poorly treated wastewater over-abstraction of the aquifers, and the excessive use of fertilizers in agriculture [1].

According to FAO about 30%of the irrigated area is suffer by salinity problems, which corresponds to an area of more than 100 million ha worldwide. Soil salinity, resulting from natural processes or from crop irrigation with saline water, occurs in many arid and semi-arid regions of the world [2].

Irrigating saline water can also result in salt accumulation in soil, leading to the deterioration in soil resource. Most of the salt stresses in nature are due to Na+ salts, particularly NaCl [3].

Salinity refers to the total concentration of dissolved salt in the soil and water. In much arid and semi-arid regions, most of the salts present in irrigation water are Chlorides, sulfates, carbonates, and bicarbonates of Calcium, Magnesium, Sodium and Potassium.

Highly Saline and Sodic water qualities can cause problems for irrigation, depending on the type and amount of salts present, the soil type being irrigated, the specific plant species and growth stage, and the amount of water that is able to pass through the root zone.

Ayers and Westcot further indicates that given water is said to have salinity problem if its ECW is above 3dS/m. Based on concentration of salt, water is classified into Freshwater, Slightly brackish, Brackish, Moderately saline, Saline and highly Saline. Many studies related to salinity have considered Na+ and Ca2+cations and Cl- anions. To correctly evaluate the effects of salinity on plants, we must first differentiate between low concentrations of salts that may well be beneficial to plant growth, even though they reduce osmotic potential and excessive concentration that have harmful effects. A simple demonstration of some of the interacting osmotic and toxic effects is found with NaCl. Low levels of Na+ are beneficial and Cl- is essential to plant health.

Table 1: Classification of water quality based on total salt

Water designation	Total dissolved salts (mg /L)	EC(dS /m)
Fresh water	<500	<0.6
Slightly brackish	500–1,000	0 .6–1.5
Brackish	1,000–2,000	1.5–3.0
Moderately saline	2,000–5,000	3.0–8.0
Saline	5,000–10,000	8.0–15.0
Highly saline	10,000–35,000	15.0–45.0

In Ethiopia, approximately 11 million ha of land is salt affected .These areas are mainly concentrated in the Rift Valley. In some parts of Ethiopia rift valley, high saline water is obvious due to the influence of saline geothermal water. The Rift extends across Ethiopia via Lakes Rudolf and Chamo in the southwest, Awasa, Nazret, Mile and Lake Afrera in the North [4].

Soil Physical and Chemical Properties

Soil Physical Properties

Soil texture: -The relative percentage of soil separates (Sand, Silt and Clay) of a given soil is referred to as soil texture. The common textural classes, as recognize by USDA (U.S. Department of Agriculture) are given in equilateral triangles are international equilateral triangles model. Soil texture, which is a description of the size distribution of the mineral soil particles composing the solid fraction of the soil (from clay <2 µm to coarse particles >2000 µm) is perhaps the most important, since it determines many other physical properties (such as infiltration rate) and some chemical properties (such as cation exchange capacity).Texture is the result of 'weathering,' the physical and chemical breakdown of rocks and minerals. Because of differences in composition and structure, materials will weather at different rates, affecting a soil's texture. Soil texture can have a profound effect on many other properties and is considered among the most important physical properties. Texture is the proportion of three mineral particles, sand, silt and clay, in a soil. It affects the soil's ability to hold onto nutrients (cat ion exchange capacity) and water [5].

Bulk density and moisture holding capacity: -Bulk density, the ratio between soil dry mass and volume, is a very important soil property influencing soil water retention, aeration, transfer ability, and infiltration rate, and is extremely sensible to soil management.

Bulk density of a soil is a dynamic property that varies with the soil structural conditions. In general, it increases with profile depth, due to changes in Organic Matter content, porosity and compaction. Bulk density is influenced by the amount of Organic Matter in soils, their texture, constituent minerals and porosity. Knowledge of soil bulk density is essential for soil management, and information about it is important in soil compaction. Bulk density values are required for converting gravimetric soil water content to volumetric and to calculate soil porosity which is the amount pore space in the soil [6].

Soil Chemical Properties

Soil pH:-Soil pH or soil reaction is an indication of the acidity or alkalinity of soil and is measured in pH units. Soil pH is defined as the negative logarithm of the hydrogen ion concentration. The pH scale goes from 0 to 14 with pH 7 as the neutral point. As the amount of hydrogen ions in the soil increases the soil pH decreases thus the soil becoming more acidic. From pH 7 to 0 the soil is increasingly more acidic and from pH 7 to 14 the soil is increasingly more alkaline or basic [7].

Soil pH is influenced by both acid and base-forming cations (positively charged dissolved ions) in the soil. Common acid-forming cations are hydrogen (H+), aluminum (Al3+), and iron (Fe2+or Fe3+), whereas common base-forming cations include Calcium (Ca2+), Magnesium (Mg2+), Potassium (K+) and Sodium (Na+) (Ann McCauley et.al., 2017). Soil pH is the most important factor in the nutrient available of soils. In most cases, a pH range of 6.0-7.5 is optimum for the adequate availability of nutrients in the soil [8].

Exchangeable Cation of the soil: -The soil's capacity to absorb nutrients in the form of cations is called its cation exchange capacity. Cation Exchange Capacity (CEC) is a parameter of soil which represents the capability of soil to attract, retain and hold exchangeable cations (K+, Na+, Ca2+, Mg2+, ETc.) and the classification is described in Table2.

Table 2: Classification of soil exchangeable cation (cmol/Kg)

Class	Exch. Na	Exch.Ca	Exch. Mg	Exch. P
Very low	<0.10	<2	<0.3	<0.2
Low	0.1-0.3	2-5	0.3-1	0.2-0.3
Medium	0.3-0.7	5-10	1-3	0.3-0.6
High	0.7-2	10-20	3-8	0.6-1.2
Very High	>2	>20	>8	>1.2

Organic Matter: Organic Matter plays a vital role in maintaining structural stability including improvement of soil aggregate stability and porosity which in turn promotes water infiltration, enhances salt leaching, soil microbiological activities and also, decreases the exchangeable Sodium percentage and electrical conductivity in most of the agricultural soils .Soil Organic Matter plays an important role on physical and chemical properties of a soil. Organic Matter is known as 'storehouse of plant nutrients' and 'life force of a soil'. A good soil should have at least 2.5% Organic Matter Bangladesh Agricultural Research Council (BARC) (2005).

Organic Carbon: Soil Organic Carbon (OC) is the carbon that remains in the soil after partial decomposition of any material produced by living organisms. It is the main component of soil Organic Matter (SOM). Soil Organic Matter is the organic fraction of the soil that is made up of decomposed plant and animal materials as well as microbial organisms, but does not include fresh and un-decomposed plant materials, such as straw and litter, lying on the soil surface. SOM supports key soil functions as it is critical for the stabilization of soil structure, retention and release of plant nutrients, and allowing water infiltration and storage in soil. Therefore it is essential to ensuring soil health, fertility and food production (FAO, 2017).

Total Nitrogen Phosphorus and Potassium: N, P and K are essential nutrient elements among these nutrient elements, N ranks first in plant requirement and Phosphorus (P) ranks second followed by Potassium (K). N, P, and K are referred to essential nutrients because nearly all plants use them for growth and development. Their deficiencies cannot be corrected by another element and are needed by the plants before they can complete their vegetative and reproductive cycles. The availability of N, P and K nutrients was reduced with the increasing salt concentration due to the highest immobilization of ions to the soil. It would be succeeded with the suitable amendments application to overcome those immobilization complexes in soils [9].

Saline Irrigation Water and Soil

The salts accumulation in soil was closely related to the salts concentration of irrigation water. There was a progressive and significant increase in soil salinity values as the increases of salinity in irrigation water [10]. The effect of the quality of irrigation water on soil properties has been discussed by many researchers found that soil electrical conductivity (ECs) values increased with increasing salinity of irrigation water and decreased soil moisture depletion [11]. Applications of saline water for crop production also affect both physical and chemical properties of soil. The physical properties of soil change occur after long period of time.

Soil physical and chemical properties affect many processes in the soil that make it suitable for agricultural practices and other purposes. Texture, structure, and porosity influence the movement and retention of water, air and solutes in the soil, which subsequently affect plant growth and organism activity. Most soil chemical properties are associated with the colloid fraction and affect nutrient availability, biota growing conditions, and, in some cases, soil physical properties. Irrigation with saline water may introduce Sodium into the exchange complex of soils.

Exchangeable Sodium deteriorates soil structure and permeability. Further the agriculture-induced salinity and sodicity also influences the chemical and physical characteristics of soils [12].

Saline Irrigation Water and Soil Physical Properties

Irrigation water qualities affect soil physical properties. These changes occur in the presence of high solute concentrations normally associated with maintaining soil aggregate stability and continued throughout the irrigation season. Soil dispersion causes clay particles to plug the soil pores, decrease the mean weight diameter and increase bulk densities. Salinity affects soil structure, which must be stable for adequate permeability and water infiltration. High Sodium levels combined with low soil-water electrical conductivity can lower a soil's permeability. Saline Water can affect soil physical properties by causing fine particles to bind together into aggregates. This process is known as flocculation and is beneficial in terms of soil aeration, root penetration, and root growth. Although increasing soil solution salinity has a positive effect on soil aggregation and stabilization, at high levels salinity can have negative and potentially lethal effects on plants. As a result, salinity cannot be increased to maintain soil structure without considering potential impacts on plant health. But, More than fifty years of research have been conducted to determine the relationship between salinity (EC) of irrigation water and its effects on soil physical properties [13].

Saline Irrigation Water and Soil Chemical Properties

Irrigation with saline water increases the total soluble salts in the soil. Soil electrical conductivity increased as a result of increasing salinity levels of irrigation water. This may be due to the great surface area of the fine particles, which adsorb more soluble and exchangeable cations of saline solution. The increases in soil EC is proportional to the salts concentration in the irrigation water [14].

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Nutrient Uptakes are reduced by salinity of soil and irrigation water. Soluble Sodium content in the soil is increased by increasing Sodium content in irrigation water. And also the content of Chloride ions in the soil increase by increasing the salinity levels of irrigation water [15]. Salinity has direct effect on soil structure due to high concentration of Sodium. If the soil is irrigated with saline water, the cation exchange capacity of soil becomes concentrated with Sodium creating a sodic soil [16].

The availability of N, P and K nutrients was reduced with the increasing salt concentration due to the highest immobilization of ions to the soil. It would be succeeded with the suitable amendments application to overcome those immobilization complexes in soils. Increase in the salt concentration of irrigation water resulted in an increase in the exchangeable Na percentage and a decrease in the exchangeable K, Ca and Mg [17].

Methods and Materials

Soil sample was taken before sowing up to 30cm to determine particle size distribution, bulk density, available P, soil pH, Organic Matter, Organic Carbon, Exchangeable Cations, EC, total Nitrogen, Phosphorus. After one season, soil samples was collected again and the parameters mentioned above were analyzed to seen the change of soil physical and chemical properties. A disturbed soil sample was collected for the determination soil parameter mentioned above except bulk density, whereas undisturbed sample was collected by using core sampler for the determination of bulk density (fig 2b). The soil sample was being air dried (fig 2a), grounded and passed through a 2 mm mesh sieve to determine soil physico -chemical properties.

Soil texture was determined by using Hydrometer method , bulk density was estimated by dividing the weight of the oven dried soil sample (dried at 105°C for 24 hr) taken with core sampler to the volume of core sampler, maximum infiltration rate, was conducted using the double ring infiltrometer. Available P, by using Olsen method, soil pH by using pH meter, Organic Carbon by using titration with ferrous ammonium sulfate, using diphenylamine indicator to detect the first appearance of un oxidized ferrous iron, exchangeable cations by using exchangeable Na and K by using Flame Photometer exchangeable Ca and Mg by using atomic absorption spectro Photo meter and the EC was determined by measuring the conductivity of saturated soil extract using Electrical Conductivity meter. The above soil data were analyzed at Hawassa University (fig 2c) and Southern Agricultural Research center of soil laboratory.

Soils sample on air drier house (b) Soil sample for measuring bulk density

(c) Soil measurement at HU soil lab

Salinity and pH value of Fresh Water

Irrigation water samples were collected using plastic cans, which were cleaned in phosphate free detergent and rinsed with tap and distilled waters. The samples were immediately forwarded to Hawassa University college of Agriculture soil laboratory for testing salinity level and pH values of water by using EC and pH meter respectively.

Experimental Design and Treatments

Different NaCl solutions with salinity levels of fresh water, 4, 5, and 6 dS/m were prepared by dissolving 0, 2.56, 3.20 and 3.84 gm of NaCl in one liter of water respectively (Asgharet al., 2009, and Mohammad, 2012).

Table 3: Factorial combination of salinity level and irrigation interval

Salinity level (S)	Irrigation interval (I)		
	I1 (3 days)	I2 (4 days)	I3 (5 days)
S1(fresh water)control	S1 I1	S1 I2	S1 I3
S2 4 dS/m	S2 I1	S2 I2	S2 I3
S3 5 dS/m	S3 I1	S3 I1	S3 I1
S4 6 dS/m	S4I1	S4I2	S4I3

Results and Discussion

Soil Physical and Chemical Properties before Sowing

The Physical and chemical properties of the soil analysis result before sowing were prepared in Table 4 and 5 respectively.

Table 4: Soil Physical Properties before Sowing

Soil Depth(cm)	Sandy (%)	Clay(%)	Silt (%)	Textural class	ρb(gm/cm3)
0-30	56.4	24.2	19.4	Sandy loam	1.3

Table 5: Soil Chemical Properties before Sowing

PH	EC (µS/m)	OM (%)	OC (%)	N (%)	P (ppm)	K(cmol/ Kg)	Ca2+ (cmol/Kg)	Mg2+ (cmol/Kg)	Na+ (cmol/Kg)
6.9	0.41	7.01	4.04	0.35	21.5	0.8	7.86	3.02	

Effects o f s alinity a nd Irrigation Interval on Soil Physical Properties

The result showed that salinity and irrigation interval has not significance effect on bulky density soil texture and water holding capacity. The reason for the non-significance of soil physical properties was due to the soil irrigated by saline water was for one season (three month) this is short period of time, but to change the soil physical properties it takes long period of time.

Table 6: Mean value of soil physical property with different saline water and irrigation interval

	Bulk density (ρb)	Soil texture
Salinity		
S1	1.310a	Sandy loam
S2	1.311a	Sandy loam
S3	1.314a	Sandy loam
S4	1.317a	Sandy loam
LSD	0.016	
Interval		
I1	1.30a	Sandy loam
I2	1.32a	Sandy loam
I3	1.32a	Sandy loam
LSD	0.014	

Means in column followed by the same letters are not significantly different at 5% level of significant according to LSD test.

Soil Chemical Properties

Effects of salinity and Irrigation Interval on Soil Electrical Conductivity (EC): The result of current study showed that the electrical conductivity of the soil was significantly ($P< 0.001$) affected by salinity, irrigation interval and interaction of salinity and irrigation interval. The electrical conductivity of soil before planting showed 0.41 µS/m. the higher electrical conductivity was recorded (15.12 µS/m) from salinity level four interactions with irrigation interval three(S4I3). This was 14.73µS/m greater than from soil electrical conductivity before planting. While the lowest electrical conductivity was observed 1.2μS/m from salinity level one interact with interval one (S1I1).

Electrical conductivity increases from0.41μS/m before planting to13.73 μS/m and to 12.63 μS/m after harvesting at (S4I2) and (S4I1) respectively. In salinity level three (S3) EC increase from 0.4 to 6.43μS/m with interaction of I3 (S3I3), 5.32μS/m interact with (S3I2) and 4.69μS/m interact with (S3I1). In salinity two (S2) also EC increase from 0.4 to 3.18μS/m with (S2I3) 2.54 with (S2I2) 2.4μS/m with (S1I1). In salinity level one (S1) EC increase from 0.41 to 1.83μS/m interact with I3 (S1I3), 1.31μS/m interact with I2 (S1I2). Increase of EC in the soil due to increase of salinity of irrigation water and irrigation interval may due to The high irrigation intervals and the high saline irrigation water imposed a more rapid salt accumulation in the root zone, which was the cause to restriction of the volume of drainage . This may be recognized to the higher direct evaporation rates leading to an increase in salt accumulation in the soil. The result in line with [18] who found that reducing soil moisture content by deficit irrigation can increased soil salinity due to lack of leaching. The study is also in line with who recorded that increase electrical conductivity of the soil with increased of salinity level of water and irrigation interval. The study also in agreement with those obtained by [14] who found that the significant increases in soil EC was comparative to the salts concentration in the irrigation water.

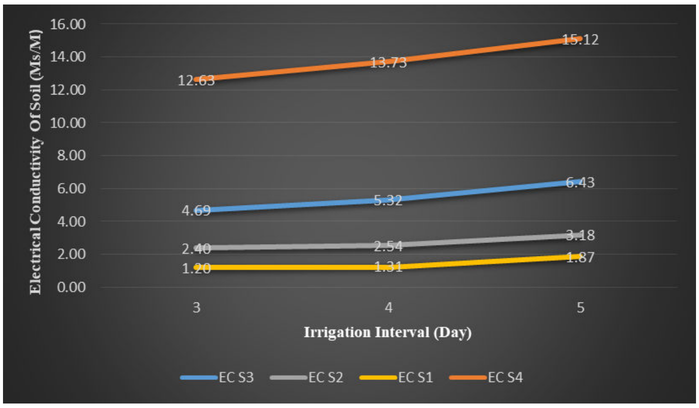

Figure 1: The effects of saline water and irrigation interval on soil electrical conductivity (EC)

Effects of salinity and Irrigation Interval on Soil PH: The result showed that salinity and irrigation interval has not significance effect on soil PH .The result agreed with Meysam Abedinpour, (2016) who reported that the soil pH was not affected by the saline irrigation water during the growing period.

Exchangeable Sodium (Na) Content: The result of this study indicated that exchangeable Sodium significantly (P<0.001) affected by salinity, interval, despite interaction of salinity and interval was not affect exchangeable Sodium. The soil analysis showed the initial Sodium of the soil was 0.2 cmol/kg. The higher exchangeable Sodium was found0.82 cmol/kg from salinity level four (S4), which was greater than 0.62 cmol/kg from the initial soil (before plating). While the lowest exchangeable Sodium was found from salinity level one (S1) which was 0.29cmol/kg. The amount of exchangeable Sodium content increased by 0.26, and 0.45cmol/kg at salinity level two and three (S2, S3) respectively. The quality of irrigation water directly related to salt accumulation in the soil. Therefore increased of salinity in irrigation water it increase soil salinity. The study in lined with Ragab (2008) who found that soluble Sodium content in the soil was increased by increasing Sodium content in irrigation water.

Exchangeable Calcium and Magnesium Content: The results of statistical analysis of this study indicated that saline irrigation water, irrigation interval significantly (P< 0.001) affect exchangeable Calcium and Magnesium of the soil despite their interaction effect was not significant. The results of soil analysis before planting showed that the initial exchangeable Calcium of the soil was 8.21cmol/Kg and Magnesium 3.02 coml/kg. At the end the experiment, the exchangeable Calcium and exchangeable Magnesium of the soil reduced to 4.07cmol/Kg and 0.63 coml/kg respectively in salinity level four (S4). This was decreased by 4.41cmol/kg from soil exchangeable Calcium and 2.39 before planting. At salinity level one, two and three was reduced by 1.13 of (Ca2+) and 0.44 of (Mg2+), 1.99 of (Ca2+) 1.04 of (Mg2+) and 3.02 of (Ca2+) 2.39 of (Mg2+) cmol/Kg from soil before planting respectively. Furthermore the result in irrigation interval I1, I2andI3, decreased by 2.38, 2.6 and 2.74cmol/Kg respectively from initial Exchangeable Calcium of the soil.

The lower Ca content due increase of salinity and irrigation interval may be due to changes in osmotic and ion-specific effects that can produce imbalances in plant nutrients, including deficiencies of some nutrients or excessive levels of Na+. The result agreed with who reported that the increase of Na+ decreases the exchangeable Calcium in the soil due to osmotic and ion-specific effect.

Table 8: The mean value of soil Organic Matter, Organic Carbon and Potassium

Treatment	Exchangeable Na	Exchangeable Ca	Exchangeable Mg	pH EC
Salinity				
S1	0.29d	7.08a	2.58a	7.19a 1.5d
S2	0.46c	6.22b	1.98b	7.05a 2.7c
S3	0.65b	5.19c	1.64c	7.04ab 5.5b

S4	0.82a	4.07d	0.63d	6.99b 13.8a
LSD	0.030	2.27	0.10	0.18 0.25
Interval				
I1	0.49c	5.83a	1.85a	7.11a 5.23c
I2	0.56b	5.61b	1.73b	7.07a 5.73b
I3	0.61a	5.47b	1.55c	7.02a 6.65a
LSD	0.026	1.97	0.09	0.17 0.22
CV (%)	5.71	4.07	6.03	2.7 4.38

LSD (0.05) =Least Significant difference at 5% level, CV=Coefficient of variation, Means in column followed by the same letters are not significantly different at 5% level of significant according to LSD test.

Organic Matter and Organic Carbon

The results of statistical analysis of this study indicated that saline irrigation water and irrigation interval significantly affect the soil Organic Matter and soil Organic Carbon (P< 0.001), despite their interaction effect was not significant effect. According to the highest soil Organic Matter (6.28 %) and Organic Carbon (3.67 %) was observed from soil, which was irrigated with fresh water (S1).

Moderate Organic Matter and Organic Carbon was found from soil irrigate with salinity level two (S2=4 dS/m) which was 4.6 % and 2.5 % respectively.

While the lowest soil Organic Matter (1.70 %) and 2.36 % soil Organic Carbon (1.36 %) and (0.92%) was found from soil irrigated with salinity level four (S4=6dS/m) and salinity level three (S3=5 dS/m) respectively. The possible reason for significant difference in Organic Matter and Organic Carbon among salinity difference might be due to the effect of decomposition and may increase the loss of dissolved Organic Carbon from the soil by dissolving Organic Matter or changing the soil to a more dispersed form.

In this study, Soil Organic Matter also decreased with increased of irrigation interval. But all soil irrigate with in irrigation interval one, two and three found in moderate Organic Matter. The result was in agreement with the result from [20] who suggested that SOC decreased with increasing salinity.

Phosphorus, Nitrogen and Potassium

The result of current study showed that the Phosphorus Nitrogen and Potassium of the soil was significantly affected by salinity and irrigation interval (P< 0.001) despite interaction of salinity and irrigation interval not significantly affect Phosphorus and Potassium.

The highest value of Phosphorus (19.74ppm) was found soils which irrigated by salinity level one (S1) or fresh water. On the other hand the lowest value of Phosphorus (9.16 ppm) was observed from soils which irrigated by salinity level four (S4).

The result of the study showed the amount of Potassium decreases from 0.8 cmol/Kg before sowing to 0.7, 0.52, 0.32 and 0.29 cmol/Kg soils at S1, S2, S3 and S4 respectively.

The result also showed soil at irrigation interval one two and three had the 0.47, 0.46 and 0.44 cmol/Kg of Potassium in the soil.

The amount of Nitrogen on the soil before sowing indicated 0.35% but after harvesting or at the end of the experiment decreased to 0.32, 0.23, 0.12 and 0.09 at S1, S2, S3, and S4 respectively. Among the irrigation interval, it reduced to 0.2, 0.19 and 0.18 % at I1, I2 and I3.

Decrease of amount of Phosphorus, Nitrogen and Potassium in the soil among increase of salinity and irrigation interval might be due to the highest immobilization of ions to the soil and fixation of available Phosphorus at higher salinities.

The results agree with [9] who reported that the availability of N and P nutrients was reduced with the increasing salt concentration. Gupta et al. (2001) also reported a slight decrease in available Phosphorus was observed with the increase in salt concentration. [21] Recorded that with increasing salt concentration decreases K availability due to this at higher salt concentration obtained low K+ value in soil. He also reported an increased concentration of Na+ and Cl -, decreased the concentration K+.

Table 8: The mean value of soil Organic Matter, Organic Carbon and Potassium

Treatment Salinity	Organic Matter (%)	Organic Carbon (%)	Nitrogen (%)	Phosphorus (ppm)	Potassium (cmol/Kg)
S1	6.28a	3.67a	0.32a	19.74a	0.70a
S2	4.62b	2.50b	0.23b	15.27b	0.52b
S3	2.38c	1.36c	0.12c	9.77c	0.32c
S4	1.70d	0.92d	0.09d	9.16d	0.29d
LSD (0.05)	0.14	0.07	0.008	0.4	0.02
Interval					
I1	3.92a	2.27a	0.20a	13.69a	0.47a
I2	3.77b	2.09b	0.19b	13.50ab	0.46a
I3	3.55c	1.98c	0.18c	13.26b	0.44b
LSD (0.05)	0.12	0.06	0.007	0.3	0.015
CV (%)	4.08	3.51	4.18	3.01	3.87

Conclusion and Recommendation

Now a day the quality of water is serious problem in all developing countries. In Ethiopia, there is a high saline ground water in some parts of rift valley including southern Ethiopia due to saline geothermal water. To take salinity management option, effects of saline water at different irrigation interval on soil physical and chemical properties is vital. Therefore, this study was conducted to determine the effects of saline water and irrigation interval on soil physico-chemical properties.

The results of this study showed an increase in soil salinity with in increased salinity of irrigation water and irrigation interval .soil salinity reached up to 15.12 µS/m at the end of the growing period, particularly under highly saline water and relatively highly irrigation interval. Also with increasing salt concentration, nutrient availability was significantly decreased. Among the treatments, S1I1 had highest Nitrogen (N), Phosphorus (P) and Potassium (K) content. Lowest K, N and P content were observed at soils, which were irrigated by salinity level four (S4). From this study, we could be concluded that the decomposition of Organic Matter and release of nutrients required to continue soil productivity were inhibited by high salinity and relatively high irrigation interval. This indicated that need for give attention for management of soil properties.

To control leaching problem and minimize cost the experiment was done by using pots. Hence, field experiment should be done to better understand the effects of salinity levels and irrigation intervals on soil physico-chemical properties before recommending to farmers.

The experiment was also done for only one season but to see the change of soil properties, which required long period of time specially soil physical properties. Therefore, repeating the experiment increases the validity of the study.

Due to laboratory technique problem and cost, the study could not include all physico chemical properties, which are related to salinity such as TDS and exchangeable anion. Therefore, it is better to repeat the experiment and identify all resulting salinity effect of the soil.

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